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Table Of Contents:

EFFICACY OF HARM-REDUCTION THERAPY IN REDUCING ALCOHOL-RELATED PROBLEMS AMONG UNDERGRADUATES IN OWERRI, NIGERIA…….....1
Ann U. Madukwe
Ikeoha I. Iwuh
Nkwams C. Uwaoma
Juliana C. Njoku

MARITAL STATUS AS A DETERMINANT OF COGNITIVE BEHAVIOR THERAPY OUTCOME AMONG CANNABIS ABUSING YOUNG ADULTS……...16
Juliana C. Njoku
Ann U. Madukwe
Nkawm C. Uwaoma

ON FORMAL TOOLS IN THE SOFTWARE ENGINEERING……...24
Arslan Enikeev
Mahfoodh Bilal Ahmed Mohammed
Elina Stepanova

THE ROLE OF BROCA'S AREA IN SYNTAX: A TMS STUDY ON WRITTEN GREEK LANGUAGE…….....36
Stefopoulou Maria-Korina
Chroni Elizabeth
Bezerianos Anastasios
Kouvelas Elias D.
Terzi Arhonto
Mitsacos Adamantia

JOINT ESTIMATION OF CHANNEL AND IMPULSE NOISE IN AN OFDM BASED SYSTEM FOR A POWERLINE NETWORK USING ADAPTIVE GUARD LENGTH…….....44
Beenish Hassan

NURSE SCHEDULING PROBLEM…….....53
Erjon Duka

STRATEGIC RISK ANALYSIS OF COMPLEX ENGINEERING SYSTEM UPGRADES……64
Matthew Cook
John P.T.

APPLICATION OF INFORMATION TECHNOLOGY TO ANALYZE THE STRATEGIES USED FOR FORMATION OF VALUES…….....81
Griselda Cortes Morales
José Luis Cendejas Valdez

REVIEW ON MULTIPLEXING TECHNIQUES IN OPTICAL COMMUNICATION SYSTEMS……...88
Ekta
Vikrant Sharma
Dalveer Kaur

EXTENDED MODELLING AND NUMERICAL INVESTIGATION OF PHASED ARRAY SYNTHETIC JET CROSS-FLOW INTERACTIONS…….....95
Sidra Malik
T.M. Shah
N.Kousar,
Zahir Hussain

REVIEW PAPER ON DWDM TECHNOLOGY……...102
Shilpa Sharma
Vikrant Sharma
Dalveer Kaur

PARENTAGE OF OVERLAPPING OFFSPRING OF AN ARBOREAL-BREEDING FROG WITH NO NEST DEFENSE: IMPLICATIONS FOR NEST SITE SELECTION AND REPRODUCTIVE STRATEGY……..109
Yeong-Choy Kam
Wan-Ping Tung
Yi-Huey Chen
Wei-Chun Cheng
Ming-Feng Chuang
Wan-Tso Hsu
Richard M. Lehtinen

COMPLEX DI-HYDRATE CALCIUM PHOSPHATE - GLUTARALDEHYDE: FORMULATION MECHANISM……118
Bouzid Mohammed
Djadi Amina
Bezzazi Boudjemaa

EFFECT OF PULSED GALVANIC ELECTRO STIMULATION AND ULTRASUONBD ON BURN HEALING. A RANDOMIZED CLINICAL TRIALS……..127
Hassane kheir Eddine
Jamal ktaiche
Ghada Radwan
Rami Abbas
Khodor Haidar Hassan

BLOOD LIPID DISORDER IN MEN WITH INCREASED WAIST CIRCUMFERENCE COMPARED TO MEN HAVING NORMAL WAIST CIRCUMFERENCE WITHIN THE SAME CATEGORY OF BMI…….136
Tarek Faour
Khodor Haidar Hassan
Zizi M. Ghanem
Ahmed E.S. Atta-Alla
Ricardos Ghanem
Rony Abdallah
Pierre Semaan
Roudaina Nasser
Fadwa Berry
Mohamad Ezzedine
Mohamad Mortada

THE ROLE OF SOME OBESITY-RELATED BIOCHEMICAL PARAMETERS IN THE INCIDENCE, DIAGNOSIS, AND PROGNOSIS OF POSTMENOPAUSAL BREAST CANCER……148
Taha I. Hewala
Samia A. Ebeid
El-Sayed Saad
Nadia A. Abd El-moneim
Mohamed Samir

EFFECT OF PULSED GALVANIC ELECTRO STIMULATION AND ULTRASUONBD ON BURN HEALING. A RANDOMIZED CLINICAL TRIALS…….167
Hassane kheir Eddine
Jamal ktaiche
Ghada Radwan
Rami Abbas
Khodor Haidar Hassan

THE EFFECTS OF FUNGAL MEDIUM ON HATCHING RATE OF BITING MIDGE……176
Jui-Yu Chou
Hung-Wei Chen
Chung-Chi Lin
Yu-Der Wen
Wei-Lung Wang

INFLUENCE OF PRACTICAL LEVEL ON DECISION MAKING IN HANDBALL……...182
Sebbane Mohammed
Benkazdali el Hadj Mohammed

PROFESSIONAL COMPETENCE REQUIREMENTS: THE VIEWS OF SEVERAL PHYSICAL AND SPORTS EDUCATION TEACHERS (CASE IN MOSTAGANEM PROVINCE, ALGERIA)…….190
Laroua. A
Sebbane. M
Benkazdali. H.M
Belkadi. A
Bensabeur. M
Benbernou. O
Gleyse.J

THE CORRELATION BETWEEN THE METABOLIC DISORDERS IN OBESE MEN AND THE BODY MASS INDEX (BMI)……...202
Tarek Faour
Khodor Haidar Hassan
El Sayed S. Atta-Alla
Edwin Parra Prada
Salam Nasreddine
Ali Mcheik
Ricardos Ghanem
Rony Abdallah
Pierre Semaan
Ahmed E.S. Atta-Alla
Fadwa Berry
Mohamad Mortada

A MODEL SUGGESTION FOR BUDGETING ACTIVITY COST REDUCTION UNDER ACTIVITY BASED KAIZEN BUDGETING APPROACH……...218
Selim Yuksel Pazarceviren
Olcay Akcin
Ugur Ozsuer

A MODEL SUGGESTION FOR CASH CONVERSION OF INVENTORY AND BASEMENT OF MODEL FINANCIAL RATIOS ANALYSIS……..234
Selim Yuksel Pazarceviren
Ugur Ozsuer
Bayram Dede

EFFICACY OF HARM-REDUCTION THERAPY IN REDUCING ALCOHOL-RELATED PROBLEMS AMONG UNDERGRADUATES IN OWERRI, NIGERIA

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Abstract

This study examined Harm-Reduction Therapy (HRT) as a technique in controlling Alcohol-Related Problems (ARPs). It was hypothesized that there will be a significant reduction in the occurrence of ARPs at each interval test following baseline occurrence. The second hypothesis compared the outcome for the participants in HRT and the control group. 28 male undergraduate students of Imo State University, who abuse alcohol, were selected using purposive and convenience sampling methods. Their age range was between 22-24years with a mean age of 22.96 (STD= .88). The Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST) was used to screen participants for alcohol abuse, while the Alcohol drinking Consequences Questionnaire (ADCQ) was used to assess their alcohol-related problems. The study employed an experimental design and data was generated by assessing participants' alcohol-related problems at baseline, 30^{th} day and 60^{th} day of therapeutic interventions. The repeated measures analysis of variance statistics with SPSS version 17 was used for data analysis. As was hypothesized, there was an increased reduction in alcohol-related problems among participants across test intervals. The result also showed a significant difference in the reduction of alcohol-related problems between participants in the control group and the harm-reduction therapy group only. It was concluded that harm-reduction therapy alone is effective in controlling alcohol-related problems (ARPs) among undergraduates. In addition, a recommendation for the benefit of the inclusion of the harm-reduction therapy in the Nigerian public health policy was made.

Keywords: Harm-Reduction Therapy, Alcohol-Related Problems, Undergraduates, Owerri, Nigeria

Introduction

Alcohol is a psychoactive substance that is readily available in our society due to its classification as a licit drug. Licit drugs are drugs whose usage is permitted by the law of the land. As such, alcohol is a licit drug in our country, though it also has addictive and harmful qualities like cannabis, cocaine, and heroin which are classified as illicit because their use is prohibited by law.

Alcohol has enjoyed a pride of place as a major source of public concern in youth drinking. Since the 18th century, rigorous efforts have been made to educate young persons about the harmful effects and the need for them to stop the behaviour (Hawker, 1978). However, alcohol drinking by youths especially university students has not just persisted, but has continued to increase in recent times (Abikoye & Olley, 2012; Abiodun, 1991; Umoh, Obot & Obot, 2012). However, the mode, pattern, and frequency of drinking exhibited by youths also point to the problematic and unwavering place of alcohol in youth activities (Alwan, 2010; Bolt, 2013; Olisah, Adekeye, Sheikh & Yusuf, 2009).

Studies have shown a rapid increase in alcohol availability, consumption, and abuse by young adults in universities and secondary schools being the primary victims (Abiodun, 1991; Ijeoma, 1997).

Findings across the globe have shown that cultures exist among undergraduates which are handed down from one generation to another. One of such cultures is the drinking culture existent among undergraduates. Undergraduate (College) drinking has been described as "a pervasive culture with its own customs and beliefs handed down from generation to generation. Beginning from students' first days on campus, these customs and beliefs are constantly transmitted" (Siebert, Wilke, Jorge, Smith, & Howell, 2003, p.123).

Consequently, alcohol drinking is a behaviour commonly found among undergraduates. The frequency of use, quantity of intake, and expected effects of alcohol use are all influenced by who is present in the drinking setting. When drinking is aimed at gaining ground, winning competitions, better performance, conquering a mate, or strength and superiority exhibition, abusive use becomes the most likely tendency. This likelihood is very potent as researchers have shown that there is a thin line between the use and misuse of drugs; and as such, individuals who lack maturity, self-esteem, confidence, and accurate information are vulnerable to

abusive drinking (Okasha, 1995; Imam, 2004). Thus, most undergraduate students fall within this category.

Abusive drinking is problematic drinking patterns often referred to as binge-drinking and/or chronic drinking. The common perception of binge-drinking is an occasion in which large amounts of alcohol are drunk in a relatively short space of time. Binge-drinkers often drink with the specific objective of getting drunk, and binge-drinking is often associated with drinking by large groups of people. Some people may do this occasionally, while others drink excessively much more regularly. In all, binge or chronic drinking is seen as drinking large amounts of alcohol regularly (Cabinet Office, 2004).

Abusive drinking is a behaviour that is readily observable among young people as they struggle to adjust to developmental, social, cultural, as well as academic demands and dictates. For some, these events become a passing fancy and are resolved with maturity. However, there exist an increasing number of others who end up as abusers, addicts or dependents. So, many reasons have been cited by several authors/researchers to explain individuals' involvement in abusive drinking. Such reasons include availability of the substance, social pressure, peer pressure, curiosity or experimentation, rebel against constituted authority, frustration, expression of maturity, vulnerable personality, insomnia, need to increase work output or better performance, search for identity, religious obligations, rejection of society, ignorance of the implications of abuse, poverty, unemployment, anxiety, depression, stress, exhibition of strength, potency, and endurance (Gaide, 2013; Imam, 2004; Kacir, 2009). Furthermore, abusive drinking has been a source of worry to humanity and a great challenge to World powers globally because of their consequent damaging effects (e. g. acute and chronic health conditions, social problems like domestic violence, marital instability, absenteeism to low productivity, accidents, criminal behaviours, etc.).

Umoh, Obot, and Obot (2012) pointed out that alcohol abuse has become a pervasive and enduring public health problem. As a result, the hazardous pattern of consumption in Nigeria is increasingly associated with social and health problems, especially unintentional injuries among young men, mental health problems, domestic and other types of violence.

According to Olisah, Adekeye, Sheikh, and Yusuf (2009), most alcohol-related problems appear in non-alcoholic dependent individuals who fall into the categories of hazardous or harmful drinkers. Alcohol-related problems are sometimes referred to as the social consequences of alcohol use (Gmel & Rehm, 2003).

The following are the associated or related-harm of abusive (binge/chronic) alcohol intake as depicted by previous research findings:

i. Abusive use (binge or chronic drinking)
ii. Physical injury to self or others
iii. Having unprotected sex or sex without consent
iv. Forgetting what happened while under influence
v. Forgetting where one was or what he/she did
vi. Doing something that will be later regretted
vii. Fighting
viii. Higher risk of Suicide/Murder
ix. Domestic violence
x. Violent offences e.g. rape
xi. Mental illness
xii. Accidents
xiii. Road accidents (drink driving)
xiv. Drug use
xv. Homelessness
xvi. Lost productivity
xvii. Alcohol poisoning
xviii. Haemorrhagic stroke
xix. Chronic liver disease
xx. Cancer
xxi. Premature deaths (culled from; Cabinet Office, 2004; Ritter & Cameron, 2006; and Siebert *et al*., 2003).

Due to these harms caused by abusive drinking and their associated cost to individuals, families, societies and nations, a concerted effort is being made by practitioners, researchers, policy makers, governments and non-governmental organizations to reduce these avoidable harms. The inability of law enforcement to curb drug demand, drug use, and drug-related harm left an obvious vacuum that called for an urgent filling. Thus, a pragmatic view of the world's drug situation necessitated a re-evaluation and re-thinking of the international, as well as national strategies to drug control and alcohol being a gateway drug. Consequently, its use also needs to be controlled. As such, new scientific and evidence-based approaches to successful drug use, control, or treatment are coming up, and one of them is the harm-reduction approaches. Alcohol harm- reduction programmes is an important alternative to abstinence only. This is so because though some people are ready to try to stop drinking for 30 days or want to learn how to abstain from alcohol, there are others who are not even interested in quitting (Harm Reduction, 2012).

According to Enders (2009), "harm-reduction therapy is a set of practical strategies that reduce negative consequences of drug use and unsafe behaviours by incorporating a spectrum of strategies ranging from safer use to managed use to abstinence" (p.2). It is a prevention and practice model that has emerged from the chemical dependency field in response to rising

dissatisfaction with abstinence and prohibition efforts along with a growing epidemic of HIV/AIDS and hepatitis infections related to needle sharing among injection drug users (Bigler, 2005). MacCoun (1998) further described harm-reduction as "a set of programs that share certain public health goals and assumptions. Central among them is the belief that it is possible to modify the behaviour of drug users, and the conditions in which they are used, in order to reduce many of the most serious risks that drugs pose to public health and safety". As a therapeutic method, harm reductionists seek to minimize the risks and negative consequences associated with alcohol and illicit drug use or other high-risk activities through various public health measures, intervention programs, or individual counseling (Marlatt & Witkiewitz, 2010). Therefore, this model looks at substance use which is related to various harms (problems) grouped as:

a) Health consequences – infection, mental health, and effects on overall health or nutrition.

b) Social consequences – interpersonal relationships, family, and stigmatization.

c) Personal development – education, happiness, and legal issues.

d) Economic and physical wellbeing consequences – employment, housing, and imprisonment (Logan, Carusone, Barnes, Rohaila, & Strike, 2014).

Consequently, in harm-reduction therapy/ treatment, the focus of attention is not on the drug or behaviour itself, but on the harm associated with it (Enders, 2009). Several harm-reduction interventions have been developed following research in this area. Some include: needle and syringe exchange, low threshold methadone maintenance, "safe-use" educational campaigns, and the use of treatment as an alternative to incarceration for convicted drug offenders (MacCoun, 1998). Furthermore, we are more interested in those interventions which can be considered beneficial to individuals experiencing alcohol-related problems. Thus, the interventions include:

a. Determine in advance not to exceed a set number of drinks
b. Choose not to drink alcohol
c. Use a designated driver
d. Eat before and/ or during drinking
e. Have a friend to let you know when you have had enough
f. Keep track of how many drinks you have had
g. Pace drinks to 1 or fewer per hour
h. Avoid drinking games or competition
i. Drink an alcohol look-alike (non- alcoholic beer, wine, etc.)
j. Avoid occasions where alcohol drinking is certain (all-night parties, clubs, etc.)

(Culled from Siebert et al., 2003).

Meanwhile, the use of alcohol has become widespread in the Western part of the globe (e.g. Holland, Sweden, Canada, Czech, etc.) and is expected to reach the shores of Africa sooner than later as indicated by the West African Commission on Drugs (WACD) (2014) report. Therefore, in order not to let harm-reduction come to Nigeria as 'a stranger', 'an immigrant' or worst still, as 'an expatriate', this research serves as one of a kind to study, understand, and clarify the effectiveness of harm reduction therapy as a treatment approach in psychology and in ascertaining its suitability in reducing harm among young Nigerian alcohol abusers. Besides, the presence of alcohol in our society is not considered as a misnomer, even when it is in the possession of underage children and young adults. As such, the rate of alcohol-related problems among young people keeps escalating. It is this seeming increase in alcohol-related problems (e.g. abusive /harmful drinking, increased tribal clashes, terrorism, mental illness, poor academic performance, increased school dropout rate, increased number of unemployable youths, accidents, sex offenses, unsafe sex, violence, unintentional injuries, premature deaths, drink-driving, etc) that calls for urgent efforts to be directed towards the control of these harms. Furthermore, it is based on this premise that the current research has taken the leap as one of the first study to examine the effectiveness of harm reduction therapy in the control of alcohol-related problems among University undergraduates in Nigeria.

Taylor, Johnson, Voas, and Turrisi (2005) studied *demographic and academic trends in drinking patterns and alcohol-related problems on dry campuses.* They found that for each measure of 29 alcohol-related problem behaviours assessed, males significantly reported higher average occurrence than females ($p < .01$). Also, students aged 20years and younger, had significantly higher mean alcohol-related problems in total and on each of the scale dimensions except risk/reckless behaviour ($p < .01$), for which students aged 21 and older, reported more problems significantly ($p < .05$). The researchers concluded that campus alcohol policies can only have limited effect on the drinking patterns of college students; as such, the prevention programs are needed on most dry campuses as well. In another study, Siebert et al. (2003) *explored the differences in African American and White college students' drinking behaviour; their attitudes to consequences, harm-reduction strategies, and health information sources*. They found that African-American students scored lower on drinking measures, reported fewer negative consequences, and employed drinking-reduction strategies more regularly than White students, except for choosing a designated driver. However, this findings points to the worrisome fact that students drive after drinking, thereby making themselves prone to auto-accident related harm.

Again, Ritter and Cameron (2006) reviewed over 650 studies on *the efficacy and effectiveness of harm-reduction strategies for alcohol, tobacco and illicit drugs*. They found that for tobacco, the result on the efficacy and effectiveness of harm-reduction interventions is controversial. Thus, promising new products that reduce the harm associated with smoking are being developed. However, they reported that for alcohol, harm-reduction interventions to reduce road trauma were well-founded in evidence. Nevertheless, there is limited research to support the efficacy and effectiveness of other alcohol harm-reduction interventions. In a study by McBride, Farringdon, Midford, Meuleners, and Philips (2003) on *harm minimization in school drug education: final results of the school health and alcohol harm-reduction project (SHAHRP)*, the researchers found that a harm-reduction programme which does not solely advocate non-use or delayed use can produce larger reductions in alcohol consumption than either a classroom-based or comprehensive programmes that promote abstinence and delayed use. Specifically, they found that during the 1st and 2nd phases of the programme intervention, students consumed 31.4% and 31.7% less alcohol compared to students in the comparison group. Subsequently, they also showed 25.7%, 33.8%, and 4.2% less likelihood to drink to risky levels on their follow-ups. They stated that the intervention reduced the harm that young people reported to be associated with their own use of alcohol. However, this was accompanied with intervention students experiencing 32.7%, 16.17%, and 22.9% less harm during follow-ups.

Smock, Trepper, Wetchler, McCollum, Ray, and Pierce (2008) studied the solution-focused group therapy for level 1 substance abusers. Their result showed no significant difference between the groups. Their findings suggested that the treatment and control groups faired similarly at the pre-test and post-test on the SASSI. In addition, the researchers concluded that SFGT may be a useful approach in the treatment of level 1 substance abusers. They reported that while clients who received either SFGT or a traditional treatment approach both improved overall, clients who received SFGT improved significantly on co-morbid factors unlike those in the traditional treatment.

Hypotheses

1. At baseline 30th day and 60th day interval tests, there will be a significant reduction in the occurrence of alcohol-related problems among participants.
2. Participants who received Harm-reduction therapy will only differ significantly from those in the Control group in the reduction of alcohol-related problems.

Method

Participants

The study involved 28 male undergraduate students of Imo State University, Owerri, who abuse alcohol. Purposive sampling method was used to select three students' inhabited hostels at the Front-gate axis of the University. They were Red house hostel, Laurel Suites, and Abuja hostel. Participants were selected from these hostels using both purposive and convenient sampling techniques. These sampling techniques were used for only individuals who are abusing alcohol. Also, an alcohol-related problem considered as common among participants in this study were selected. Secondly, individuals were not compelled to participate or continue with the therapy; as such, only those willing to join were selected. In addition, participants' age ranged from 22 to 24years. They were of all academic levels (i.e. year one to year 5) and from all Faculties of the University except the Faculty of Social Sciences. Thus, this selection was done to avoid bias due to familiarity with both the researchers and the study tools.

Instruments

Alcohol abuse was measured using the Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST), English version 3.0 (Humeniuk & Ali, 2006). The ASSIST was used to assess the rate of alcohol abuse among participants prior to therapy. Alcohol abuse is one alcohol-related problem that is common to all participants in this study. It was therefore considered as a key variable in selecting and ensuring the equivalence of participants on the dependent variable. The instrument is an 8 item questionnaire covering 10 substances. It uses a 5-point likert scoring pattern for items 2, 3, 4, & 5 and 3-point likert scoring pattern for items 6 & 7. In addition, item 1 is a nominal question with "yes" or "no" response. However, only items 1, 2, 4, 5, and 6 for ascertaining alcohol abuse were considered in this study. The screening test result based on a participant's score is interpreted as 0-10 Low (requires no intervention); 11-26 Moderate (requires brief intervention), and 27 and above High (requires intensive treatment).

Consequently, a validation study was conducted to adapt the scale for local use. Internal consistency for the ASSIST was Cronbach alpha 0.71. For validity, concurrent validity between the ASSIST for alcohol and AUDIT was $r = 0.\ 54$, $p<.01$; and discriminant validity between ASSIST for alcohol and RTQ- Smoking was $r = 0.\ 59$, $p<.01$

The second instrument in this study, which is the Alcohol Drinking Consequences Questionnaire (ADCQ) was used to measure Alcohol-related problems (harms). The instrument is a 14 item questionnaire developed and validated by the researchers. It was used to assess the students' resultant

drinking problems as experienced in the last three (3) months. The items were coded using a 3 point likert type scale of 3= yes, 0= no, and 1= I can't say.

Internal consistency of the instrument was Cronbach alpha 0.78. Concurrent validity was obtained by correlating the scores of the instrument with those of the GENACIS Drinking Problem Instrument. However, concurrent validity was $r = 0.66$, $p<.01$.

Procedure

Pre-treatment Phase: Ethical approval to carry out this study was granted and received from the departmental Post-graduate Board through the study supervisors following which the study commenced. A one day closed lecture was organized on '*ALCOHOL CONSEQUENCES ON EDUCATION'* which involved oral explanation and a video show of people who abused alcohol and the different alcohol-related problems they experienced. In the course of the lecture, the participants were required to respond to ASSIST and ADCQ questionnaires at different points. Assurance of confidentiality of every process and information undertaken, released, or shared in the course of the research was given to the participants. The lecture and all other processes described here lasted for a maximum of 90 minutes. At the end of the lecture, all those present and who also gave informed consent were encouraged to come for further harm-reduction therapy; and they were given the venue, date, and time. The first session took place the day following the lecture. This close dating was to prevent a renewed ambivalence among participants.

Treatment Phase: The treatment adopted a group counseling approach and the intervention technique was the harm-reduction therapy. The therapy involved two clinical psychologists and two counseling psychologists. Harm-reduction therapy was a 10 behaviour based activities taught over 13 group sessions of 20-30minutes each and assessed at baseline, on the 30^{th} day and on the 60^{th} day of the therapy using the ADCQ questionnaire. Therapy lasted for 2months, twice a week (5pm on Fridays and Saturdays) on an outpatient basis. Individuals who were present at the lecture and gave informed consent, but did not participate in the counseling sessions at all, were considered as the control group and they were assessed at the same rate.

Post-Treatment Phase: A compilation of some alcohol treatment service centers *Out-Patient Counseling, Day Treatment, Residential and Detoxification Programs, and Mental Health Programs that deal with Alcohol-Related Problems* within southern Nigeria was made available to participants. Also, phone numbers, address, contact person, and a brief description of the services they offer were also provided. This was made

available at all sessions for participants who might need further assistance than the therapy sessions offered. The entire treatment process took place in a temporary clinic at the hall in the Red House hostel, Frontgate, Imo State University. The hostel was chosen because of its proximity to the other two hostels and all participants gathered there for each counseling session. After termination, the data gathered during the study was used for statistical analysis.

Design and Statistics

This is an experimental field study that utilized a mixed-experimental repeated measures design.

The repeated measures analysis of variance (Repeated Measures ANOVA) was used to test the hypotheses.

Results

Table 1 Mean and Standard Deviations of Alcohol-Related Problem arranged by Experimental Groups and at Different Points of Assessment

	Experimental Groups	**N**	**Mean**	**Std. Deviation**
Baseline	Control Group	14	19.14	4.45
	HRT Group	14	17.36	3.62
	Total	28	18.25	4.08
30th Day	Control Group	14	15.00	5.64
	HRT Group	14	9.86	4.88
	Total	28	12.42	5.80
60th Day	Control Group	14	8.79	4.96
	HRT Group	14	4.00	2.93
	Total	28	6.39	4.68

Note: HRT= Harm Reduction Therapy.

Result from table 1 above shows the mean scores of participants from different experimental conditions and at different stages of the intervention. Generally, there is a mean difference showing reduction in alcohol related problems which was reported at baseline of 18.25 (4.08), at first assessment after 30 days of intervention of 12.42 (5.80), and at final assessment after 60 days of intervention of 6.39 (4.68).

Table 2 Summary of Repeated Measures Analyses of Variance (ANOVA) Showing Within-Subjects Effect of HRT on Alcohol-Related Problems

APR 1 M (SD)	**APR 2 M (SD)**	**APR 3 M (SD)**	**F**	**df**	**Sig.**
18.25 (4.08)	12.42 (5.80)	6.39 (4.68)	232.81***	2,25	.001

***p = .001

Repeated measures ANOVA result of table 2 above showed that the within-subject main effect was significant (sphericity assumed) (F (2, 25) = 232.81, p= .001; Wilks' λ = .05). The linear trend analysis was also significant (F (1, 26) = 481.81, p = .001), while the quadratic trend analysis was not significant (F (1, 26) = .06, p<.05). *Post- hoc* test to further examine the within-subject effect using multiple comparison with Bonferroni adjustment (in order to prevent Type 1 error), showed a significant reduction in alcohol-related problems (5.48, p = .00) between baseline and 30th day assessment with less problem reported at the second assessment. Similarly, a significant difference in the reduction of alcohol-related problems was found (11.71, p= .00) between baseline and 60th day assessment with even lesser problems reported at the 60th day assessment. Again, a significant difference in the reduction of alcohol-related problems was found (6.24, p = .00) between the 30th day assessment and the 60th day assessment with less problems being reported at the 60th assessment. All the findings showed that alcohol-related problems reported by participants continued to decrease as intervention progressed. Thus, the first alternative hypothesis that there will be a reduction in the occurrence of alcohol-related problems from baseline to 30th day and 60th day interval tests was accepted.

Table 3 Summary of Repeated Measures Analyses of Variance (ANOVA) Showing Between- Subjects Effects on Alcohol Related Problems Based on the Experimental Groups

Control group	**HRT only group**			
M (SD)	**M (SD)**	**F**	**df**	**Sig.**
14.31 (1.13)	10.41 (1.13)	6.03	1,26	.02*

The test of between-subjects effects (experimental groups) was significant (F (1, 26) = 6.03, p = .02), indicating that there is a significant difference in the reduction of alcohol-related problems between the two experimental groups. Thus, the second alternative hypothesis that there will be a greater reduction of alcohol-related problems in participants who received Harm-reduction therapy than those in the control group was accepted.

Discussion

The present findings are in line with previous empirical results. The efficacy of brief interventions in the control of alcohol abuse and alcohol-related problems (Smock *et al.*, 2008), and alcohol consumption rate, binge drinking or drinking patterns (Marlatt *et al.*, 1998; Taylor *et al.*, 2005) have been strongly established in previous studies. Furthermore, brief interventions like harm reduction therapy used in this study have recurrent scientific evidence for being effective intervention in controlling or initiating control for problematic behaviours like abusive drinking, eating, especially in reducing the harm due to these behaviours, but are not particular about

abstinence. In the researchers view, the significant reduction reflected between the 30th and 60th day tests suggests that the initial enthusiasm to change was maintained throughout the sessions. The cumulative effect of the counseling sessions helped participants in reducing problems that are both social and personal in nature.

Again, the finding that the difference in the reduction of alcohol-related problems between undergraduates in the harm reduction group and those in the control group was not negligible is supported by previous studies. Collins, Carey and Sliwinski (2000) control group showed a psycho-educational brochure about alcohol use. Also, Marlatt *et al*. (1998) used an assessment group only as their control group.

For this finding, the researchers explained that participants in only the harm-reduction therapy group received solution-focused kind of therapy, in which they were basically taught skills and strategies necessary to overcome their alcohol-related problems. This practical approach to treatment might have agreed with the disposition of the participants who by the virtue of their age bracket believe more in action than in words. And as such, they practiced the newly found skills. In addition, this also agrees with their proneness to behavioral experimentation. Again, the effectiveness of harm-reduction therapy in this study can be linked to the fact that HRT did not insist on abstinence as a condition of effectiveness. Thus, this means that participants can have their alcohol drinks and also reduce the problems due to alcohol drinking. Social desirability as a developmental need of this age group could have favored the use of harm-reduction therapy in this study. This is so because participants are likely to prefer those behaviors that would help to put them in 'good light' with others like their parents and peers. Therefore, they adopted those skills that helped reduce their alcohol-related problems, like pacing their drinks and not drinking in rowdy environments in order to avoid possible fights. The researchers opine that this finding indicates the efficacy of harm-reduction therapy in controlling alcohol-related problems. This shows that the application of only HRT as a brief intervention to individuals experiencing alcohol-related problems is effective. In other words, Nigerian undergraduates experiencing alcohol-related problems would benefit from harm-reduction therapy.

Conclusion/Recommendation

This study concludes by stating categorically that alcohol-related problems are prevalent among undergraduates in Owerri. Therefore, based on the findings of this study, harm-reduction therapy is effective in reducing these problems. Furthermore, it is recommended first and foremost that Nigerian Policy makers should begin to consider alcohol-related problems as a public health issue. Hence, it should be treated as crucial societal concern

with free access to good psychological treatments. Secondly, with the clear demonstration of the efficacy of harm-reduction therapy in this study, the researchers recommend that harm-reduction therapy be given during orientation programmes in universities, at hospital out-patient units, hospital emergency rooms, and even at police checkpoints. Finally, sponsorship for more empirical research studies and trainings in this area is recommended in order to help curtail the spread of alcohol and other drugs related problems and their consequent cost in our society.

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MARITAL STATUS AS A DETERMINANT OF COGNITIVE BEHAVIOR THERAPY OUTCOME AMONG CANNABIS ABUSING YOUNG ADULTS

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Abstract

This study examined how marital status would have an impact on the outcome of Cognitive Behavior Therapy (CBT) treatment of cannabis abuse among young adults in Owerri, Imo State, Nigeria. It was hypothesized that CBT would be effective in the treatment of cannabis abuse among young adults and that marital status will be a determinant of the outcome of CBT. 20 young adults (10 males and 10 females) within the age range of 25 and 38 years, with a mean age of 30.00 were randomly selected to participate in the study. Two group pre-test / post-test experimental designs were used. Also, Repeated Measures ANOVA statistics was employed for data analysis. CBT was found to be effective in the treatment of cannabis abuse among young adults. In addition, marital status determined the outcome of CBT. It was concluded that CBT is effective in the treatment of cannabis abuse among young adults. In recommendation, the researchers pointed to the need for Nigerian therapists in this area to pay attention to those of single marital status because they seem to be less responsive to treatment.

Keywords: Cannabis, Cognitive Behavior Therapy, Marital Status, Nigeria, CBT

Introduction

Cannabis is a psychoactive substance popularly called marijuana. In Nigeria, it has such local names as Indian hemp, Igboo, Weewee, etc. Though the drug is designated as one of the illicit drugs in the nation, Nigerians still grow marijuana in their farms and backyards. However, many consider the marijuana market as a very lucrative business. As such, the cultivation and distribution of marijuana in the country continues in spite of

vigorous war on drugs posed by the National Drug Law Enforcement Agency (NDLEA) and other policies in the nation. In other words, marijuana has remained very accessible and available; and as such, its consumption rate continues to escalate. Consequently, the incidence and prevalence of cannabis abuse in the nation could be second only to alcohol. Studies have shown that cannabis is the primary drug of abuse among most persons treated for drug-related problems in Nigeria (Oshodi, Ikeji, Olotu, Ihenyen, & Obianwu, 2009). Reports of cannabis abuse incidents have increased since 1960s when it was only 21% of all drug-related cases reported in health facilities to near 80% in recent times (Asuni, 1964; Oshodi, et al., 2009). Also, many local and international studies have shown cannabis as a major drug of abuse (Haddock, Lewis, Bentall, Dunn, Drake, & Tarrier, 2008; Carroll, Nich, Lapaglia, Peters, Easton, & Petry, 2012; Dennis, Godley, Diamond, Tims, Babor, Donaldson, Titus, Kamner, Webb, Hamilton, & Funk, 2004; Helwick, 2010; & Oshodi, et al., 2009). However, none of the reviewed studies concentrated on young adults (i.e. individuals between 18 – 40 years) as their study participants.

Cognitive-behavioral therapy which is also referred here as CBT, is a form of psychological treatment that involves both thought and behavioral therapies in the management of psychological-related problems. It is a technique that involves changing the way one thinks (cognitive) and how one responds (behavior) to those thoughts. According to Busari (2013), there is evidence that suggests that clients who develop new ways of thinking get better from psychological difficulties. Again, "cognitive behavioral therapy has been found to be very effective in the treatment of all forms of antisocial behaviors such as stealing, socially undesirable behaviors, faulty thinking-frustration, recidivism, and delinquent behavior" (Busari, 2013, p. 54) Magil and Ray (2009) in a meta-analysis of 53 randomized trials aimed at providing an overall picture of the efficacy of cognitive-behavioral therapy treatment, found that the effect of CBT was largest in marijuana studies, when compared with no treatment. Consequently, the effect of CBT may be greater for men than women. Helwick (2010), Danis, Lavie, Fatseas, and Auriacomber (2006), as well as Carroll et al., (2012) in their different studies pointed out the efficacy of CBT for the treatment of cannabis dependence and associated problems. Meanwhile, Copeland, Swift, Roffman, and Stephens (2001) revealed that six sessions of cognitive behavioral therapy helped participants to achieve continuous abstinence, become less severely dependent, achieve higher levels of control over their cannabis use, and have fewer cannabis-related problems. Busari (2013) in a study revealed that participants from intact homes (husbands and wives) responded more positively to treatment with cognitive behavior therapy than those from separated homes. Hollon and Beck (2004) in their study discovered that

marital status is associated with positive therapeutic outcome in the management of depressive patients using cognitive behavior therapy. Grail, Leanne, Lawrence, and, Gilbert (2007), in another study, discovered that being married predicted a greater treatment response.

In this study therefore, the researcher is looking at the role CBT will play in the management of cannabis abuse among young adults and to find out how marital status will affect the outcome of CBT in the management of cannabis abuse among young adults.

Hypotheses

1. Cognitive behavior therapy would be effective in the management of cannabis abuse among young adults.
2. Marital status would influence the outcome of CBT on the management of cannabis abuse among adults.

Method

Participants

The study comprised of randomly selected twenty young adults who abuse cannabis. The study was carried out in Nekede and Egbu in Owerri West and Owerri North local government areas of Imo State. Imo State is one of the states in the South-eastern part of Nigeria. Nekede and Egbu were purposively selected for this study because they are urban areas, and as such, attract people from all works of life mostly young adult population. Various crimes including criminal activities such as sexual harassment, rape, cultism, stealing, house breaking, cannabis sales, use and abuse, etc, occur within these environments. Ten participants (5 males and 5 females) were drawn from each community. However, their demographic variables are reflected as gender (10 males and 10 females), marital status (10 unmarried and 10 married), and their age ranged between 25 and 38 years with a mean age of 30.00 and standard deviation (STD= 4.49).

Instrument

The instrument used was Alcohol, Smoking and Substance Involvement Screening Test (ASSIST), English version 3, developed by Humeniuk and Ali (2006) for the World Health Organization (WHO). It was used in screening for cannabis abuse among participants. A validation study was conducted to adapt the scale for local use. The instrument was reliable at Cronbach alpha .87 and discriminant validity of $r = 0.4$, $p < .01$, after correlating ASSIST Cannabis with Alcohol use Disorder Inventory Test (AUDIT). The instrument is an 8 item questionnaire covering 10 substances. It uses a 5-point likert scoring pattern for items 2, 3, 4, & 5 and 3-point likert scoring pattern for items 6 & 7. Consequently, item 1 is a nominal question

with “yes” or “no” response. However, only items 1, 2, 4, 5, and 6 for ascertaining cannabis abuse were considered in this study. The ASSIST rates participants scores 0-3 as low and require no intervention, 4-26 as moderate and require brief intervention, and 27 and above as high and require intensive intervention.

Procedure

Pre-treatment Phase: The ASSIST was administered to selected participants after gaining their oral consent of participation and assuring them of the confidentiality of the entire research process. Individuals whose scores were lower or higher than 4-26 on the ASSIST Cannabis Abuse subsection were excluded from participation. Those within the accepted score range were randomly assigned to control and treatment groups with marital status as a factor.

Treatment Phase: The treatment adopted individual therapy approach which was delivered on an outpatient basis and lasted for four weeks of twelve sessions, that is, three sessions per week. The therapy involved three clinical psychologists and a counseling psychologist. They also cared for likely clinical manifestations that were beyond the purpose of the present study. However, this provision was made particularly to ensure non-maleficience for participants in the study. Cognitive behavioral therapy sessions involved techniques like cognitive restructuring, thought stopping, refusal skills, communication skills, interviewing, stimulus control, and shaping. However, participants in the control group were only interviewed and given words of encouragement in every session. The goal of therapy was majorly to reduce the consumption rate of cannabis and ultimately to achieve abstinence among participants.

Post Treatment Phase: At the end of the treatment protocol, both groups were retested using the ASSIST for cannabis abuse. Data generated from the assessment was used to ascertain if there was a significant difference on their pre and post test scores. In addition, it was also used to ascertain the role marital status played in the treatment of young adults with cannabis abuse using CBT. Finally, those in the control group were treated and debriefed. The entire treatment process took place in a temporary clinic at the community hall of each of the selected communities. This choice was to minimize discomfort, cost, and other inconveniences participants would experience if they were to travel out of their communities for the sessions.

Design/Statistics

This study used a two group pre-test and post-test experimental design. This is because the study involved two groups, that is, the experimental and control groups. Therefore, both groups were assessed

before and after treatment. Repeated Measures Analysis of Variance using SPSS version 17 was used for data analysis.

Result

Table 1a: Summary Result of Repeated Measures ANOVA Showing the Means, Standard Deviations, and F Value of Cannabis Abuse in Pre-Test and Post-Test Condition

Pre-test	Post-test			
M(SD)	M(SD)	Df	F	Sig.
21.68 (.59)	16.14(1.16)	1,12	13.91*	.00

Note: * p<.05

The result in table 1a above shows a mean difference in the participants' pre-test and post-test scores. The pre-test mean score of 21.68 was very much higher than the post-test mean score of 16.14. The within-subject effect result of F (1, 12) = 13.91, p<.05, shows that there was a significant difference in participants' cannabis abuse rate after cognitive behavior therapy was administered.

Table 1b: Summary Result of Repeated Measures ANOVA Showing the Means, Standard Deviations, and F-value of Cannabis Abuse of Participants in Different Treatment Conditions

Experimental Group	Control group			
M (SD)	M (SD)	Df	F	Sig.
16.93 (.68)	20.89 (.70)	1,12	22.75*	.00

Note: * p<.05

Again, descriptive statistics in table 1b above revealed that at the end of assessment, participants in the experimental condition showed reduced cannabis abuse with a mean score of 16.93 more than those in the control group with a mean score of 20.89. Thus, the between-subject effects result of F(1,12) = 22.77, p <.05, revealed a significant difference between the experimental and control groups. Those in the experimental group shows more reduced cannabis abuse rate than their counterparts in the control group. Therefore, the first alternative hypothesis that cognitive behavior therapy would be effective in the management of cannabis abuse was accepted.

Table 2: Summary Result of Repeated Measures ANOVA Showing the Means, Standard Deviations, and F-Value of the Effect of CBT in the Management of Cannabis Abuse of Participants with Different Marital Status

Unmarried	Married			
M (SD)	M (SD)	Df	F	Sig.
21.14 (.59)	16.68 (.08)	1,12	10.80*	.00

Note: * p<.05

Descriptive statistics in table 2 above revealed that at the end of assessment, there was a statistical mean difference between the unmarried and the married participants in the effect of CBT on the treatment of cannabis abuse; with the unmarried having a higher mean score of 21.14 than the married with a mean score of 16.68. The between-subjects effects result of $F(1, 12) = 10.80$, $p < .05$, revealed a significant difference between the unmarried and the married participants, with the married participants reporting greater effect of CBT on the treatment of cannabis abuse than the unmarried participants. Therefore, the second alternative hypothesis that marital status will influence the effect of CBT in the management of cannabis abuse was accepted.

Discussion

The present findings are in line with Copeland, Swift, Roffman, and Stephen's (2001) study which shown CBT to be effective in a brief intervention for cannabis abuse. Similarly, Carroll, Nich, Lapaglia, Peters, Easton, and Petry (2012) found that attrition rate for cannabis was highest in the CBT alone condition. The present researchers are of the opinion that every drug abuser to an extent, knows that he/she has a problem; and as such, he/she desires a solution. Consequently, those who abuse drugs in Nigeria contact faith-based organizations and native doctors in search of a remedy. The popular belief is that their problems are beyond their control, and as such, must be due to punishment from the gods or as a result of evil manipulations from their enemies. Hence, providing them with CBT which was neither harmful nor costly, administered free of charge and at the participants' convenience was considered to be beneficial all-round. As a result, participants yielded to the process with keen interest.

The result that married participants responded to CBT better than the unmarried was in line with the findings of Busari (2013) and Grail et al. (2007), who independently stated that being married predicted better CBT treatment outcome.

This finding could be explained by the fact that the difference in treatment (CBT) outcome evident among the married and the unmarried was as a result of their level of responsibility. In Nigeria, the married have more responsibilities as regards their family, and as such, are more eager to quit the cannabis abuse. This is because the marriage institution is highly valued in this part of the world, and as such, the married most times avoid activities that are derogatory in nature, especially those that leads to stigmatization of the individuals involved. On the other hand, the unmarried most times have less responsibility with regard to family matters (e.g. catering for the welfare of wife and children). They are mostly free to socialize with little or no caution (e.g. clubbing, smoking and drinking in groups, night activities, etc.),

and as such, they are more prone to initiate, maintain, and sustain abusive use of cannabis. In other words, because individuals in their pre-marital stage also have strong peer group involvement (that offers social support as well as relevance for drug use), they have reduced need to quit the abusive behavior. As a result, they responded poorly to treatment.

Conclusion/Recommendation

It is hereby concluded that cognitive behavior therapy plays an effective role in the management of cannabis abuse among young adults, and that marital status influences the outcome of CBT. Therefore, it is recommended that the Nigerian Psychological Association in conjunction with Nigerian Universities should start training and retraining of clinical and counseling psychologists on how to conduct brief cognitive behavioral therapy in clinical treatments of cannabis abuse. However, this will help minimize the cost of treatment for clients. Brief therapy mean the reduced time spent in therapy. Thus, this could motivate potential clients to seek clinical help. Clinicians should inculcate CBT in their clinical practice to help patients, especially those who abuse cannabis and several other drugs. Consequently, this is because in the shortest brief intervention, CBT worked effectively.

This study also recommends that Clinical psychologists should intensify their efforts when treating unmarried cannabis abusing young adults, since they respond less effectively to brief cognitive behavioral therapy unlike the married ones.

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ON FORMAL TOOLS IN THE SOFTWARE ENGINEERING

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Abstract

This paper presents an overview of different approaches to a creation of the technique of software application development based on the integrated development environment which contains a model and tools for its implementation. Our results in this field are also presented. We study a formal model specification and analysis tools which may have potential for the software application development.

Keywords: Formal specifications, model, CSP, UML

Introduction

Software systems have significantly increased in complexity and diversity in recent years, requiring the use of new, more efficient technological tools for their development. Traditional tools based only on programmer‘s intuition cannot guaranty high reliability in software products and do not allow their complete analysis. These problems can be solved using formal mathematical models which provide a rigorous approach to the software development. However, the experience of software development shows that the use of formal methods in the design of software systems often leads to cumbersome constructions which cause a serious obstacle to the development process. It follows that we need to create an appropriate conceptual apparatus which will make these formal methods more applicable to software development in practice. In this paper we study different formal tools and methods which could be useful to apply to software application development.

The formal tools for the software models

The strongly held common philosophy of the current state of software engineering in 1970s is admirably expressed in the following quotation from professor Christopher Strachey, the founder of the Programming Research

Group which represents a part of the Computing Laboratory at Oxford University ("History and Structure", 2007, "Undergraduate handbook", 2007, Hoare, 1982): "It has long been my personal view that the separation of practical and theoretical work is artificial and injurious. Much of the practical work done in computing, both in software and in hardware design, is unsound and clumsy because the people who do it have not any clear understanding of the fundamental design principles of their work. Most of the abstract mathematical and theoretical work is sterile because it has no point of contact with real computing. One of the central aims of the Programming Research Group as a teaching and research group has been to set up an atmosphere in which this separation cannot happen." If we consider this statement from today's perspective we can see that the gap between theory and practice in the field of software engineering has not only become larger but has in fact increased significantly. However what reasons would have caused this? There are many reasons; among them the following seem to be significant:

- most software developers rely on their intuition and experience, ignoring formal methods and tools in the software development process;
- despite many theoretical works having appeared recently in the software engineering, the appropriate formal tools continue to be inadequate for their application to the practice of software engineering.

Next, we will consider some of the formal tools and methods which could be useful in software engineering.

Hoare logic is a formal system with a set of logical rules for reasoning rigorously about the correctness of computer programs (Hoare,1982, Hoare,1969). It was proposed in 1969 by the Oxford professor C.A.R. Hoare. The central feature of Hoare logic is the Hoare triple. A triple describes how the execution of a piece of code changes the state of the computation. A Hoare triple is of the form {S} P {S'} where S and S' are assertions and P is a command. S is named the precondition and S' the postcondition: when the precondition is met, executing the command establishes the postcondition. Assertions are formulae in predicate logic. Based on this logic Hoare formally defined basic programming constructions. For example: if b then P else Q = $\neg(D_b) \vee (b\&P) \vee (\neg b\&Q)$, where D_b is a definition domain of logical expression b, P and Q are the predicates defining specifications of the corresponding programming constructions. This formal system can be useful in the transformational programming technique (Georgiev , Enikeev, 1992). Program transformation is the process of converting one program to another using the appropriate transformational rules which can be deduced and proved on the base of Hoare logic. Transformational programming technique used to be applied to code optimization and program

generators. Code optimization is a transformation of source code into a simpler and more efficient code using the appropriate transformational rules. The greatest effect is achieved by automating the process of transformation. Here is an example of the transformational rule: while i<n do i:=i+1 = if i<n then i:=n. Program generators provide automated source code creation from generic frames, classes, prototypes and templates to improve the productivity of software development. This technique is often related to code-reuse topics such as component-based software engineering and product family engineering. In this case the transformational rules are represented by substitution rules. One of the most interesting fields of the transformational programming technique is partial evaluations (mixed computations) concerning automatic compiler generation from an interpretive definition of a programming language (Ershov, 1982). The technique also has important applications in scientific computing, logic programming, metaprogramming, and expert systems.

The theory of communicating sequential processes (CSP) (Hoare, 1985) is a formal system, which, by using the conceptualization of sequential processes, enables the specification and analysis of various patterns of communication between processes (including parallelism). In the next part of the paper we present a study of CSP tools based on the example of a menu - select interactive system model specification (Enikeev, Hoare, Teruel, 1987). The behavior of a menu –select interactive system can be modeled as a set of sequences of possible responses. This allows the description of the menu-select interactive system model using CSP theory. In CSP notation these sequences are called traces. A trace is a finite sequence of symbols recording the actual or potential behavior of a process from its beginning up to some moment of time. Each symbol denotes a class of events in which a process can participate. The set of symbols denoting events in which a process can participate defines the alphabet of a process. A process is defined by the set of all traces of its possible behavior. From the definition of a trace, it follows that; process P with alphabet A:

P0. $P \subseteq A^*$, where A*denotes the set of all traces with symbols from a pre-defined alphabet A;

P1. $<> \in P$, where <> denotes an empty trace;

P2. $st \in P \Rightarrow s \in P$, for all $st \in A^*$,where st is the concatenation of s with t.

Below we present some important definitions from CSP that will be used subsequently. If s is a nonempty trace, we define s_0 as its first symbol, and s' as the result of removing the first symbol from s. Let √ be a symbol denoting successful termination of the process. As a result, this symbol can appear only at the end of a trace. Let t be a trace recording a sequence of events

which start when s has been successfully terminated. The composition of s and t is denoted (s; t). If √ does not occur in s, then t cannot start. If s is a copy of an initial subsequence of t, it is possible to find some extension u of s such that su = t . We therefore define an ordering relation $s \leq t =_{df} \exists u\ (su=t)$ and say that s is a prefix of t . For example, $<x,y> \leq <x, y, z>$, $<> < <x, y>$. The ≤ relation is a partial ordering, and its smallest element is <>. The expression (t ⌈A) denotes the trace t when restricted to symbols in the set A; it is formed from t simply by omitting all symbols outside A. For example, <a, d , c, d> ⌈ {a,c} =<a, c> . The expression P^0 denotes the set of first symbols of all traces in process P (initial state of process P). To put it formally: $P^0 =_{df} \{ c \mid < c > \in P \}$. Process FAIL $=_{df} \{<>\}$, which does nothing, process SKIP $=_{df} \{<>, <√>\}$, which also does nothing, but unlike FAIL it always terminates successfully. Let x be an event and let P be a process. Then (c → P) (called 'c then P') describes an object which first engages in the event c and then behaves exactly as described by P. The process (c → P) is defined to have the same alphabet as P; more formally, $(c \rightarrow P) =_{df} \{c \rightarrow s \mid c \in \alpha P \ \&\ s \in P\}$, where $c \rightarrow s =_{df} < c > s$, αP denotes an alphabet of process P. Let P be a process and s ∈ P then P / s (P after s) is a process which behaves the same as P behaves from the time after P has engaged in all the actions recorded in the trace s. If s ∉ P, P / s is not defined; more formally, $P / s =_{df} \{t \mid st \in P\}$. Let P and Q be processes. The operation P | Q is defined as following: $P \mid Q =_{df} P \cup Q$, where $\alpha (P \mid Q) = \alpha P \cup \alpha Q$ (the choice between P and Q). The choice depends on which event from $(P \mid Q)^0$ occurs. For example, if R= (a → P) | (b →Q), R/<a> =P and R/< b > = Q. Let P and Q be processes. Sequential composition P; Q is defined as a process which first behaves like P; but when P terminates successfully, (P; Q) continues by behaving as Q. If P never terminates successfully, neither does (P;Q). More formally, $P;Q =_{df} \{ s;t \mid s \in P \ \&\ t \in Q \}$. Let P and Q be processes. The operation of parallel composition P || Q is defined as following: $P \parallel Q = \{s \mid s \in (\alpha P \cup \alpha Q)^* \ \&\ s \lceil \alpha P \in P \ \&\ s \lceil \alpha Q \in Q\}$, where $(\alpha P \cup \alpha Q)^*$ is a set of all possible traces from the alphabet $(\alpha P \cup \alpha Q)$.

In CSP a menu select interaction can be specified as communicating process P. The initial menu, with a set of events, is displayed on the screen, represented as P^0. After the user has selected one of these events, say x ($x \in P^0$), the subsequent interaction is defined by P/< x.> (P after x), i.e. $(P/< x.>)^0 \ldots$.

Example1.

P^0={ a, b}, $P/< a > = P_a$, $P/< b > = P_b$, P= a-> P_a | b-> P_b

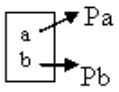

Figure 1.

A set of menus and interactive prompt representations are provided for a set of functions logically used together. Each symbol in the menu denotes a function, invoked after the user's selection. We will make a distinction between the commonly used functions, controlling the interaction process, and the problem dependent functions, the choice of which can be defined depending on the particular sort of problems. The most typical commonly used functions of the menu-select interaction are the following:

(1) functions for terminating or quitting a process;

(2) functions allowing the return to any of the previous steps.

The main objective of this paper is the specification of an abstract menu-select interaction on the basis of CSP, concentrating our attention on these three commonly used function types. In greater detail, these functions are;

(1) 'stop' – to terminate or quit a process;

(2) 2.1. 'reset' – to start again from the beginning of a process;

2.2. 'back' - to undo the most recent action in a process;

The model of a menu-select interactive system is based on the specification of these functions, which can be described in CSP. But CSP facilities are not enough to describe a menu-select interaction model completely. Therefore we need to extend CSP facilities with new processes which define the above mentioned functions. For a definition of the appropriate processes we will use a derivative definition, defining a process P by two objects: a set I, defining the initial state of process P , i.e. P^0 and a function mapping each member 'c' of I into a process, defining the subsequent behavior of P, i.e. P/<c>. If P is a process, let's define the following processes:

Stoppable(P).

Let 'stop' be a symbol not in the alphabet αP. Then the process stoppable (P) can be defined as a process which behaves like P, except that
(1) 'stop' is in its alphabet;
(2) 'stop' is in every menu of stoppable (P);
(3) when 'stop' occurs, stoppable (P) terminates successfully.
For example: <a, b, c, stop, $\surd$ > $\in$ stoppable (P) $\Leftrightarrow$ <a, b, c> $\in$ P, where symbol $\surd$denotes the event of a successful termination of the process.
Definition 1.
$stop \notin \alpha P$ & $(stoppable(P))^0 = P^0 \cup \{stop\}$ &

SKIP, if x=stop

(stoppable(P))/<x>= {

stoppable(P/x), if x ≠ stop

Example 2.

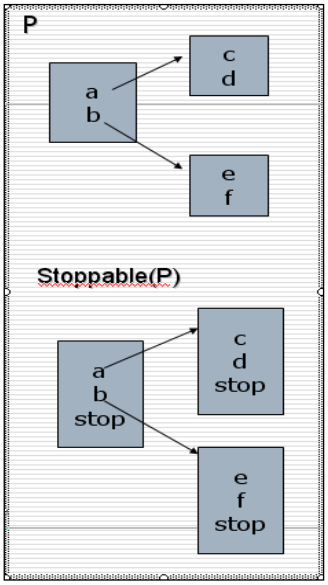

Figure 2.

Resettable (P).

Let 'reset' be a symbol not in the alphabet αP. Define 'resettable (P)' as a process that behaves like P, except that (1) 'reset' in its alphabet; (2) 'reset ' is in every menu of resettable (P); (3) when 'reset' occurs, resettable (P) starts again from the beginning. For example: <a, b, reset, c, d>∈ resettable(P) ⇔ <a, b>∈ P & <c, d> ∈ P.

Definition 2. reset∉αP& resettable(P) =start(P,P), where

$(start(P,Q))^0 = P^0 \cup \{reset\}$ &

start(Q, Q), if x=reset

(start(P,Q))/<x>= {

start(P/x, Q), if x ≠ reset

Example 3.

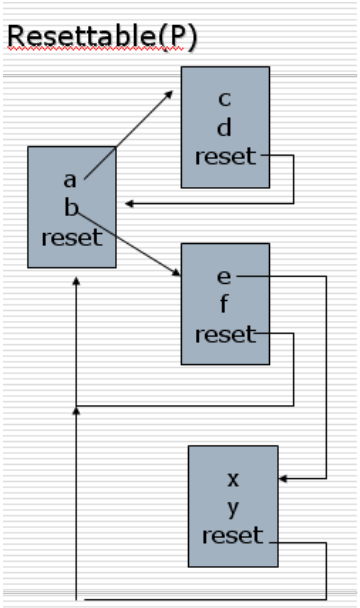

Figure 3.

Backtrackable (P).

Let 'back' be a symbol not in the alphabet αP. Define backtrackable(P) as a process that behaves like P, except that (1) 'back' in its alphabet; (2) 'back'is in every menu of backtrackable (P); (3) backtrackable (P)/s<x,back> = backtrackable (P)/s provided x ≠ 'back'.

The intention is that 'back' will cancel the effect of the most recent action which has not already been cancelled (other than 'back' itself). For example: <a, b, back, d>∈ backtrackable (P) ⇔ < a, d >∈ P, <a, b, c, back, back, d>∈ backtrackable (P) ⇔ < a, d >∈ P

Definition 3.

back∉ αP& backtrackable(P) =recover(P,P), where

$(recover(P,Q))^0 = P^0 \cup \{back\}$ &

$(recover(P,Q))/\langle x \rangle = \begin{cases} Q, & \text{if } x=back \\ recover(P/x, recover(P,Q)), & \text{if } x \neq back \end{cases}$

Example 4

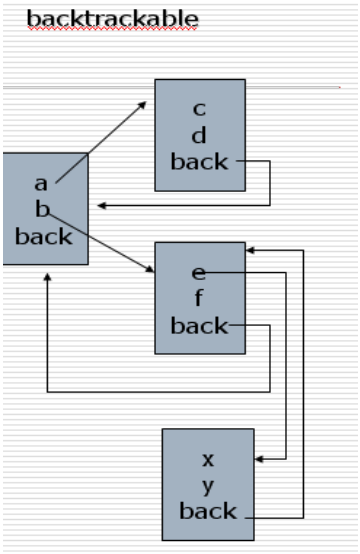

Figure 4.

The above sited definitions can be adequately implemented in the form of recursively defined functions or procedures. CSP theory permits the creation of models for a variety of software applications and is especially appropriate for those that are based on an event-driven programming paradigm. This paradigm is widely used in the majority of object –oriented programming systems. The evolution of the object-oriented programming technique led to the appearance of the CSP-OZ theory, which is based on a combination of CSP and the object-oriented specification language Object-Z (Fischer, 1997, Duke, 1995). This theory provides a specification of the behavior of communicating processes and, in addition to CSP it permits the description of object-oriented models. Materials concerning the application of CSP-OZ theory to the development of information systems have been published in a monograph (Enikeev, Benduma, 2011).

OCCAM is a concurrent programming language that builds on Communicating Sequential Processes (CSP) and shares many of its features. It was developed as the programming language for the transputer microprocessors, although implementations for other platforms are available (Roscoe, 1986, Inmos Limited Prentice-Hall,1984). The example of the OCCAM program is:

An analog volume control of a digital radio

```
DEF max=10, min=2

VAR volume:

SEQ

  volume:=0

  WHILE true

    ALT

      (volume<max ) & ( louder ? ANY )

         SEQ

           volume:=volume +1

           amplifier ! volume

      (volume>min ) & (softer ? ANY)

         SEQ

           volume:=volume -1

           amplifier ! Volume
```

As an example, a digital radio replaces an analog volume control with two buttons, one marked “louder”, the other marked “softer”. These buttons are connected to two channels, “louder” and “softer” respectively, and whenever either button is pressed it causes a message to be sent along the corresponding channel. By pressing the buttons we may increase or decrease the volume, the value of which is transmitted to the amplifier. Here SEQ(P,Q) denotes P;Q, chan?var is an input of a value from the channel chan into the variable var, chan!expr is an output of the value of the expression expr to the channel chan, alter(P,Q) is P | Q (alternative processes).

Model-driven engineering (MDE) is a software development methodology which focuses on creating and exploiting domain models (that is, abstract representations of the knowledge and activities that govern a particular domain of application) [Meyer,1997, Swithinbank, Chessell, Gardner, Griffin, Man, Wylie, Yusuf, 2005, E. Gamma, R. Helm, R. Johnson, and J. Vlissides, 1994). The first project to support MDE were the Computer-Aided Software Engineering (CASE) tools developed in the 1980s (Rational Software Corporation, Rational Rose,2001, Hubert, Johnson, Wilkinson, 2003). Companies like Integrated Development Environments (IDE - StP), Higher Order Software (now Hamilton Technologies, Inc., HTI), Cadre Technologies, Bachman Information Systems, and Logic Works (BP-Win and ER-Win) were pioneers in the

field. Several variations of the modeling definitions (see Booch, Rumbaugh, Jacobson, Gane and Sarson, Harel, Shlaer and Mellor, and others) were eventually combined to create the Unified Modeling Language (UML). Rational Rose, a product for UML implementation, was made by Rational Corporation (Larman, 2004). UML language representing a high level of model-driven engineering approach provides the possibility of software application development using special diagrams (see figure 5 below).

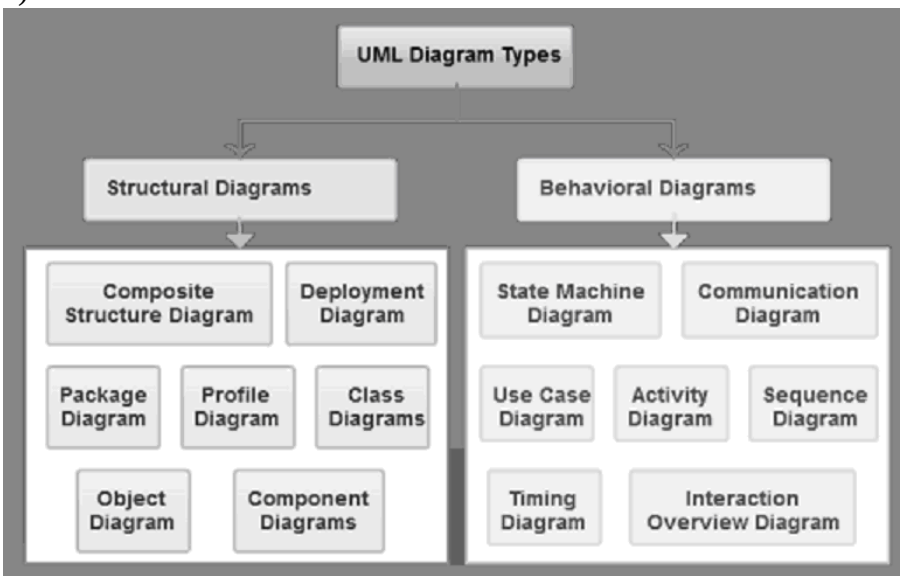

Figure 5.

The advantages of UML

- UML is an object-oriented language, therefore the methods of describing the results of the analysis and design are semantically similar to the methods of programming in modern object-oriented languages;
- UML permits the description of the system from any possible point of view and with different aspects of system behavior;
- UML diagrams are relatively easy to learn;
- UML permits the definition of new text and image stereotypes;
- UML is widely used and is currently being intensively developed.

The disadvantages of UML

- superfluity of language;
- ambiguous semantics;
- Trying to be everything to everyone;

Conclusion

This paper presents an overview of formal tools for a creation of mathematical software models which may be useful in the software

engineering. Despite many theoretical works having recently appeared in software engineering, the problem of their application to software engineering continues to be crucial. One of the most promising ways of solving the problem is to train professionals who combine practical experience in software engineering with an appropriate mathematical background. In addition to this we need to create new technological tools based on an optimal combination of developer intuition and a formal, rigorous approach to the software development process.

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THE ROLE OF BROCA'S AREA IN SYNTAX: A TMS STUDY ON WRITTEN GREEK LANGUAGE

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Abstract

A number of recent papers have addressed the potential of transcranial magnetic stimulation (TMS) to interfere with linguistic processes or speech production. In this paper we present an experiment with TMS to clarify the role of Broca's area in syntactic processing. An experimental paradigm contrasted sentences that require syntactic and semantic decisions on written Greek language. We found a clue of selective priming effects on syntactic decisions but not on semantic decisions. Our results provide evidence of the involvement of Broca's area in syntax.

Keywords: TMS, syntax, Broca's area, Greek language

Introduction

In the last 20 years there has been an explosion of studies into the neural basis of language in human brain (Price, 2012). A number of papers have addressed the potential of **t**ranscranial **m**agnetic **s**timulation (**TMS**) to interfere with linguistic processes or speech production (Epstein, 1998 – Pascual-Leone et al, 1991). TMS can be used to identify the language dominant hemisphere by targeting the language relevant areas in temporal, parietal or prefrontal cortex of both sides (Mottaghy et al, 2006). It is generally accepted that TMS or rapid TMS (rTMS) applied to a circumscribed cortical area has not only a local effect but can also influence functionally connected brain regions. TMS therefore seems to be able to

modulate areas which are remote from the site of stimulation. Single pulse TMS and rapid TMS have been used in many studies, such as in speech arrest (Pascal-Leone et al, 1991), in safety of TMS studies (Pascal-Leone et al, 1993), in human brain research (Hallet, 2000), in syntax (Sakai et al, 2002), in chronic aphasia (Naeser et al, 2005), in picture naming studies (Mottaghy et al, 2006), in artificial syntax processing (Uddén et al, 2008).

The specialization of syntactic processing in human cognitive systems is one of the central issues in neuroscience (Sakai et al, 2002). Broca's area seems to play a major role in syntax of language. Previous imaging studies have identified cortical regions, like Broca's area, which are involved in syntactic processing (Embick et al, 2000, Hashimoto & Sakai, 2002, Peterson et al, 2003). The narrowest definition of Broca's area is the left pars opercularis (F3op, Brodmann's area [BA] 44) and the left pars triangularis (F3t, BA 45), a part of the third frontal convolution (F3) or the left inferior frontal gyrus (IFG) (Sakai et al, 2002).

I.

The purpose of this study is to determine if TMS over Broca's area has any effect in taking a linguistic decision. By that way we aim to clarify the essential role of Broca's area in syntax. The experiment uses Greek language stimulus and is based on the experimental setup of Sakai et al (2002).

Materials & method

Participants: Six (6) right-handed, healthy and native Greek speaking adults volunteered to participate in this study (5 female and a male subject). None of the subjects used any medication, had a health problem history or any kind of metallic implement. All subjects had normal or corrected to normal vision. The local Ethics Committee at the Patras University Hospital approved the experiment. All subjects gave written informed consent. Due to technical problems, three (3) of the participants had to be excluded from the analysis of our results. The subjects were asked to respond to the optical stimulus by pressing one of two buttons as quickly as possible while ensuring correct responses.

Stimulus Material: 20 normal sentences, 20 sentences with syntactic errors and 20 sentences with semantic errors, having the same number of syllables and syntactic type VERB-OBJECT (no need for SUBJECT in Greek) were presented to the subjects of the study. The stimulus was written in Turbo Pascal n.12 (DOS environment – Windows 98) in a special PC program, which was especially made for this study. This program was able to collaborate with a single-pulse Magstim 200 TMS, so the PC was providing signal to the Magstim when to make stimulation (TMS). The stimulus (sentences) was presented on black screen, written in white letters. A mouse

was attached to the PC with two (2) colored buttons, a green one and a red one.

TMS was delivered through a cycle 9 cm diameter coil. TMS intensity was set at 45% at a rate of 0.3 Hz and duration about 1 sec. The coil was placed over the left hemisphere at a distance 10% from the ear for T3 point and 20% over for F7 point. The center of the coil was over F7 point.

Experimental procedure: We tested two language tasks which require linguistic decisions and were performed in separate sessions. The first task was a syntactic language task (**SynT**), where subjects had to judge whether the sentences were either *syntactic normal* (**N**) *or not* (**A**). The other task was a semantic language task (**SemT**), where the participants had to judge whether the sentences were either semantic normal (**N**) or not (**A**). In both tasks, we presented normal sentences and abnormal sentences. The participants had to read the sentences in silence and then decide as fast as they could if the sentence was N one or A.

We focused on a universal aspect of syntactic operations that is common to both English and Greek: a distinction between transitive verbs and intransitive verbs. This distinction is critical in sentence comprehension because the type of verb in a sentence determines the syntactic structure of it (Smith & Wilson, 1979). Subjects were explicitly instructed to detect a syntactic anomaly, but not instructed to pay attention to the type of the verb in the sentence. In the Sem Task, subjects judged whether the sentences were either semantically normal or anomalous while presented sentences were syntactically correct as to the usage of the verb. We focused on a lexico-semantic relationship between a noun and a verb. Normal sentences were identical among these tasks, so we tested each task in separate sessions so that the TMS effect on judging whether a normal sentence is syntactically correct can be dissociated from that on judging whether the same sentence is semantically correct. Alternatively, anomalous sentences had only one type of linguistic error in each task. Therefore, these stimuli formed minimal pairs for both intra-task pairs (N and A sentences) and inter-task pairs (anomalous sentences for Syn and Sem Task). Sakai et al (2002) named this experimental design a minimal-pair paradigm.

In every task there were 20 normal sentences, 20 semantically abnormal for the SemT and 20 syntactically abnormal for the SynT. Every time a normal sentence was presented on the screen, the subject had to press the green button of the mouse (which was attached to the PC): in case of an abnormal sentence, the subject had to press the red one. The PC program estimated the time since the sentence was on screen until the time the person made her decision. This time is called reaction time (**RT**). Event-related TMS was delivered over Broca's area at a specific timing, which was called *Real Condition* (**R**). As a control to the R condition, we presented recorded

discharge click without concomitant TMS at the same volume and timing, just like the R condition: that condition was called *Sham Condition* (**S**). So, the only difference between those two conditions was the presence or not of the TMS. TMS was delivered 150 ms after the onset (T=150 ms).

We chose to deliver TMS at the time of 150ms after the onset because of the results of Sakai et al (2002). When TMS was delivered at T=150 ms, ΔRTs were significantly negative for both sentence types in the Syn Task but not for the Sem Task. When TMS was delivered at T=0 ms or T=350 ms ΔRTs were not significantly different from ΔRT=0 (p>0.1).

Results

The subjects performed the SynT and SemT at the accuracy of 100% across all individuals and conditions.

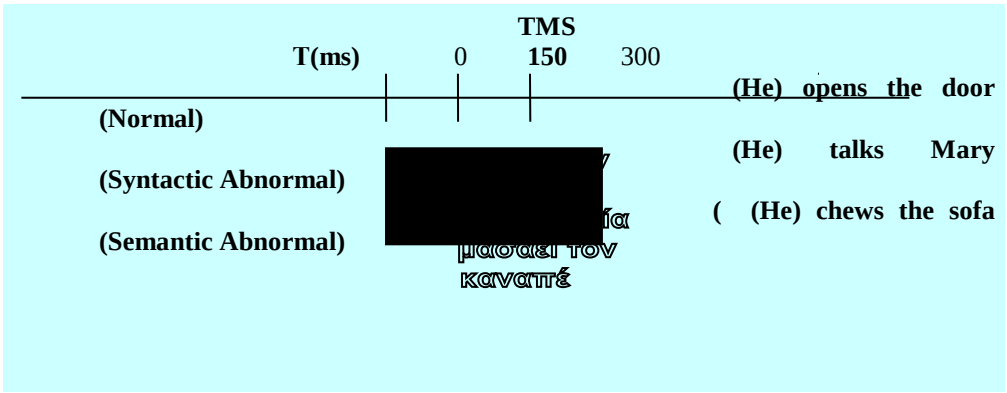

Figure1. TMS was delivered at 150ms from the presentation of the sentence. Normal sentences were the same in both tasks (SynT & SemT)

We separately analyzed the two conditions of TMS (***R**eal Condition & **S**ham Condition*) for each task (Syntactic Task-SynT & Semantic Task-SemT). We also analyzed the Reaction Time (RT) for both R & S conditions and we found out the difference of RT (ΔRT) for N and A sentences in the SynT and SemT.

ΔRTs were **positive** for N and A sentences of SemT: so ΔRTs in the SemT were not different from ΔRT=0 (according to *one population t-test* P>0.5). ΔRTs for N sentences of SynT were also **positive** (P>0.5), but ΔRTs for A sentences of SynT were **negative**: so ΔRTs in the SynT for A sentences were different from ΔRT=0 (P<0.2).

We also compared:

- ΔRTs between N sentences for both tasks (SynT & SemT): according to *two populations t-test* there was no significant difference (P>0.8).

- ΔRTs between N and A sentences for SemT: according to *two populations t-test* P>0.9 (no significant difference).
- ΔRTs between N and A sentences for SynT: according to *two populations t-test* **P<0.25** (close to significant difference).
- ΔRTs between A sentences for both tasks (SynT-SemT): according to *two populations t-test* **P<0.25** (close to significant difference).

	Syntactic Task				Semantic Task			
Subject	N sentences (ΔRT)	**Mean ΔRT** (ms)	A sentences (ΔRT)	**Mean ΔRT** (ms)	N sentences (ΔRT)	**Mean ΔRT** (ms)	A sentences (ΔRT)	**Mean ΔRT** (ms)
A	8.82± 17.71		-21.92± 40.33		103.15± 47.0		101.58± 39.38	
B	189± 70.01	**51.24± 70.75**	-28.18± 47.62	**-50.85± 25.86**	68.37± 8.83	**38.67± 48.14**	-35.02± 41.53	**31.14± 39.49**
C	-44.46± 63.32		-102.47± 11.50		-55.50± 21.69		26.88± 52.08	
		P= 0.54419		**P= 0.18823**		**P= 0.5061**		**P= 0.51293**

Table 1: ΔRTs of the subjects after TMS for the SynT and the SemT

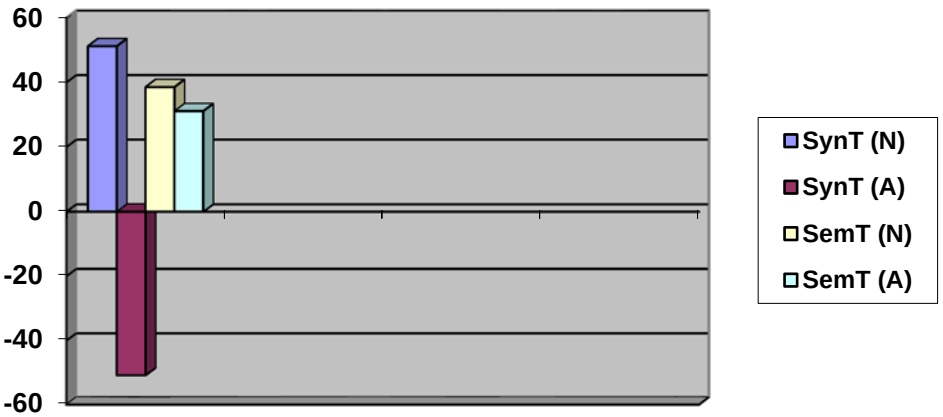

Figure2. The results of the study: TMS over Broca's area seems to have an effect on SynT (for A sentences)

Conclusion

Our study shows two basic results:

a) Event-related TMS seems to reduce RTs in SynT but not in SemT and

b) The effect of TMS was only observed during abnormal syntactic processing and not during abnormal semantic processing.

These results are consistent with previous functional imaging studies which have implicated selective activation of the left F3op/F3t during syntactic processing in comparison with semantic processing (Dapretto and Bookheimer, 1999, Ni et al, 2000). Also Stromswold et al. (1996), Embick et al (2000), Moro et al (2001), Indefrey et al (2004), Kinno et al (2014), Bernal et al (2015) have mentioned the crucial role of Broca's area in syntactic processes and other language processing by using fMRI and PET techniques in their research. In this study we have chosen to use the TMS method instead of a functional imaging method because it creates plasticity on the brain, while neuroimaging techniques (fMRI, PET) record brain activity, measuring hemodynamic changes (Price, 2012).

Sakai et al (2000) use rTMS in a similar linguistic study to ours. We find out reduction of ΔRTs in abnormal syntactic sentences but not to normal sentences as they did. We have also chosen to stimulate just at 150 ms and not to 0 ms or 350 ms on set as they did, in order to reduce stimulation sessions because of our inexperience with TMS and linguistic tasks on normal subjects.

We found no significant difference in our results. This might be due either to the small number of subjects (three) or the sex used on this research. There is probably need for more subjects to make significant results. The subjects used in our study were women while Sakai et al (2002) used three male subjects in their study. Hartshorne & Ullmann (2006) suggest that gender factor is very important in any kind of linguistic processes and research.

Carreiras et al (2012) used TMS to investigate the involvement of Broca's area in morphosyntactic processing, while working memory and cognitive control demands are low. They presented word pairs, not sentences as we did, that could either agree or disagree in grammatical gender or number while stimulating Broca's area and other regions. Stimulation over Broca's area significantly reduced the advantage for grammatical relative to ungrammatical word pairs. The interaction between grammaticality and stimulation was specific to that region (Broca's area), suggesting a clear involvement of the region to the morphosyntactic process. Grodzinsky and Santi (2012) by using event-related fMRI imply that an alternative or modified functional account of Broca's area is required.

Many recent studies use TMS over Broca's area to demonstrate the casual role of this region in the encoding of grammatical gender (Cattaneo et al, 2009), as also to provide evidence that this region contributes to word recognition speed (Zhu et al, 2015).

Price (2012) suggests that the next 20 years will need to focus on understanding how different regions interact with one another and how

specialization for language arises at the level of distinct patterns of activation in areas that participate in many different functions.

We strongly believe that TMS studies give possibilities to research into the localization, specialization and interaction of different brain regions in language.

Acknowledgment

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JOINT ESTIMATION OF CHANNEL AND IMPULSE NOISE IN AN OFDM BASED SYSTEM FOR A POWERLINE NETWORK USING ADAPTIVE GUARD LENGTH

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Abstract

This paper considers OFDM based joint estimation of channel and impulse noise with an adaptive guard length for a powerline channel. The purpose of adaptive guard length is to cater for the channel variations caused due to time varying behavior of powerline network. Results show that the utilization of joint channel and impulse noise estimation gives improved bit error rate performance as well as efficient utilization of available bandwidth. Also the simulation results confirm that performance of proposed adaptive guard band method with joint estimation is better as compared to the fixed guard length for the communication system.

Keywords: Powerline channel, Guard band, channel estimation, impulse noise, channel impulse response

Introduction

Pilot based channel estimation plays a vital role in the overall system performance improvement in communication regime. The situation becomes more challenging in the presence of impulsive noise in both wireless and wired communication systems, where the occurrence time of impulse noise (IN) cannot be predicted beforehand. If not dealt with, this unpredictable timing along with high power of IN can degrade the system performance severely. In case of wired communication, powerlines are gaining attention day by day as a cheaper communication medium.

The global standards including IEEE 1901, HomePlug etc. have defined a powerline communication (PLC) channel to be capable of accommodating broadband communication. But powerlines exhibit above defined harsh and unpredictable behavior for communication signal propagation, as their primary usage was intended for power transmission

only (J Lin, Brian, L Evans 2013). As a result the usable channel bandwidth drops more beneath the theoretically defined limits. Hence it is important to devise mechanisms of pilot based estimation which are bandwidth efficient to deal with this problem and to make PLC channel an appropriate candidate for broadband applications. One solution can be the utilization of compressed sensing algorithm using joint pilot set instead of separate ones for both channel and IN estimation (H. Gacanin 2013). This will result in reduced pilot overhead, thus making the system bandwidth efficient. In (A. Mehboob et al 2013) a joint scheme for both channel and IN estimation has been suggested but no attention is paid to the varying channel impulse response (CIR) length.

In order to capture the accurate picture of a varying PLC channel contaminated with IN, it is important to cater for the channel and IN estimation along with adaptive adjustment of windowing function to the varying CIR length. It is seen that the load conditions in a powerline network keep varying, due to the devices switching on and off, which results into change in multipath behavior causing different number of delayed copies of transmitted signal arriving at the receiver every time. If not taken care of, these delayed signal copies interfere with the next symbol resulting into inter symbol interference (ISI) causing an increase in bit error rate (BER).

In recent past, orthogonal frequency division multiplexing (OFDM) scheme has been utilized to cope with this multipath interference. It provides better shielding against ISI and results into improved BER. To avoid the delayed copies of previous symbol interfering with the next one, OFDM provides the user with a guard band in the form of a cyclic prefix. The presence of GI makes OFDM a good choice for PLC channel but keeping in mind the varying channel conditions, fixing guard interval (GI) at a single value may compromise the overall system performance (H. Gacanin, F. Adachi 2009). In case the number of multipath gets larger than the fixed GI length the result would be performance degradation of the equalizer due to increased ISI. Conversely, if the CIR length is decreasing in comparison with the predefined guard band, the useful system bandwidth will be wasted in extra length of fixed guard band. These changes in channel are reflected upon the CIR length (effective CIR length may decrease or increase).

The purpose of this research is to device a mechanism that can jointly estimate the channel and IN and also adjusts the GI length according to the varying channel conditions mentioned above. The rest of the paper is arranged as follows; section 2 expresses the system model being analyzed, section 3 provides simulation results and section 4 concludes the paper.

Compressed Sensing Based Channel Estimation

This section provides readers a brief overview of CS estimation. We utilize the least absolute shrinkage and selection operator (LASSO) algorithm from RIPLess theory of CS. Its mathematical expression is given,

$$min_{x \in C^N} \frac{1}{2}\{\|A * \emptyset_i - y\|_2^2 + \lambda|\emptyset_i|_1\},$$

The approach used by CS is different in that the received signal is not sampled at all the locations, instead, only J<<N noisy measurements are taken from the dictionary matrix [11], [12]. Here J×N sensing matrix is built from the dictionary to ease the reconstruction of signal at the receiver side. It is worth noticing that the signal is reconstructed from the dictionary along with the received pilot symbols information carried in Y(t). Mathematically CS problem can be given as,

$$Y(t) = x * \emptyset + n_0(t)$$

Here $\emptyset$ is the sensing matrix and 'x' is being observed by the sensing matrix (this observation is taken in the form of inner product between sensing matrix and the channel coefficients matrix). After finding 'x' it is easy to reconstruct x from the received signal Y(t). Here 'x' will be computed by using the LASSO algorithm.

System Model

We assume an OFDM based communication system where each subcarrier in OFDM is further binary phase shift keying (BPSK) modulated, with no interference of CIR and IN supports and an increasing CIR length (H. Gacanin 2013), (A. Mehboob et al 2013). Also transmitter and receiver are assumed to be perfectly synchronized. Figure 1 represents the diagram of the system utilized in this work. Let N be the total number of subcarriers and J be the number of pilot subcarriers. So, in each OFDM frame there would be N-J data symbols. The pilot positions are uniformly allocated. An initial GI length is appended and is denoted by L_G, the symbol duration is represented by T_{sym} and the OFDM symbol is modulated. The resultant signal x is transmitted over the PLC channel, with channel impulse response h.

The received signal Y can be represented mathematically as,

$$y = x * h + n_k$$

Frequency domain equivalent of the received signal can be given as,

$$y_k = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} \left(\frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} (s_k H_k) e^{\frac{j2\pi kn}{N}} \right) e^{\frac{-j2\pi kn}{N}} + N_k$$

where k and n vary from 0,1,2,…,N-1 and s_k, H_k represent the kth symbol in OFDM frame and the channel frequency response at kth index respectively. 'N_k' is the kth noise component in the received OFDM frame. The noise N_k in frequency domain is

$$N_k = \frac{1}{\sqrt{N}} \sum_{i=0}^{N-1} N_i e^{\frac{-j2\pi in}{N}} \text{ with i=0,1,…N-1,}$$

The time domain equivalence of this noise is assumed to be composed of two components, Gaussian component and IN,

$$n_i = n_g + n_{IN}$$

We utilize a multipath channel with P paths, where P may vary from 5-20 taps in a typical PLC channel.

Next step is to perform channel and IN estimation to obtain the transmitted signal 'x' free of IN and other channel impairments. This requires the estimation of both PLC channel

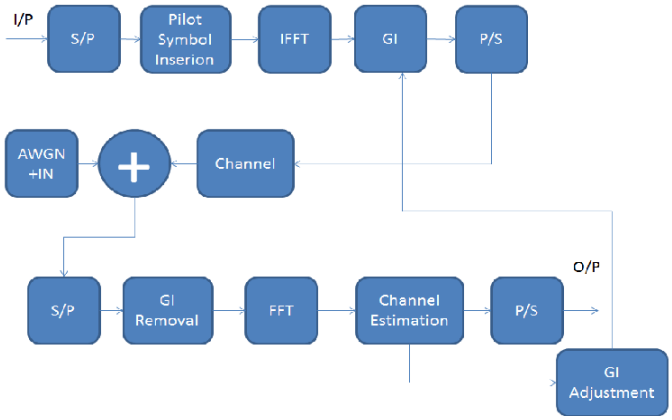

Figure 1. Block diagram showing the OFDM based communication system utilized.

and IN to counteract the effects of both from the received signal 'y' and to recover the signal correctly [3]. The received signal sampled at pilot indices J is mathematically expressed as,

$$Y_J = X_J H_J + N_{g,J} + N_{IN,J}$$

Where $N_{g,J}$ and $N_{IN,J}$ is sampling of AWGN and IN at pilot locations,

Let,

$$N_{t,J=} N_{IN,J} + N_{g,J},$$

$$Y_J = X_J H_J + N_{t,J}$$

As discussed already, we will consider the joint estimation of channel and IN to lower the number of pilot tones than those required by the separate schemes for channel and IN estimation. The assumption is made that due to non-zero pilot symbols, the values of channel and IN would be superimposed upon each other at the pilot indices. But the IN and channel support set are not supposed to interfere. Authors in (A. Mehboob et al 2013) state that the probability of IN occurrence in the first r samples q=0,1,..5 against the overall IN occurrence in OFDM frame is as low as 0.01, hence it is safe to recover the channel estimates from the first r samples of Y_J only without

interference with IN samples. Figure1 shows the probability function of the occurrence of q=0,1,..5, impulses in first r samples.

Joint Estimation of Channel and IN

We have utilized here a joint set of non-zero pilot symbols for estimation of both channel and IN.

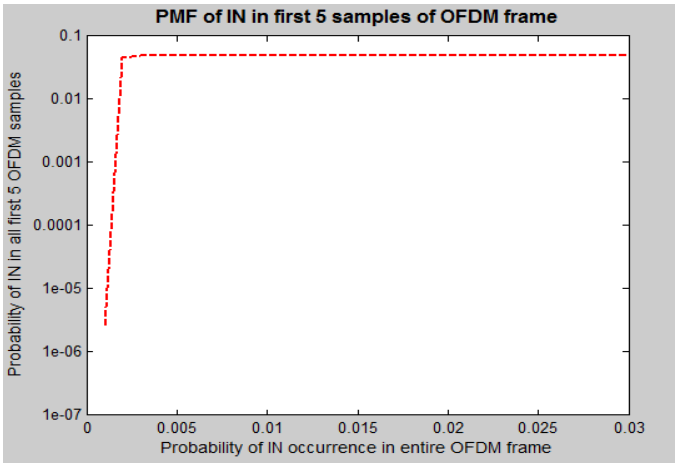

Figure 2. Probability distribution of IN supports interfering with CIR.

The CS estimate of the intermediate signal can be given as;

$$\hat{h}_{Cs}(t) = (X^H * X)^{-1} X^H * Y = X^{-1} * Y$$

Having obtained the intermediate joint estimate we can get the channel estimate h(t) by taking the first K samples only i.e.

$$h_t = \begin{cases} h_{Cs}(i), & i = 0,1,..K-1 \\ 0, & otherwise \end{cases}$$

h_t can now be interpolated using FFT and then IFFT operation can be performed to get CIR. The IN estimation can be performed upon the remaining $\hat{h}_{Cs}(t)$ as follows;

$$n_t = \begin{cases} 0, i = 0,1,...P-1 \\ h_{Cs}(i), i = P,..N-1 \end{cases}$$

Since IN is additive in nature, this estimated IN response is to be subtracted from the received signal. The channel equalization is performed in the next step to mitigate the channel effects from the received signal.

The joint estimation provides improvement in the performance of channel estimates. To fully capture the varying nature of a powerline channel and to further optimize the system's bandwidth efficiency, length of guard band needs to be adjusted according to the varying CIR length. This technique is discussed next.

GI Length Adjustment Method

We consider the decrease in effective CIR length as compared to the pre-defined GI length. Purpose of this GI length adjustment is to save the excess bandwidth that is being wasted in appending greater length of GI interval than actually required. GI length adjustment method will take the initial channel estimates using the LASSO estimation discussed earlier. Let h(t) be the required initial channel estimate. We run the procedure for V=0,1,.. L_G-1, thus performing the windowing of the CIR. After performing the windowing $h_i(t)$ is obtained, whose FFT can be taken to obtain improved frequency response $H_I(K)$. Next, for every iteration of search method, we calculate the MSE on that index K using the formula;

$$MSE(V) = \sum_{r=0}^{N-1} |H_I(K) - H_c(K)|^2,$$

where H_I is improved frequency domain channel response and H_c is the initial channel estimate in frequency domain. The cost function to be computed here is the ratio of mean error of present value to the previous one.

$$C(K) = \left| \frac{MSE(K+1)}{MSE(K)} \right|$$

Next we estimate the K index that will maximize the cost function C(K). As maximum C(K) value denotes the maximum distance between initial channel estimates H_I and the improved ones, which in turn points to the number of samples by which the CIR needs to be adjusted. The output of the search method is the number of samples 'alpha' by which we need to estimate the optimized frequency response $H^{\alpha}(K)$. Finally that value of alpha is assigned to L_G. This new value of GI length is next time utilized for transmitting the OFDM frame. Every time the GI length is required to be appended, this method will be called except for the first iteration which will be using the initial value of GI length.

Simulation Results

An OFDM based communication system is utilized with N=256, J=32, P=5, L_G=16 and p=0.01. Whereas for separate estimation, we take J_I=12 and J_C=20 tones for IN and channel estimation respectively. We compare the performances of both separate and joint CS based schemes in terms of bit error rate for CIR and IN estimation using LASSO algorithm. It can be seen in figure 2 that the proposed joint scheme gives 4 dBs gain in achieved BER over the separate estimation scheme. The reason is that the increase in number of pilot tones in case of joint estimation increases the estimation accuracy of IN and as a result the BER improves. It is also evident from the results that the joint estimation scheme gives better results although the number of pilot overhead is small, which means that joint estimation scheme is bandwidth efficient.

Next we investigate the impact of GI length adaptability, figure 3 shows that at lower Eb/No values the increase in value of alpha does not affect the cost function very much which stays under 10 dBs. But as Eb/No increases, the cost function also gives better resolution in terms of defining the difference between previous and present value of channel frequency response. Also it is evident from figure 3 that at each Eb/No level, the cost function stays at the same level till the value of alpha is equal to P. This proves the dependence of cost function on the number of channel reflections and their effect upon channel frequency response.

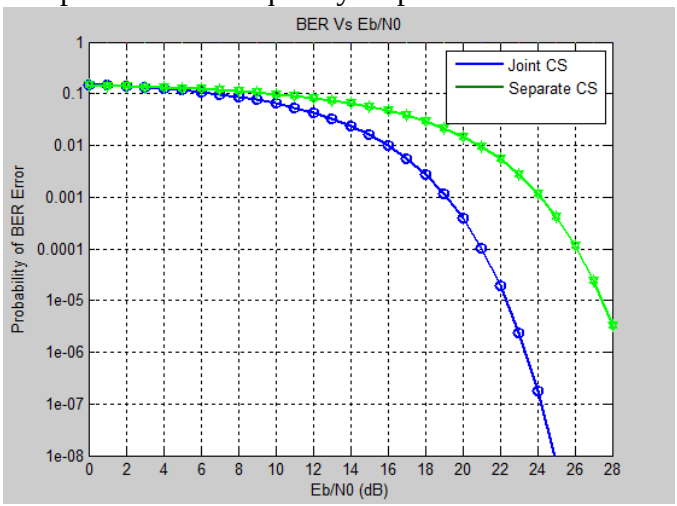

Figure 3. BER comparison of separate and joint CS based estimation schemes.

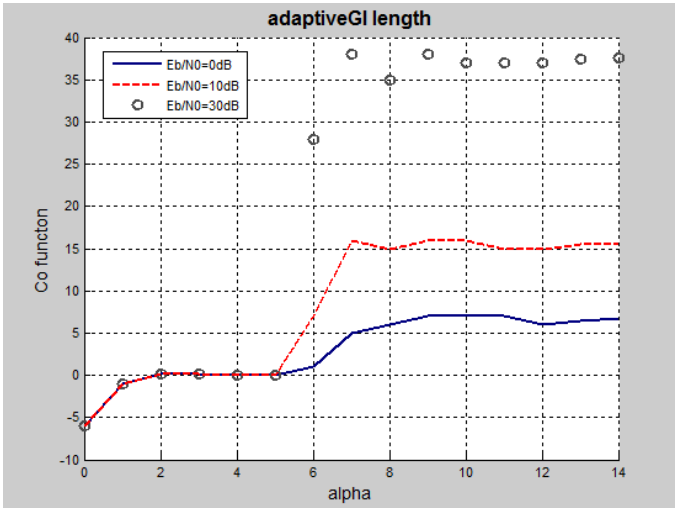

Figure 4. performance evaluation of GI length adjustment for different Eb/No levels.

Conclusion

In this research, we have proposed a joint channel and IN estimation scheme along with adaptive GI length. It is shown that the said technique performs better in a time varying PLC channel, by giving almost same BER as the separate channel and IN estimation scheme and at the same time it cuts down the number of pilot overhead, thus providing a bandwidth efficient estimation scheme. The adaptive GI length further allows the system to utilize the available bandwidth more efficiently, by reducing or increasing the GI length according to the changes in channel conditions. The results show performance improvement of the proposed technique over the separate estimation technique without GI length adjustment, in the form of improved BER rate.

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NURSE SCHEDULING PROBLEM

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Abstract

In this paper, what i have been discussed, is analyzing penalties and cost shifts based on several elements for nurse scheduling problem (NSP). NSP's issue is to assign nurses to different tasks based on constraints. The problem is known to be NP-hard, in other words it does not have a solution or needs years to be solved. In this work we try to solve the problem by satisfying the constraints set, and we also include the nurse's preference and try to balance the difficulty level of all the involved nurses. We also analyze the complexity of the problem as a function of parameters such as number of nurses, number of shifts, and optimality of the function. According to the importance in practice, many scientists have developed NSP problems in a satisfactory time limit.

Keywords: NSP(Nurse Scheduling Problem), IP(Integer Programming), LIP (Linear Integer Programming), NIP(Non Linear Integer Programing), SIP(Scheduling in Integer Programming)

Introduction

Scheduling is always defined in the following way: Scheduling concerns in allocation of limit resources to tasks over time. It is a decision making process with the goal of optimizing one or more objectives e.g.: competition time or resource utilization. Most of works focuses in scheduling the time domain. The importance of good scheduling is strongly motivated by the present development of technology [1]. In most literature materials about scheduling problem are focused in two kinds of scheduling problems. One type is allocating resources to a program in order to optimize a given performance measure and the other type is scheduling the machine or other processors to produces a minimal time or cost. If there are tasks which can be performed by several devices, scheduling is needed in other case is not important (different devices performed exclusive tasks). A scheduling problem may not be hard to formulate but solving it is entirely another matter. Most scheduling problems are NP-hard. My problem, nurse scheduling is a NP-hard problem (Non- deterministic Polynomial-Time

hard). NP-hard means that the result of the optimal time that we find can be verified in polynomial time. Combinatorial problems constitute an important set of problems in computer science and applied mathematics. Scheduling concerns the allocation of limit resources to tasks over time. A scheduling problem is defined by description of the processors, by description of the task and the measure of performance. Nurse Scheduling Problem is a typically Constraints Satisfaction Problem (CSP) since it consists in assigning a value from a finite domain to each variable of a finite set. In Constraints Programming the constraints are the same as Integer Linear Programming. The nurse's attendance in work is to a certain degree more important than the presence of doctors as they have to be alert all the time. The doctors are needed for an intervention, but the nurses are needed all the time as long as the patients are in the hospital, they are like baby-sitters: they have to be there. At first i will propose my problem, then i will explain the constraints and the code. I will run several experiments with the code in order to see the performance and i will discuss the results.

My code is structured by sets in Lingo 15 Application Software that is part of Lingo Systems. Sets are the foundation of Lingo Modulating Language and simple groups of related objects. A set must be a list of products, employees etch. Each member in the sets must have one or more characteristics associated with it. We call these characteristics attributes. My sets are:

```
Data
        N = 20;
        H = 7;
        T = 38;
        TMAX = 48;
ENDDATA
SETS:
        NURSE / 1..N/: RATE, DIFF, EXE, P;
        DAYS / 1..H/;
        WEEK /1..10/;
        ACTIVITY / REGULAR, DAY-A, DAY-B, NIGHT, SSPI/:
NBHOURS;
        JXK (DAYS, ACTIVITY): NEED, PENALITY;
        IXJ (NURSE, DAYS);
        IXJXK (NURSE, DAYS, ACTIVITY): AFFECT;
        IXK (NURSE, ACTIVITY);
        ENDSETS
```

In the sets we have nurses days and weeks. In the activity path we have the shifts that are regular DAY-A (first day shift), DAY-B(second day

shift) we need to shifts in the first period that means double nurses more than night shifts), NIGHT(Night shift) and SSPI (Supervisor Shift). The number of Rows is the 20 as the number of nurses. The number of colums is the number of shifts (5Shifts per day). We have 7 groups of columns (7 days). In a row we must not have more that seven 1-s . For example the first nurse in the first day is not working. In the second day on Tuesday is working on the first shift, on Wednesday is not working too. We have 20 Nurses(N) but before running the code we can change the number of nurses in **N = 20;** The interval of adding/deleting must be [15;25]. The software will not run less than 15 nurses and more that 25 nurses in the period of 10 weeks. When we add a nurse in these rows we must add the binary numbers 1 and 0 in the code in the row of RATE and 0 in the row of EXE. The numbers after the exclamation mark are considered as comments.

RATE = 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 ; !.8 .8 .8 .8 .8 .8 .8 .8 .8 .8 .8 .7 .7 .5 .5 .5 .5 .3;

EXE = 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0; !0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0;

Ps : we must have 20 binary 1-s and 0-s. RATE and EXE rows. We have 7 Days (N) in a week and 5 shifts (k). When we see these attributes IXJ (i=nurse, j=day, k=shift). Affect must be 0 and 1 that means it works or not. We have other activities Affect (Nurse, Day and Shift).

The values of the output are either 0 or 1, which means that a nurse does not work in a certain shift if the result is '0', and works if the result is '1' . Now we have the table for the Affect.

P is Penallty the value of Penallty. Diff is the difference between how many hours works per week and time minimum. *For example a nurse is working =8*3+1*12=36.*

*The number of variables is:7 days*5shifts/day*20nurse=700 (integer variables). From the definition of X_{ijk}, whre X can have values of '0' and '1'.*

i=1:20 (20 nurses), j=1:7 (7 days of the week), k=1:5 (5 shifts),

In the code there is a variable called Diff that calculates the difference between the working hours and the minimum time a nurse can work. The minimum time a nurse can work is 38 hours. For example: a nurse that works three 'regular' shift (8 hour/shift) and one 'Day_B' shift (12 hour/shift) then the total working hours are 8*3+1*12=36. Since the minimum working hours are 38, the DIFF-value for this nurse is 38-36=2.We can generate different type of constraints. If we want to arrange the schedule so that the 7^{th} nurse never meets the 11^{th} nurse, we can set a constraints of the type as below:

$$\mathbf{X_{7jk}+X_{11jk}<2}$$

Based on our output of the code, and based on the hours that each nurse works we can always minimize the number of nurses in order to reduce

the costs of the hospital. In one run of the cod with 5 shifts, 20 nurses that was executed for 1 minute we notice that some of the nurses work 14 hours less than the minimum working hours which is 38 hours/week.

Diff = T_{min}-$T_{working}$=38-36=2

14	***3.6***
5.45	***3.6***
6	***3.8***
10	***3.8***
5.45	***3.6***
14	***3.6***
10	***3.8***
5.45	***3.6***
10	***3.8***
2	***4.2***
6	***4***
14	***3.6***
2	***4.2***
10	***3.8***
6	***4***
14	***3.6***
14	***3.6***
14	***3.6***
4.9	***4.2***
0.9	***4***
0	***0***
0	***0***
0	***0***
0	***0***
0	***0***
0	***0***

Total Diff and Penalties :

8.79375	**3.675**
14	**4.2**
5.45	**3.6**

Table 1 Diff and Penalties (N=20, 5 shifts, 10 weeks)

NSP Model Statistics:

Vars= 742 (all are linear)

Integer vars= 700 Binary vars= 700

Nonzeros= 6711 Const nonz= 6240(3400 are +- 1) Density= 0.014

Smallest and largest elements in abs value= 1.00000 48.0000

No. < : 440 No. =:195 No. > : 20 No. posd : 0, Obj= MIN, GUBs <

Single cols= 40

700 integer variables = 20 nurses * 7 days * 5 shifts. Binary Variables that means the value is zero or one. Nonzero variables means that we have no result equal to zero. Smallest and largest elements in absolute value are 1 and

48. We have also **NBHOURS = 8 12 12 12.55 8 8**. How many hours works a nurse in a shift.

Shifts	Hours
Regular	8
Day A	12
Day B	12
Night	12.55
SSPI	8
Auxiliary Shift	8

Table 2: NBHOURS

An attribute that is in the code is NEED that mean how many hours a nurse must need to work. T_{max} is an other attribute that is calculated **Tmax=Affect* NBhours.** For a nurse the Diff is the multiplication of penalty and NB-hours for a nurse

The excel file is updated it we change the number of nurses the tables will always change. If we have 18 nurses the table will have 2 rows less. In a hospital the different assigned tasks require the introduction of a new "shift" at the same time. So in this work an extra shift may define a completely different task at the same time at the same section of the hospital. An anasteolog may be needed, a nurse that is specialized in bones may be need etc. When we solve these problems, as the number of shifts increases the complexity of the problem is increased. A question until now, is that the weekly total penalty is 38. But in the outputs we get 76. And on average we get a penalty (difficulty score) of 3.8 (76/20=3.8). The total 'penalty' that is needed per week is 76. Because we have a need of 7 nurses for the 'regular' shift (7 nurses*5days*1),

$$\mathbf{7 \times 1 \times 5 + 1 \times 1.2 \times 5 + 1 \times 1.4 \times 5 + 1 \times 1.4 \times 2 + 1 \times 1.4 \times 5 + 1 \times 1.6 \times 2 + 2 \times 1.6 \times 5 = 76}$$

We executed the code for 4 seconds at least 3 times and we did not see any difference in the assigned jobs, the penalty values and the difference between the hours worked and the t_min (t_min=38 hours per week.) The only difference was in the 'solver steps' and the 'solver iterations'. We observe a penalty of 3.8+/-0.3. When we executed the code for a longer time (60 seconds) we observed a smaller penalty value (P_{max}-P_{min}=0.6). The penalty is 3.8+/-0.2. We have a smaller standard deviation of the penalty value distribution. We also noticed that there are 54 different job assignments, i.e. a different of 7.7% in the job distribution. 2 subsequent executions of 1 minute (58.37) showed no difference at all for the assigned tasks. The Diff and penalties are exactly the same. We executed the code for 3 min and we noticed no change from the the 1 minute executed case. Everything was the same, the Pmax-Pmin (still 0.6), Diff, and the individual penalties. We can comment on the 'Diff' and the penalty for each nurse. For all the runs/execution of 4 sec and 60 seconds the values of Diff are the same

(Diff_ave=8.4075). The difference is in the distribution of these less-working hours.

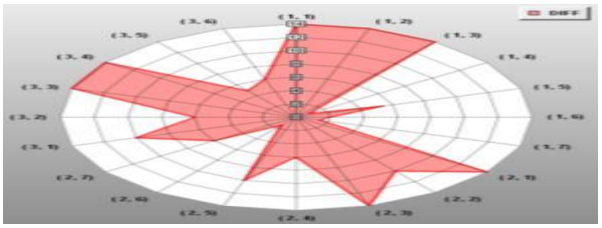

Figure 2 :The Diff for 5-shifts, 20 nurses, executed for 60 seconds

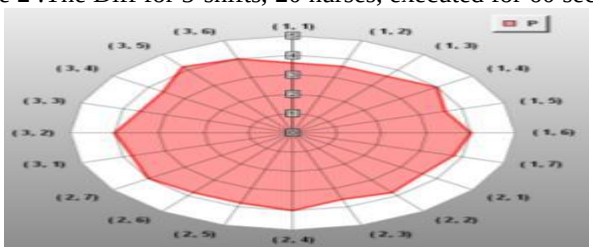

Figure 3 :The penalty for the 20 nurses.

The ideal case would be when we see a 'perfect' circle

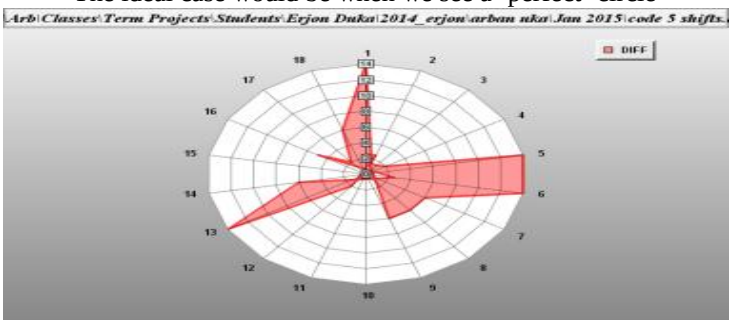

Figure 4 : 18 nurses, 5 shifts 57.85 seconds run

Review the Constraints

We can add different constraints for example Nurse 7 and Nurse 11 must nor work a day together

X7jk + X11jk >=1

In the code we have added other constraints. To create and implement the code in Lingo 15 Application we must remember the constraints:

C1: Coverage constraints require a number of nurses for each shift (DS, EDS, ENS and S) and each day.

C2: Working hours must not exceed 12 hours per day

C3: Working hours must be close to 38 hours per week, and must not exceed 48 hours per week

C4: A nurse cannot work more than three night shifts during a week.

C5: If a nurse works an EDS (respectively ENS) on Saturday, then he/she also works an EDS on Sunday and than next Monday and Tuesday is free.

C6: This allows minimal rest time between 2(two) shifts. If a nurse works a Night Day Shift the following day is free. If a nurse works an EDS the following day is free.

In the graph is shown that nurse 5 works first night and second night but nut the third night. The first thing that we do in the code is after declaring the sets, attributes and constraints is minimize the gap between nurses with the highest rate of strain and the nurse having the low estate.

MIN= PMAX - PMIN;

The*@FOR* function is used to generate constraints across members of a set.

A binary integer variable also called a 0/1 variable is a special case of an integer variable that is required to be either zero or one. It's often used as a switch to model Yes/No decisions. In our case @BIN is associated to the Affect that we have told before is 0 and 1.

As we said before a nurse canbe assigned to onlyone activity per day.

@FOR (nurse(i):
@FOR (days (j): [unicity]
@SUM (ACTIVITY (k): AFFECT (i, j, k))
<= 1.

Testing for 5, 6 and 7 shifts

After we have done a lot of test of NSP we create a table for the results. When we see carefully the table we detect that when we run the code several times without changing any data we see that objective value (our case to solve) change from 0.1 to 0.6 When we change nothing but also we add time the objective value becomes minimum from 0.8 to 0.6 and sometimes if we are lucky we can see it 0.1. The maximum time for running the code is 3 days from Friday to Monday in my work PC'lab in Fastip, University of Durres. The objective value was 0.12. Our scope is to make it 0.1 or the ideal value that is zero. In this table we have write in the columns : number of nurses, number of weeks, ESS (Extended Solver Steps), TSI (Total Solver Iterations) ERS(Elapsed Runtime Seconds that is time in the table) , Total Variables, Integer Variables, Total Constraints, Non-linear Constraints, Total Nonzero Non-linear Nonzero . The search have been stopped after a reasonable time for different reasons :

- Solvers , especially the ILP Solver have found a very good solution almost reaching the asymptotic value after a short time
- Even after 12 works of search the best value found was the one given after one hour
- A good schedule could be acceptable even if it has not exactly the minimal difference between Pmin and Pmax.

One interesting issue that I would like to underline in this thesis is that when i minimize(15 nurses) the number of nurses the Generator Memory Used of Lingo Program reduced itself by 1KB. The minimum number of starting the program is 15 Nurses. I cannot solve my application using 10 nurses. The minimum number of weeks would be 5 weeks .In other words program will not run in 10 nurses and 3 weeks.

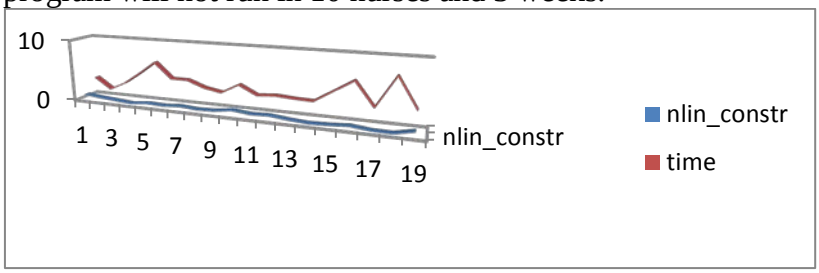

Figure 6 Non-Linear Constraints vs Time

The Objective Value vs. Time 20 Nurses 5 Shifts.

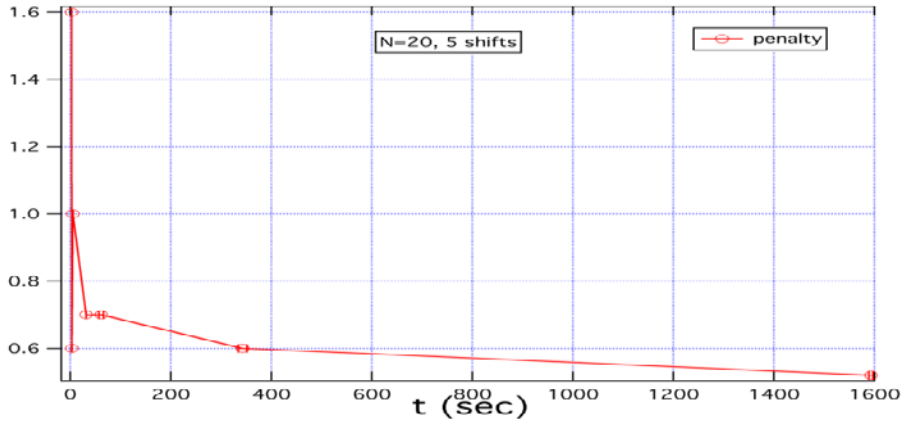

Figure 7 Penalty VS Time 20 Nurses 5 Shifts 10 weeks

In this graph we see that when the time executing is growning the objective value goes closed to Zero that is your scope. The Problem is resolved . All summary' penalties of the shifts for each employer are equal.

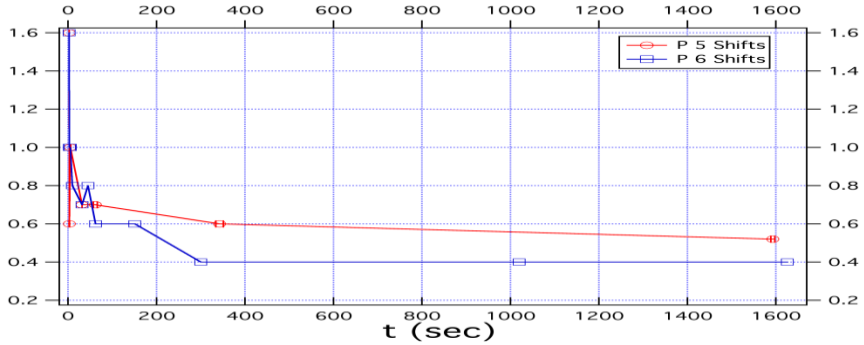

Figure 8. Objective value vs. Time: for 5 shifts and 6 shifts.

Interestingly, we notice a faster convergence (in computer time) for the case of 6 shifts. This seems counterintuitive, as with more shifts that have to be filled, there would be much more possibilities to check. We see that when we increase the number of shift the objective value is decreasing. It si fact that when we add a shift the software must do more iterations but the penalty is decreasing.

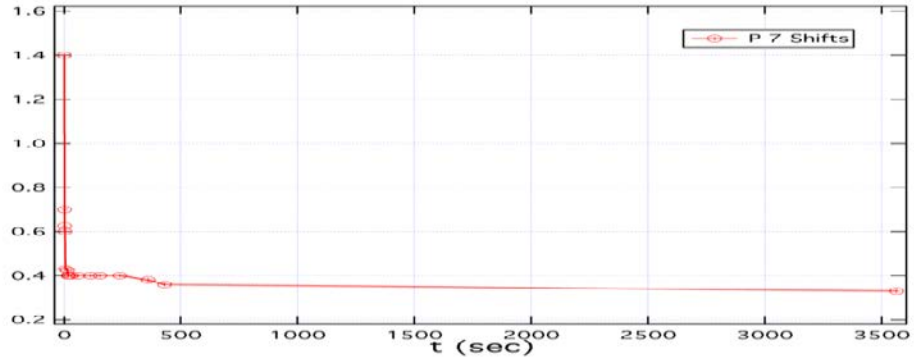

Figure 9. Objective value vs. time for 7 shifts.

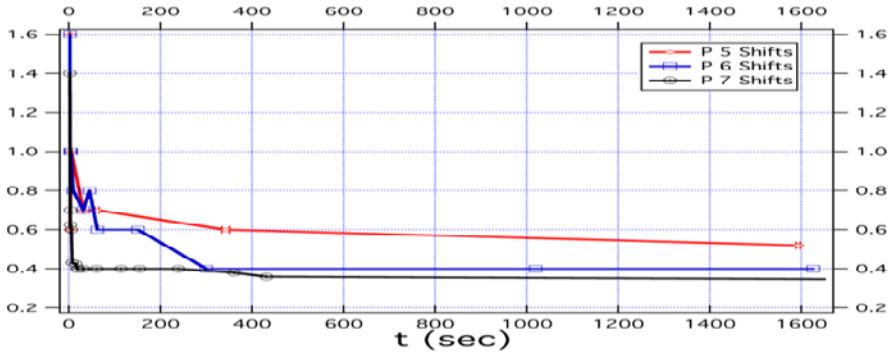

Figure 10. Objective value vs. time for 5, 6 and 7 shifts

In the last graph we notice that the case which has more combinations to check for an optimal solution, it takes less time. During the whole range of the values of time, the case with 7 shifts has always values that are lower than the cases for 5 and 6 shifts. At first look this seems very counterintuitive. One interpretation of these results may be that with more combinations to deal with, the easier it is to keep balance among all the nurses with respect of the penalty assigned to them. It is fact that when we add a shift the software must do more iterations but the penalty is decreasing. In the figure 11 we show the value of the optimal value of the penalty as a function of the total iterations for 6 and 7 shifts. Here we notice that when there are 7 shifts, for the same number of iterations, the objective value is smaller.

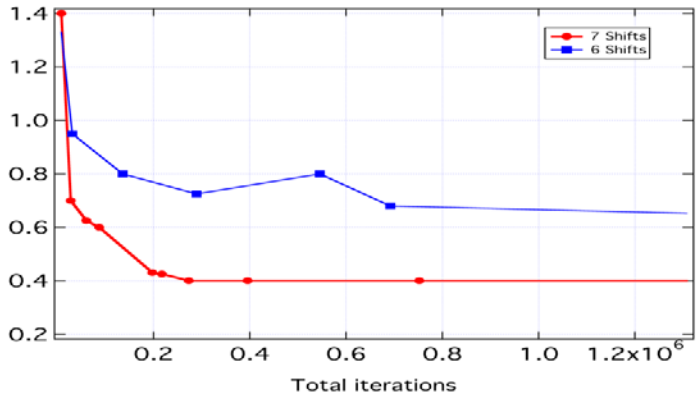

Figure11 The penalty as a function of the total iterations for 6 and 7 shifts

Conclusion

This project aims to apply learnings of operations research and optimizing resources to practical cases. The aim of this problem is to maximize the the fairness of the schedule , while respecting all the constraints . In regards with the results obtained after some tests ILP hase found a very good solution to our problem . Better values of the penalties associated to the shifts could be defined in order to represent the reality more accurately especially by taking into account the length of the shifts.

The models can also be solved by means of optimization software. As shown in this paper, the current schedules can benefit from this work. My problem is NP-hard that it means unsolveable.My objective is to do the objective values (diff =0.1) . The ideal must be 0 but it is impossible.there is shown in the table in 5 shifts , 20 nurses 10 weeks. We see that when we increase the number of shift the objective value is decreasing. It si fact that when we add a shift the software must do more iterations but the penalty is decreasing. We see that with the same number of iterations the penalty is smaller when we add a shift.

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[5] Formulating SPStochastic Programming Scenario Planning Models in What's*Best*! www.lindo.com December 2011

STRATEGIC RISK ANALYSIS OF COMPLEX ENGINEERING SYSTEM UPGRADES

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Abstract

Highly complex bespoke engineering products require upgrades during their long service life. These engineering changes can be risky due to the absence of an engineering baseline and/or multiple undocumented operational changes. They present significant challenges to the engineering contractor in terms of budget overruns, schedule impacts/delays, technical failures and ultimately a disappointed customer. Current risk management methods can be subjective and inaccurate. This paper outlines methodology to potentially predict, identify and visualize risks in a strategic structure which can ultimately lead to establishing necessary risk mitigation actions to significantly reduce and manage the risk of complex engineering system upgrade projects.

Keywords: Mid-life upgrade, risk modelling, capability framework, complex engineering project, risk visualisation

Introduction

Highly complex platform systems such as ships, land vehicles and aircraft often require modifications and upgrades to some areas of the system during their long service life [1]. These engineering change projects are inherently ill-informed due to the absence of an engineering baseline and undocumented operational changes. Many of the decisions taken both at the early stages and throughout large scale engineering projects are injudicious due to poor understanding of key risks and their consequences. This leads to budget overruns, schedule impacts/delays, technical failures and ultimately a disappointed customer [2]. In order to develop a sound strategy when undertaking complex projects, engineering organisations need to fully

understand what their risk profile is, so they can manage, mitigate or even in some cases decline the task completely.

One of the critical issues in risk management is the perceived subjectivity of the risk assessment by specific personnel, for example, those who are actually working on the project, as compared to those who are related and may have a different set of imperatives to the work. A process that can eliminate as much as possible the subjectivity in both the evaluation stage as well as the data collection would minimize the hazard of inappropriate decisions being made on incorrect information and perception [5].

It is clear that an analysis tool that will allow an organisation to better understand the risks in a new project prior to and at early stages of the project is desirable. This tool should be supported by a risk model that is built on a comprehensive project enterprise model and be able to create a risk profile quantitatively. This paper outlines the methodology for conducting risk analysis into complex engineering projects and developing a potential risk model. The study has been initiated under the Engineering Support Services requirements within the Australian Naval Maritime environment, but it could equally be applied to other countries, industries and disciplines.

Literature Review

In a large engineering project the chief element of risk arises from the fact that there are many variables that influence and determine the final cost and duration of the project. Every step of the process is laden with risk. Traditionally, for large scale engineering projects, the focus is on reliability, availability, maintainability and supportability (RAMS). Barabadi et al [3] claimed that product issues and failures could be reduced and their consequences minimized by the use of tools such as failure mode and effects and critical analysis (FMECA), fault tree analysis (FTA) and event tree analysis (ETA). These are good methods of representing the performance of an engineering system by a quantitative value which can be linked to risks. Markeset and Kumar [4] proposed the idea of the gate model. By passing through checks or gates, and ensuring the tasks were evaluated, the project risks should be better controlled and reduced.

In an alliance, as the different players begin to assess their contractual duties, they try to reallocate risks to the next party. Abi-Karam [6] focused on design-build in construction projects and identified the risks in the proposal, pricing, project schedule, performance measures, contractual liability and safety areas. These risks should be identified in detail and managed continuously even beyond project completion.

Modarres [7] went further to identify, rank and predict contributors to risk. Modarres calculated probabilistic risk for different scenarios and some

interesting methods of presenting risk in graphical forms. This work illustrated ways of quantifying risks and hence the possibility of ranking accordingly. Ayyub [8] used a number of real life examples and the method used explained. While they are not completely relevant to this research project, they do offer ways of being manipulated or partially used to achieve my required outcomes. These methods were useful for specific cases but were limited in scope for application to large scale engineering projects. Claypool et al [9] reviewed some basic risk management techniques that had been used for years. However, after conducting surveys with 110 managers they believed there was much room for improvement. They highlighted that little work was conducted in reducing risk in the supply chain which large scale engineering projects would depend heavily upon. The authors went on to offer several methods of evaluating a supply chain mainly through surveys and analysis.

Mo [10] studied systems that were designed to support assets in service. The method was based on categorization of capabilities into six elements as shown in Figure 1. Through a simple modelling process including both cost and availability, the performance of a service system can be estimated. This model appeared to be somewhat relevant to the analysis of risk in complex engineering system upgrade projects by calculating indicators of where a company should increase capacity, effort and expenditure to reduce or mitigate risk.

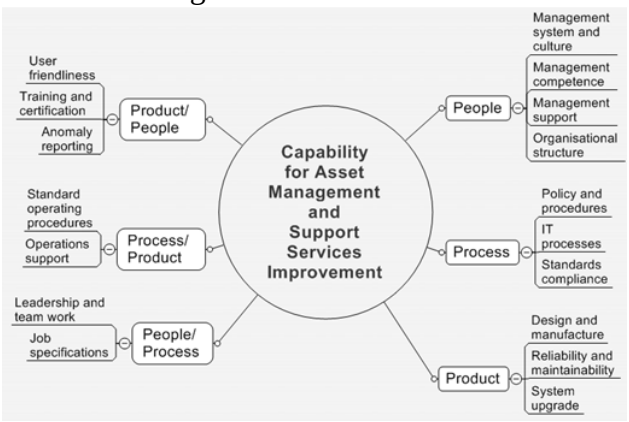

Figure 5 - Capabilities of service systems

With a similar approach, Yim et al [11] developed an interesting methodology for obtaining data and illustrated how they could relate to different complexities of engineering projects. The methodology was to enable project managers to identify risk indicators early in the lifecycle of a project according to complexity of the project and to subsequently initiate effective mitigation. Cohn [12] offered a commercial software that calculated risk in the form of a risk burndown chart as shown in Figure 2.

Essentially the chart is built from the probability of risk, size of loss in days which gives the number of days' exposure to risk. The chart is created by plotting the sum of the risk exposure values.

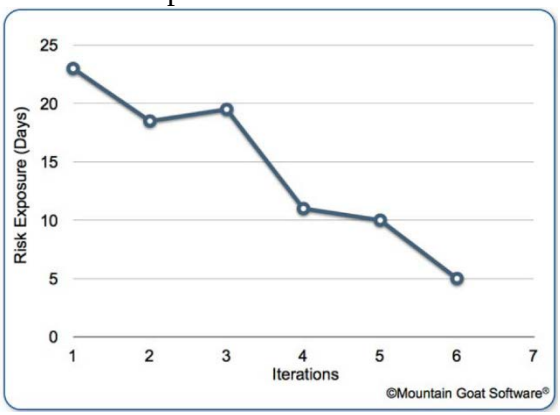

Figure 6 - Risk brundown chart

The risk burndown chart would be an ideal tool for visualizing how different strategies in the allocation of resources, financial investment, cash flow etc could affect risks. However, the risk assessment method is subjective and the outcome can vary greatly among different groups. The value of any risk model will only be perceived as useful if it successfully highlights key risks from quantitative data, offers ways to improve/mitigate the risks identified and is relatively simple and straightforward to apply. While many organisations already attend to highlighting potential risks with an array of tools, software and/or methods, their calibre is often diminished by over-complexity and convoluted processes that are too involved.

Industry Perspective

To understand the value of the proposed risk analysis/model, it is important to develop an understanding of both the organisation being studied and how the business currently manages risk, and the tools and processes that are used.

The activity of UK defence organisation BAE Systems in the Australian marketplace can be traced back to 1961 when the British Aircraft Corporation (Australia) was formed. The business underwent a name change in 1977 when it became British Aerospace Australia. Over the next two decades the business acquired a number of additional companies as it grew and secured its reputation within Australia. In 2008 the company more than doubled its size with the acquisition of Tenix Defence, a privately owned

business involved primarily in naval contracts. Since then BAE Systems[1] has gone from strength to strength and is now the largest defence contractor within Australia.

Due to the nature of business, BAE Systems needs to develop risk management tools that provides accurate assessment of the merits and pitfalls in their bids and projects, under the constraints of the organisation's characteristics. Through its lifecycle management strategy, BAE Systems Australia operates a Risk and Opportunity Management Plan (ROMP) for business units, projects and functions. The purpose of the ROMP is to:

- Describe the methodology for clear and continual identification, assessment, development, and monitoring of treatment/promotion plans for R&Os;
- Increase the chance of achieving the Project objectives by facilitating improved decision making based on effective insight into the risks and their associated impacts; and
- Maximise Project performance in terms of the achievement of scope, time, cost and quality objectives by assessing the risks.

The ROMP goes on to state benefits generated by the application of Risk Management include:

- Identification of those risks that require management focus before potential negative impacts are manifested;
- Enables the timely development of treatments to mitigate risks before they occur or reduce negative impacts if they occur;
- Delivery of benefits achieved through the realisation of opportunities. Opportunities are considered potential commercial benefits to BAE Systems; and
- The Risk and Opportunity Management Procedure is compliant with AS/NZS ISO 31000:2009 [13] and is subordinate to the BU Project Management Plan.

The BAE Systems Maritime business unit separates risk into two categories. The first relates to commercial and project risk. The description of this risk is 'an event that may occur causing a negative impact on project objectives, typically expressed in terms of cost, schedule and performance (quality and functionality) or a combination thereof' (BAE Systems Risk handbook). The second is described as technical risk and is defined as 'an event, with a finite probability of occurrence, which could lead to an adverse impact on the technical objectives of a project'. Risks are managed through a process of identification, analysis, evaluation and mitigation which is defined in more detail in Figure 3.

[1] The organisation became known globally to BAE Systems in 1999 with the merger of British Aerospace and Marconi Systems.

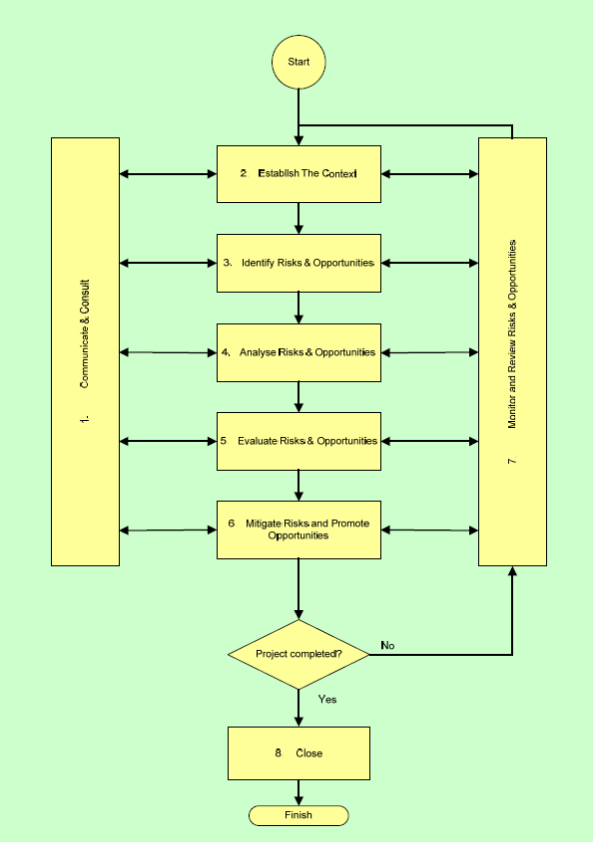

Figure 7 - BAE Systems risk process

The main tool used by BAE System Maritime for risk management is a risk register which is usually populated by project managers and engineers alike. The register is based on assessing risks against the likelihood/consequence ratings which are qualitatively defined typically by brainstorming and project meetings both internally and involving the customer and alliance partners.

When the risk register is populated with risk assessments on the severity/impact of the risk is judged using likelihood and consequence levels from AS/NZS ISO 31000:2009 [13]. These likelihood and consequences values are used to generate potential cost implications of these risks and schedule implications. As part of the alliance these risks are flowed up to the System Programme Office (SPO) and eventually to the Commonwealth of Australia (CoA) where they are combined with risks from other aspects of the proposed change.

BAE Systems also uses some risk management software, but it is important to note that this is not generally used by project managers or engineers. Both the risk register and the risk management software offer

sound methods of identifying risks, assessing their significance and financial and schedule implications. However, these tools are not easily maintained or updated as a project progresses and residual risks can in some cases fail to be properly managed resulting in serious financial and schedule impacts. This problem is compounded by the lack of ability to visualise the risk profile and monitor how it evolves through the project life cycle.

Research Approach

This research aims to develop a tool that will allow an organisation to better understand the risks in a new project prior to and at the early stages of the project. To support the tool, a risk model based on generic enterprise architecture framework is being developed to provide a risk profile quantitatively. By segmenting the enterprise into three major sectors, it is possible to identify and visualise specifically what are the key risk drivers and monitor them through the life of the project.

The approach taken for this research is primarily a staged process. This consisted of developing an understanding of the risks of conducting large scale system upgrade projects within the commercial sector, outcome based contractual environment involving key stakeholders in the defence industry and the government and a study to investigate the current thinking of risks and what contemporary methods, models and tools are used in this type of organisation. Research was then conducted into the Australian Naval Maritime environment to develop a theoretical model which could ameliorate the current processes involved in understanding and managing risk throughout the project life cycle.

A survey focusing on three recent major engineering projects was used to assess the perception and experience of a variety of stakeholders involved in these projects while still fresh in their memories. The data generated from the risk survey was analyzed and presented by various methods to determine meaningful and useful results. Visualisation tools were also employed to highlight, visualise, manage and control risk as a project progressed through the life cycle. The outcomes of this analysis can then be used as a basis to plan necessary risk mitigation actions that can significantly reduce the risk of conducting complex engineering system projects.

The three projects detailed below have their own unique challenges and risks to overcome in order to achieve success. They have been chosen as sample projects for the risk modelling research conducted within this report, because they are well known within BAE Systems – Maritime, and familiar to the both the Project Management and Engineering Teams. They also offer a good delta in overall financial value and variation in the risk profile.

MH60R Project

The Royal Australian Navy (RAN) ANZAC class of Frigates were originally designed for the operation of the Sikorsky S-70B-2 Seahawk helicopter. However, in June 2011, the Australian Government approved the acquisition of 24 MH-60R Seahawk 'Romeo' naval combat helicopters (Figure 4). The 'Romeo' helicopter was chosen because it represents the best value for money for taxpayers and was the lowest risk option [14].

The acquisition means that Royal Australian Navy will have the capacity to provide at least eight RAN ANZAC class frigates with a combat helicopter at the same time. In order to safely operate the new helicopter from the ANZAC platform, a number of modifications to the ships are required. This has included:

- Installation of new support equipment;
- Changes to the configuration of the hangar and flight deck area; and
- Installation of new landing and taking-off navigation equipment;

This project was successfully completed on the first RAN ANZAC ship in late 2014 with a successful landing of the MH60R helicopter being achieved in early 2015. This project is considered medium size and combined OEM equipment and BAE Systems design and installation.

Figure 8 - MH60R helicopter

A. 1448 4B Phase Array

In late 2005, the RAN ANZAC class frigate 1448 2B Anti-Ship Missile Defence (ASMD) programme commenced. This programme was tasked with delivering an increased defensive capability to the vessels, with the installation of a newly developed phased array radar (PAR) system for target indication/tracking and mid-course guidance and target illumination of the evolved anti-ship missiles in conjunction with other sensor and combat management system upgrades. Major changes to the ship included a new mast and cupola to house the PAR which was developed by CEA Technologies of Australia (Figure 5).

During this programme, some of the highest risks related to the development by CEA Technologies of a cutting-edge phased array radar performance technology, or the product.

Figure 9 - RAN ANZAC frigate with ASMD installation

In addition to the 1448 2B ASMD PAR programme, there is now a pressing need to replace the obsolete long range radar capability on the RAN ANZAC class frigates. Project SEA 1448 Phase 4B – ANZAC Air Search Radar Replacement has been commenced by the Australian Government. The RAN ANZAC frigates use their air search radar to scan at long ranges for potential threats. The radar is an integral part of a modern warship and important for ensuring the safety of the vessel and other friendly ships in dangerous areas. The current RAN ANZAC frigate radar is old and requires replacement with modern technology to maintain the robust front-line capability provided by these ships.

A risk reduction phase of implementing a new technology is currently underway and CEA Technologies are again being considered to design and develop a long range PAR which will most likely be installed on top of the extant ASMD mast. This is considered a major project, with significant risk surrounding the product or new PAR system.

B. New Bilge Keel

Since inception, the RAN ANZAC class frigate has suffered from fatigue cracking of their bilge keels (Figure 6). The origins of the fault can potentially be linked to operating environments which have seen higher loads than originally design for. The primary function of the bilge keel is to stabilise the ship and reduce rolling, this is important for the performance of the vessel especially one that operates a helicopter.

BAE Systems - Maritime has been tasked with the design, manufacture and installation of a new bilge keel set for the RAN ANZAC class of frigates. The project is considered medium with risks surrounding the keel design and installation.

Figure 10 - Example of Bilge Keel on RAN ANZAC Frigate

Modelling Principles

This research aims to remove the subjectivity of risk assessment and define a baseline or 'Ideal' project that is based on a 50% probability of success. Risk analysis can then be conducted on new projects in a similar manner and the results compared to this 'Ideal' project to assess what 'percentage of success' is possible. This will subsequently allow an organisation to assess whether this risk profile is acceptable and what strategy/approach can be taken to improve the percentage of success if necessary.

In order to set some form of qualitative baseline which could then be used for both quantitative assessment and analysis, an investigation into risks surrounding complex engineering projects was undertaken as part of the research. The initial objective was to compile a list of risks and then categorize these into product, process and people (3P model).

The compiled risks were then analysed for repeats and commonality within each category. Over 150 risks were identified. To help focus the research in developing quantification methodology, 10 risks from each of the 3P categories was selected based on their generic nature and applicability to the majority of BAE Systems Maritime projects.

In order to ensure the survey participants were not either influenced or mislead by the identified risks, each of the 30 risks identified was reworded so they can be appropriately populated into the survey. For each of the questions, it was necessary to establish a quantitative value which could be used for analysis purposes. To ensure that a good spread of data was achieved, a value or metric for each of question (risk) above was a score out of 1 to 10.

Table 1 - Data analysis for three projects

	MH60R	***1448 4B***	***NBK***
Product			
Mean	*6.8143*	*7.5286*	*6.2714*
Std Dev.	*2.3676*	*2.4800*	*6.5929*
Process			
Mean	*6.5929*	*7.0214*	*6.6143*

Std Dev.	*2.5101*	*2.1707*	*2.4276*
People			
Mean	*7.1786*	*7.6500*	*7.2714*
Std Dev.	*2.2321*	*1.9413*	*2.0736*
3P combined			
Mean	*6.8619*	*7.4000*	*6.7190*
Std Dev.	*2.3727*	*2.2084*	*2.4488*

To overcome the lack of a large data set and develop a model that could provide some useful/meaningful comparisons between the data, it was assumed that the data is normally distributed. For each of the three projects, the data was separated into the 3P model categories. The mean and standard deviation for each project was calculated and can be seen in Table 1. To visualize the effect of the data, a bell-curve for each of the 3P categories was generated as shown in Figure 7, Figure 8 and Figure 9.

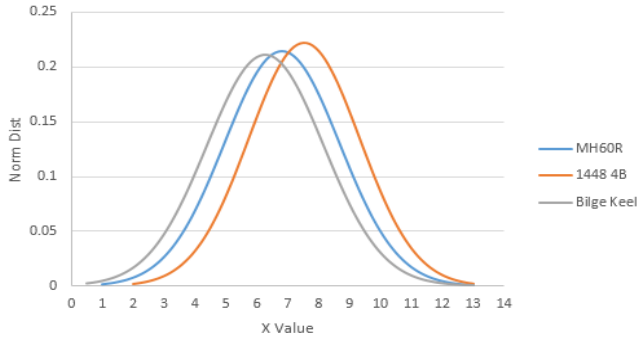

Figure 11 - Product results for three BAE Systems projects

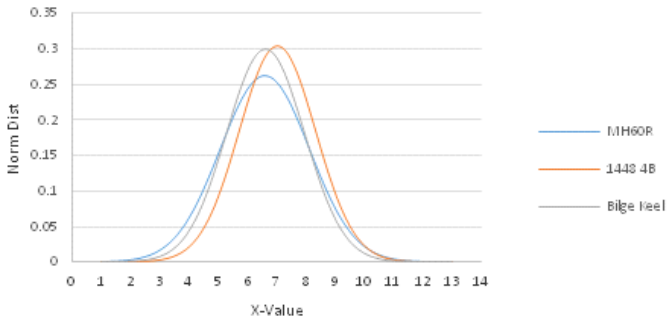

Figure 12 - Process results for three BAE Systems projects

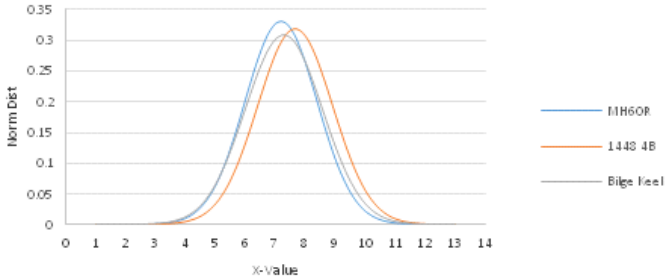

Figure 13 - People results for three BAE Systems projects

A combined graph of the 3P distribution was also generated and is shown in Figure 10.

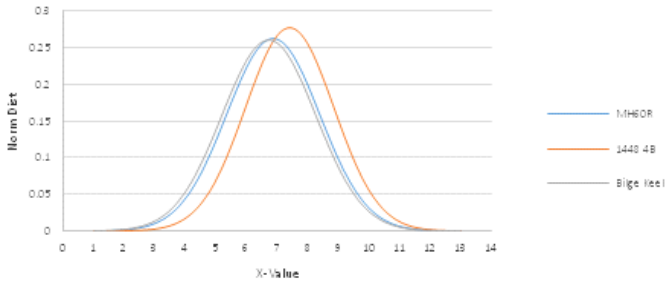

Figure 14 - 3P model results for 3 BAE Systems projects

From the perceived understanding of the nature of the three projects within BAE Systems - Maritime, it is generally agreed that serious challenges relating to the 1448 4B project need to be overcome and it is considered a 'risky' project. MH60R has actually been completed and generally considered a success, while the bilge keel project is clear in scope and is found to sit somewhere between the two.

Benchmark Model

In order to develop the risk model further, the idea of generating a percentage of success for a given project was explored. The hypothesis being that an 'Ideal' or 'Perfect' project, would have minimal risk that could be easily mitigated and has a percentage of success which can be established as the benchmark. Like the flip of a coin, there is a 50% chance it will be heads or tails, a project also has natural chance of 50% for success or failure. So if 50% is as close to the 'perfect' project as it is possible to get, it stands to reason that the greater the delta from 50% a project sits, the less chance of success.

As previously mentioned, the MH60R project is considered a successful project. It can therefore be judged that its data results must in some way align towards an 'Ideal' project. The approach taken in this research is to assume that an 'Ideal' project would improve, for each

question, by one value (1 to 10) better than the MH60R data results (or 10%). The outcome of this calculation can be seen in the resulting graph in Figure 11. It should be noted that other methods of setting the benchmark 'Ideal' project can be used, for example, survey a special expert group or find the "best" project in BAE Systems. However, in the context of this research, the outcome does not affect the methodology discussed in this paper.

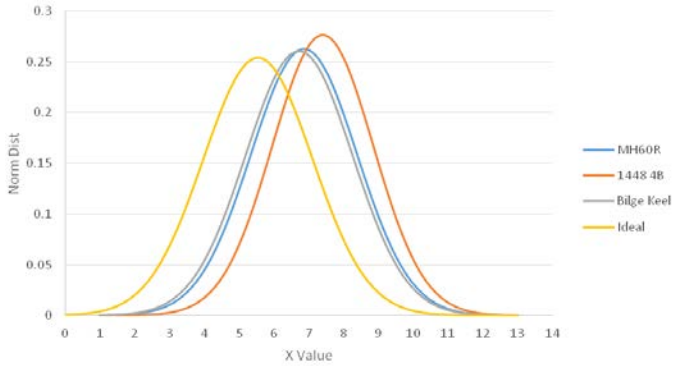

Figure 15 - Three BAE Systems Projects and predicted Ideal Project

As explained before, the 'Ideal' project would have a 50% chance for success. To define this percentage value to the risk model, the area under the graph of the 'Idea' project was established as the 50% success area, or the 'perfect success' area, so the mean of this project was set as the 50% marker. The results of the calculation can be seen from the generated graph in Figure 12.

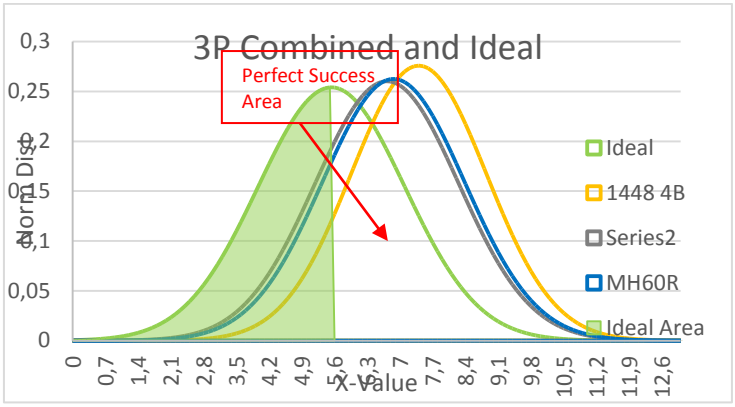

Figure 16 - Theoretical Area of Perfect Success (50%)

As a project moves away (to the right) of the 'Ideal' project, the chance of success begins to diminish because the area under the project curve that is sitting within the 'Perfect Success' area is reducing.

To demonstrate how this risk model can be used to determine potential for success, Figure 13 focuses on the 1448 4B project and compares its percentage for failure against the 'Ideal' project. The graph's X-axis starts at mean value for the 'Ideal' project, with any shift to the right considered an increase in the percentage for failure.

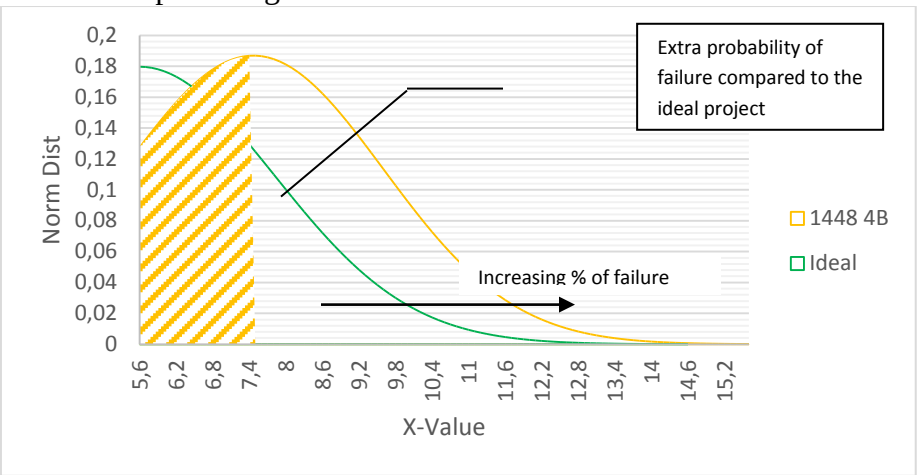

Figure 17 - 1448 4B vs. Ideal - Percentage for success

The failure probability for both 1448 4B and 'Ideal', with normal distributed data was calculated by:

$$\mu_u = \mu_y - \mu_x \quad (1)$$

$$\sigma_u = \sqrt{\frac{\sigma_y^2 + \sigma_x^2}{2}} \quad (2)$$

These formulas could be used in MS Excel to develop a differential data set for each project.

From the data analysis and subsequent normal distributions/bell curves, it can be determined that for engineering projects sitting to the right of the 50% success rate mark, the area under the curve is the probability of failure. This area is made up of the potential risk factors identified within the 3P model. Figure 14 indicates the probability of failure (area under the bell curve) for task 1448 4B. The mean value of project 1448 4B is 69%, which is indicated by the calculation: 50 – (69 – 50) = 31. It is within this area that risk factors relating to the development of the new phased array radar, technical expertise, installation concerns, etc. reside.

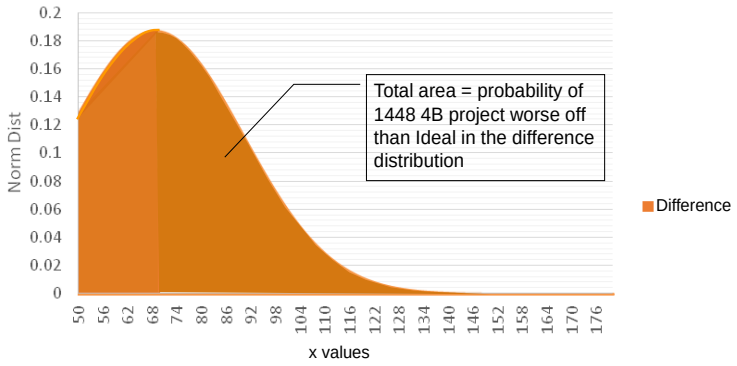

Figure 18 - Probability of failure of 1448 4B

Conclusion

For organisations like BAE Systems, large, complex and challenging projects throw up a myriad of potential risks, and developing an understanding of these risks, their implications and how they can either be managed or mitigated can often be the difference between success and failure. Without a clear understanding of the risk profile the business will be carrying, project managers and engineers critically lack both direction and knowledge to execute tasks. The objective of this research is to develop a risk model that not only identifies the risks but also crucially allows managers and engineers to visualise the risks and manage them throughout the life cycle of the project.

The initial risk model developed in this research provides a bell curve which offers a risk profile of the project for comparison with the established benchmark or 'Ideal' project. This risk profile leads to a graphical representation of the risk the task is carrying and the predicted percentage for success. The graphical interface could also offer visualisation of the 3P model categories to potential define/indicate where the main risks primarily reside.

The initial data analysis and early development of a risk model, based on the data sets generated from the survey, offers some interesting results. It is essential to acknowledge that the research scope was limited to only three projects, and clearly lacks enough data to be considered comprehensive. Due to the diversity of projects across organisations such as BAE Systems, there will always be some risks that are unique to that specific project. However, there are also many risk factors that are ubiquitous to all projects which vary in their significance and can be used to develop a risk profile baseline.

The risks developed and used in the survey constitute the model's baseline risks which are by no means fully defined or exhaustive. Further development of this work could be a proposed interface for the risk model, such as an internet browser, would allow project managers and/or engineers

to apply a risk severity to these baseline risks. It is essential that this interface is quick and friendly to use, to ensure it encourages and meets the expectations of the users. Time consuming complex interfaces put users off and result in poor data entry and meaningless results.

By developing a survey based on some fairly generic risks, and applying it to three well understood projects, the model has offered a method of generating quantifiable data. Of the three projects chosen, one has been completed and was considered successful (a baseline), one was considered fairly mainstream and the third was considered challenging and risky. The early stages of a risk model was developed to compare the risk profile of these three projects and the initial results look promising. An attempt to identify an ideal project was proposed and a 50% success rate was set. This was used to compare the other projects against and determined a percentage of success value. While the results appear to follow the perceived nature of the three projects, the risk model is by no means conclusive as a data set of three projects is clearly inadequate and further work is required.

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APPLICATION OF INFORMATION TECHNOLOGY TO ANALYZE THE STRATEGIES USED FOR FORMATION OF VALUES

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Abstract

The research has been developed with the objective to provide an analysis of the values education strategies used by teachers in public high schools at Monclova, Coahuila, México; to promote formation of values in their students. Participants were a total of 131 teachers of both sexes chosen randomly from seven different public high schools, with ages ranging between 21 and 65 years. Through field research and descriptive documentary, it was found that the strategies used by teachers are: self-regulation of behavior and values clarification. To conclude, any attempt to values education will only succeed if it does occur under certain conditions as an open dialogue climate, an appropriate methodology and most importantly, the teacher must estimate values, feel them, practice them, and have the desire above all of transmitting them.

Keywords: Education, values, strategies, formation

Introduction

Socialization occurs to people in two stages: in the family and at school. In the family this is habitually developed during childhood. One of its characteristics is the affective load with which the contents are transmitted and the identification of the world just as the adults present it. This is not universal nor remains static. At school, individual already socialized to new sectors of the objective world of society (Fragoso, 2007).

The family and the school are responsible for the education in values. Educational institutions are responsible for this formative process, "by the mere fact that children and youth participate in an institution in which they build their social identity as students for many years of their life" (Arellano, 2010 cited in Magendzo, Donoso and Rhodes, 1997).

It is important to emphasize that education must fully train students not only providing a preparedness of academic knowledge, but forming their personality and promoting the full growth, integral values and culture among others. Is in education, where the wealth and potential are to make positive changes for life in the population, when changing or fortifying the life habits of a student, his values about health and environment, as like his rights and obligations (Flores and Zamora, 2009).

According to Diaz (2006) and Esquivel (2009), the task of education in values requires for all members of the institution coherency and credibility; i.e. consistency between what is said and done. You can hardly form an attitude in a school environment immersed in contradiction, when the set of teachers and the school institution perform behavior contrary to those values of citizenship, tolerance, and respect for others.

The objective of this research is to identify the strategies used by teachers in public high schools at Monclova, Coahuila, México to promote the formation of values in students.

Methodology

This research was documentary and of descriptive type field. Documentary when collecting information and performing an analysis on what the Secretariat of Public Education, (in Spanish *Secretaría de Educación Pública, SEP*), demands the high school teachers nationwide to work on the forming of values in their students. On the other hand it is considered a field study, since the information was collected directly from reality under investigation.

Educational institutions to conduct this investigation were seven public high schools randomly selected.

Sample of Teachers

The study population in the 2011- 2012 school year, regarding teachers who give classes in high schools from the entity of Monclova, Coahuila, is 628. This information was obtained from The Department of Education of Coahuila, (in Spanish *Secreatría de Educación de Coahuila, SEDU*)

The size of the final probabilistic sample was obtained using the Decision Analyst STATS™ 2.0 Software, the characteristics shown in Table 1.

Table 1. Characteristics of the probabilistic sample of teachers

Characteristics	Numerical value
Universe Size	628
Maximum Mistake	6% - 7%
Estimated Percentage of the Sample	50%
Confidence Level	93%
Sample Size	131

Source: Own elaboration.

Is worth mentioning that the sample size wasn't of 238 teachers due to the following:

a) There were difficulties because many teachers wouldn't want to take the questionnaire. At that time, the changes in the basic education reform were starting.

b) For time matters, because much time was invested in the final sample obtained.

The definitive sample of teachers to which the questionnaires was applied is a total of 131, with a confidence level of 93%.

The 62.3% are females teachers and 37.7% are male teachers. In relation to the age of the teachers is in the range of 21 to 65 years. Regarding the education level of the teachers, 1.6% has a doctorate, 9.8% have a master, 80.5% have a bachelor, 6.5% have a technical career, and 1.6% has a specialty.

Table 2 shows the characteristics of the actual sample size of teachers that was used in the research. This was obtained using Netquest: Samples Calculator.

Table 2. Characteristic of the Actual Sample of Teachers

Characteristics	Numerical value
Universe Size	628
Maximum Mistake	6% - 7%
Estimated Percentage of the Sample	50%
Confidence Level	93%
Sample Size	131

Source: Own elaboration.

Selecting the Instrument

In this research a questionnaire was drawn up, for an evaluation of the strategies used by teachers to form their students in values as established by the Secretariat of Public Education. This instrument is based on the program of Civics and Ethics and in the Formative Journey of Civics and Ethics Education itself, and consists of 20 questions.

Valdés (2000) mentions that teachers evaluations are not to project their reasonable limitations or deficiencies of the education system; but is taking a new style, climate, and a horizon of shared reflection to optimize and enable real opportunities for professional development for a generation

of teachers of innovative cultures in schools.

The scale used for the questionnaire was of Likert type.

Validity of the Instrument

To validate the data collection instrument variable, The Formation of Values and Strategies, used by teachers were analyzed. To determine the reliability of the instrument applied to the teachers the Cronbach's alpha coefficient (Table 3) was calculated using the SPSS Statistics 17.0.

Table 3. Reliability-Questionnaire for teachers and teachers

Cronbach's Alpha	0.876
Number of items	20

Source: Own elaboration

Data preparation

The information obtained from the questionnaire was first captured in Microsoft ® Office Excel version 2007, and then exported to SPSS Statistics 17.0 where the data was coded and the statistical analysis was realized.

Results

The strategies used by teachers for training in values according to the Secretariat of Public Education (*SEP*) are presented in Table 4, including the average and standard deviation.

Table 4. Strategies used by teachers in high schools

Strategies	**Average**	**Standard deviation**
Discussion of Moral Dilemmas Strategy	3.63	0.974
Case Study Strategy	3.59	0.938
Critical Comment Strategy	3.56	1.039
Values Clarification Strategy	3.67	0.884
Values Analysis and Critical Analysis of Reality Strategy	3.82	0.885
Autoregulation of Behavior Strategy	3.96	0.830

Source: Own elaboration

Next, in Table 5 it shows how the strategy of Discussion of Moral Dilemmas is used by teachers, for training in values. It is observed that 37.4% of teachers use it most of the time, and only 19.1% always use it.

Table 5. Using the Discussion of Moral Dilemmas Strategy

Scale	Frequency	Percentage
Never	4	3.1
Most of the time no	9	6.9
Sometimes	43	32.8
Most of the time	49	37.4
Always	5	19.1
Missing Data	1	0.8
Total	131	100

Note: Missing data refers to a question not answered or answered with more than two response scales.
Source: Own elaboration

In Table 6 we can see the use of Case Study Strategy which shows that the highest percentage of 37.4% indicates that teachers use it sometimes, while a 35.1% uses it most of the time.

Table 6. Using the Case Study Strategy

Scale	Frequency	Percentage
Never	3	2.3
Most of the time no	9	6.9
Sometimes	49	37.4
Most of the time	46	35.1
Always	23	17.6
Missing Data	1	0.8
Total	131	100

Note: Missing data refers to a question not answered or answered with more than two response scales.
Source: Own elaboration

In Table 7 the Critical Comment Strategy is presented, showing that it is used in 38.2% by teachers and only 18.3% is always used.

Table 7. Using the Critical Comment Strategy

Scale	Frequency	Percentage
Never	5	3.8
Most of the time no	15	11.5
Sometimes	37	28.2
Most of the time	50	38.2
Always	24	18.3
Missing Data	0	0
Total	131	100

Note: Missing data refers to a question not answered or answered with more than two response scales.
Source: Own elaboration

Presented in Table 8 is the using Values Clarification Strategy, it is observed that 44.3% of teachers use it most of the time in class.

Table 8. Using the Values Clarification Strategy

Scale	Frequency	Percentage
Never	2	1.5
Most of the time no	9	6.9
Sometimes	40	30.5
Most of the time	58	44.3
Always	21	16.0
Missing Data	1	0.8
Total	131	100

Note: Missing data refers to a question not answered or answered with more than two response scales.
Source: Own elaboration

The Table 9 presents the use of Values Analysis and Critical Analysis of Reality Strategy, showing that teachers apply it in their classes a 38.9% most of the time.

Table 9. Using the Values Analysis and Critical Analysis of Reality Strategy

Scale	Frequency	Percentage
Never	1	0.8
Most of the time no	6	4.6
Sometimes	40	30.5
Most of the time	51	38.9
Always	32	24.4
Missing Data	1	0.8
Total	131	100

Note: Missing data refers to a question not answered or answered with more than two response scales.
Source: Own elaboration

The use of Autoregulation of Behavior Strategy is presented in Table 10, which shows that it is used by teachers in 46.6% most of the time and only 26.7% always used.

Table 10. Using the Autoregulation of Behavior Strategy

Scale	Frequency	Percentage
Never	1	0.8
Most of the time no	4	3.1
Sometimes	29	22.1
Most of the time	61	46.6
Always	35	26.7
Missing Data	1	0.8
Total	131	100

Note: Missing data refers to a question not answered or answered with more than two response scales.
Source: Own elaboration

Conclusion

According to the results obtained during the research conducted among 131 teachers imparting classes in public high schools in Monclova,

Coahuila; it was found that there are six strategies that teachers have to be used on the formation of values in their students. These six strategies were established by the Secretariat of Public Education.

It is concluded that the strategies used by high school teachers are: Self-regulation of Behavior Strategy in a 44.6% and Values Clarification Strategy in a 44.3%.

To conclude, it is important to mention that any attempt to values education will not succeed if it does not occur under certain conditions as an open dialogue climate, an appropriate methodology, and most importantly the teacher must know the values, estimate them, feel them, practice them, and have the desire to transmit them.

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REVIEW ON MULTIPLEXING TECHNIQUES IN OPTICAL COMMUNICATION SYSTEMS

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Abstract

In this paper, we present an overview of different multiplexing techniques. We focus on TDM, FDM, WDM, DWDM and CWDM. Basically multiplexing is an important part of communication system in which large number of users send data at the same time through a single link. Multiplexing is widely used in communication systems due to its potential to increase the channel utilization or transmission capacity and decrease system costs.

Keywords: OFC, WDM, DWDM, CWDM, FDM, TDM, MUX, DEMUX

Introduction to OFC

OFC is a technique which is used for communication purpose. In OFC the information is transferred in the form of pulses over long distance through an optical fiber offers higher data rates. Basically optical fiber is a medium which carrier information from one place to another [1]. Optical fiber communication consist a transmitter section and a receiver section as shown in Fig:-1.The transmission device converts electrical signal into light signal, which is carried out by optical fiber cable at the receiver end .This light signal is converted back to electrical signal when a single mode fiber cable with small cross –section area is used for transmission of pulses it causes number of deleterious effects that damages the signal integrity in communication system. The telecommunication companies uses optical fiber to transmit telephone signals, internet communication, and cable television signals. The complexity of the fiber optic varies with respect to the distance [2].

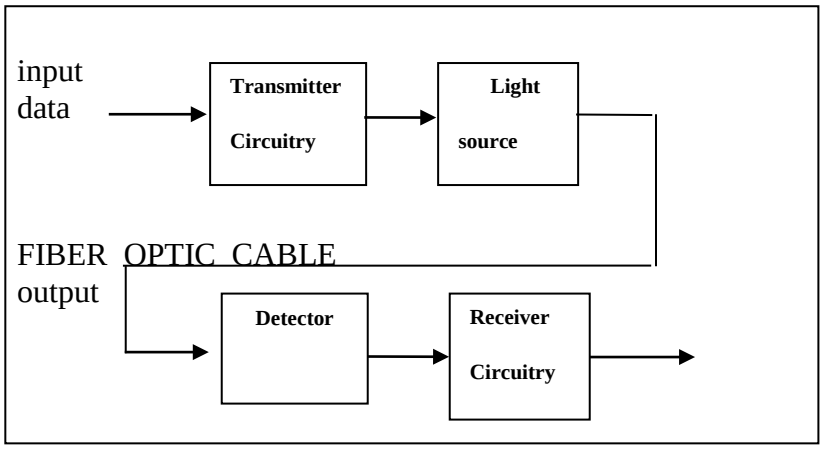

Fig:-1 FIBER OPTIC COMMUNICATION SYSTEM

Losses in fiber

Loss of light energy which is travelling in the form of light pulses from one end of fiber optic to another is called attenuation.

Optical fiber is also facing binding problem Called as binding loss. Macroscopic bending and

Microscopic bending are the basic two types of bending loss.

Due to the microscopic variation in the material density, scattering loss is introduced. There are two types of scattering loss known as linear and non-linear scattering Rayleigh scattering loss, Mile scattering loss, and waveguide scattering loss comes under the linear scattering losses whereas (a) Stimulated brillouin scattering and (b) Stimulated Raman scattering are the types of non-linear scattering.

When an optical signal travels in the optical fiber, it gets distorted which is called dispersion. Intermodal dispersion and Intermodal dispersion are the two types of dispersion loss [3].

Multiplexing

Multiplexing is a technique, in which multiple users transmit data over a single channel. The channel may be co-axial cable, a fiber, radio or satellite.

Multiplexing is useful as to increase the channel utilization and the transmission capacity. Multiplexing has two devices called multiplexer (MUX) and De multiplexer (DEMUX) Multiplexer combines the different signals into a single signal. De- multiplexer performs the inverse operation of multiplexer [4].

Types of Multiplexing:-Multiplexing is mainly of two types Analog and Digital. Analog multiplexing technique is further classified into FDM

(Frequency division multiplexing) and WDM (wavelength division multiplexing).Where as digital multiplexing is has only one type called TDM (Time division multiplexing) as shown in Fig:-2.

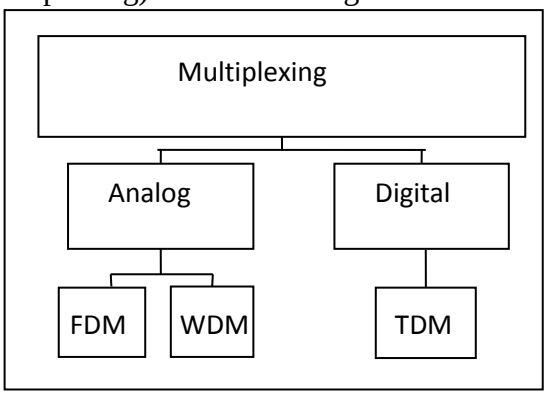

Fig:-2. TYPES OF MULTIPLEXING

TIME DIVISION MULTIPLEXING:-Time division multiplexing is a type of digital process. Fig:-3 shows Time division multiplexing. When data rate capacity is higher than the data rate required by sending and receiving time division multiplexing is used. The multiplexer and de-multiplexer needs to operate at equal frequency to the total combined bit rate ,Which is faster than the bit rate of single user by n times in TDM[4]-[5].

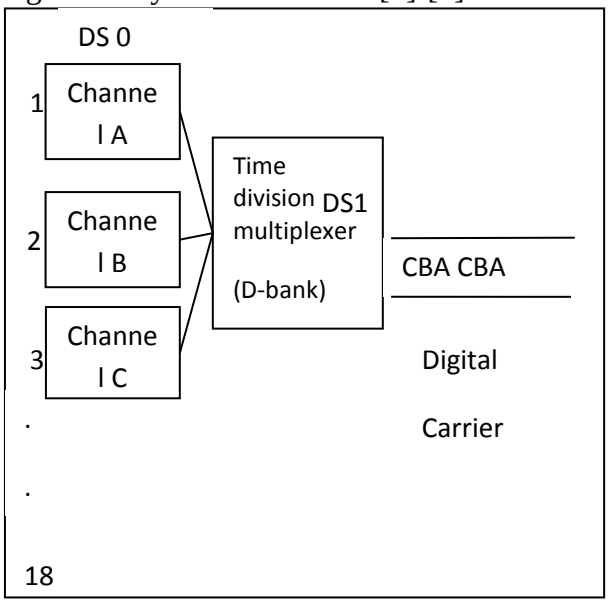

Fig:-3. Time division multiplexing

FREQUENCY DIVISION MULPTIPLEXING:-Frequency division multiplexing is an analog multiplexing technique in which different frequency is assigned to every signal within a common bandwidth [6] as

shown in Fig:-4. The signals are modulated in separate carrier frequencies using frequency modulation and amplitude modulation in frequency division multiplexing.

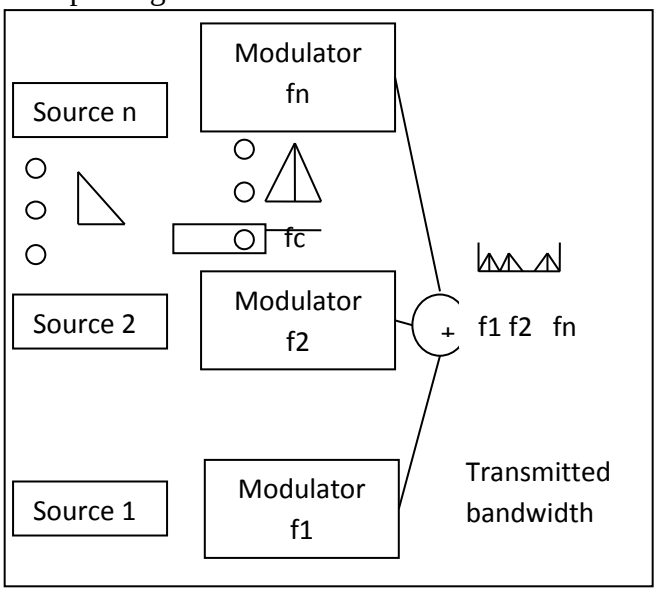

Fig:-4. Frequency division multiplexing

WAVELENGTH DIVISION MULTIPLEXING:-Wavelength division multiplexing is also an Analog multiplexing technique which uses optical fiber to carry many separate and independent optical channels. To increase the bandwidth of communication wavelength division multiplexing is used. The process of combining number of wavelengths onto a single fiber is called wavelength division multiplexing [7]. By reducing the channel spacing and increasing the bit rate we can increase the transmission capacity of wavelength division multiplexed systems. Low dispersion fibers and erbium-doped fiber amplifier are used in WDM systems to arise the demand for broadband information distribution. Fig:-5. Shows the Wavelength division multiplexing technique.

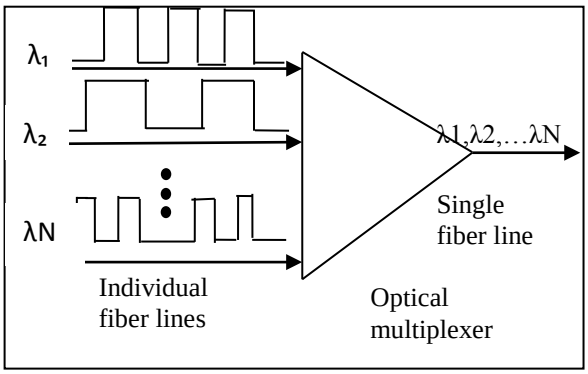

Fig:-5. Wavelength Division Multiplexing

From last few years wavelength division multiplexing plays a vital role for large capacity transmission systems.

First wavelength division multiplexing systems combined only two signals but modern WDM systems can handle up to 160 signals

Multiplexer is used at the transmitter end systems to combine the signals together and De-multiplexer is used at the receiver end systems to split the signals.

There are two types of wavelength division multiplexing.

1).DWDM (Dense wavelength division multiplexing)

2).CWDM (Coarse wavelength division multiplexing)

1).DWDM (Dense wavelength division multiplexing):- DWDM is the type of wavelength division multiplexing. DWDM is an optical fiber communication technique as shown in Fig:-6. The process of multiplexing many different signals onto a single fiber is called dense wavelength division multiplexing. Each fiber has a set of parallel optical channels each using different light wavelengths. Light wavelengths transmit data parallel-by-bit or serial-by-character. For long-haul transmission where wavelengths are packed tightly together DWDM is designed.

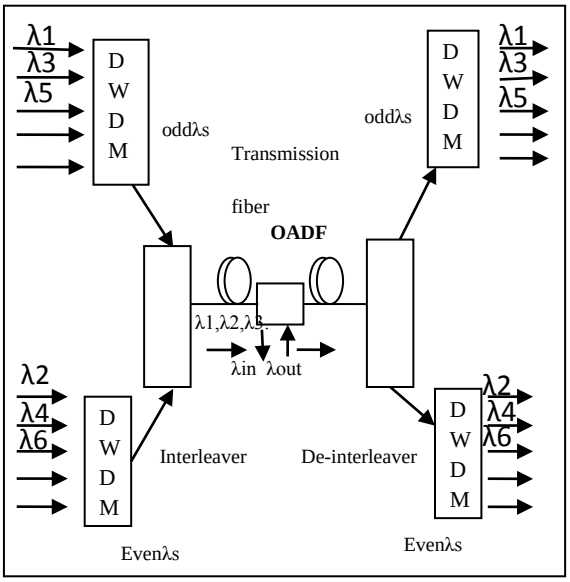

Fig:-6. DWDM SYSTEMS

2).CWDM (coarse wavelength division multiplexing):-Because the light signal of coarse division multiplexing is not amplified .It do not span long distances. Therefore the cost is kept down and also propagation distances are limits to maximum value. Fewer channels have been supported by the coarse division multiplexing and these channels may be adequate for metro carriers who prefer to start small and expand as the demand increases. The signaling systems which are not amplified keep the cost down with retaining high loss tolerance. There is often a trade-off between the capacity and distance every time when a non-amplified signal is used [8]. The two functions performed by CWDM are filtering of light and multiplexing or de- multiplexing of different wavelengths, which are travelling in a same medium.

Comparison between CWDM and DWDM		
Types	**CWDM**	**DWDM**
Channelspacing	20 nm	100 GHz/ 50 GHz/ 25 GHz
Cost	70 %	100 %
Laser	Un-Cooled Laser	Cooled Laser
Capacity	18 × 10 Gbps	192 × 10 Gbps
Application	100 Km	5000 Km

Table:-1. Comparison between CWDM and DWDM

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EXTENDED MODELLING AND NUMERICAL INVESTIGATION OF PHASED ARRAY SYNTHETIC JET CROSS-FLOW INTERACTIONS

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Abstract

A classical analysis of incompressible unsteady Navier-Stokes equation have been under discussion for a long time by various reasearchers, it has been found that the exact analytical unique solution existed only below and undefined Reynolds number limit. Several solutions were existed for a range of Reynolds number above the limit, and that has no solution exsisted above the second undefined Reynolds number (i.e, solution enter into turbulent region and one has to solve another set of equations for turbulance). A useful study was done for two dimensional unsteady incompressible flow in which vorticity is propotional to stream function perturbed by uniform stream. Recently this unsteady sloution was used to analyse the flow behaviour on flat plate using Synthetic Jet Actuators (SJA) which consists of oscillating membrane expels in fluid through orifice. The results obtained at different time level were presented and it was found as the time progresses streamlines, on the flat plate with number of actuators placed in an array, become flatter caused rapidly decay in vortices on trailing edge. The authentication of these results were needded to be validated through experiment or numerical simulation. In this paper, an attempt has been made to solve incompressible unsteady Navier-Stokes equations numerically to analyse the behaviour of single and multiple sythetic jet actuator in a cross flow conditions. The behaviour of SJA implemented by imposing a special kind of boundary condition on the bottom of flate plate was studied. Results have been obtained for various Reynolds numbers and were presented. These numerical results were in close agreement with [1].

Keywords: Incompressible unsteady Navier-Stokes equations, two dimensional flat Plate, Cell centered discrete Navier-Stokes equations, SOR solution method

Introduction

In [1], an attempt was made to predict the flow condition on an aero-plane wing by introducing SJA through the exact analytical solution of Navier-Stokes equations. The exact analytical solutions of linearized Navier-Stokes equations have been obtained and observed that the nonlinear convective term in the Navier-Stokes equations vanished when vorticity is the function of stream function alone or proportional to stream function [2]. In [2], it has also been observed an exact analytical solution that represent a double infinite array vortices decaying exponentially with time. The same was used with minor modification for the reverse flow about the flat plate with suction[4] .

In [1], we have attempted to predict the influencing fluid flow through suction and blowing with the help of exact analytical solutions of Navier-Stokes equations. The suction and blowing were created by SJA, a device that is used for zero mass-flux momentum addition to fluid flow. The actuators play an important role as control authority. In present study, it has investigated this control authority through plume core identification and array momentum coefficient.

The study was motivated by application of virtual shaping of flow for example air-foil with shape of streamlines over an aero-foil through a single synthetic jet which produces the lift. In [1], this situation was studied with the help of solution of exact analytical NSEs with special boundary condition having source and sink. Validation of the theoretical results obtained in [1] would be done either by experiment or numerical simulation. Experiment was beyond our scope, therefore, we carried out the validation through numerical experiment.

In present paper, incompressible unsteady Navier-Stokes equations were solved numerically in a two dimensional horizontal channel. A special type of boundary condition in space and time are specified on bottom boundary of the channel which simulates the behavior of actuators. A Conventional SOR (successive over relaxation) method was employed to solve pressure Poisson equation whereas the time dependent momentum equations were discretized on cell centered MAC type grid. The pressures were defined on the cell center and velocities were at cell boundaries. In the following section, we described the details of discretization of NSEs in primitive variables together with discretized equations on a MAC type grid.

Differential and Difference Navier-Stokes Equations

The incompressible unsteady Naiver-Stokes equations in two dimension are given below :

Continuity

$$\frac{\partial \rho}{\partial t}+\frac{\partial}{\partial x}(\rho u)+\frac{\partial}{\partial y}(\rho v)+\frac{\partial}{\partial z}(\rho w)=0 \qquad (1)$$

U momentum

$$\rho\left(\frac{\partial u}{\partial t}+u\frac{\partial u}{\partial x}+v\frac{\partial u}{\partial y}+w\frac{\partial u}{\partial z}\right)=\rho g_x-\frac{\partial p}{\partial x}+\mu\left(\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}+\frac{\partial^2 u}{\partial z^2}\right) \qquad (2)$$

V momentum

$$\rho\left(\frac{\partial v}{\partial t}+u\frac{\partial v}{\partial x}+v\frac{\partial v}{\partial y}+w\frac{\partial v}{\partial z}\right)=\rho g_y-\frac{\partial p}{\partial y}+\mu\left(\frac{\partial^2 v}{\partial x^2}+\frac{\partial^2 v}{\partial y^2}+\frac{\partial^2 v}{\partial z^2}\right) \qquad (3)$$

where u, v, are the velocity components in x and y directions respectively. P, ρ and μ were pressure, density and viscosity respectively. A MAC staggered grid system is used to locate flow variables.

Discretize Navier-Stokes Equation

The discrete equations were derived by first integrating the differential equations over each control volume surrounding the location of variables. They were expressed for a unit volume and fluxes over each control volume surface were taken to be constant. The discretized Navier-Stokes equation were given as follows;

Continuity equation:

$$u^{n+1}_{i+1/2,j}-u^{n+1}_{i-1/2,j}+v^{n+1}_{i,j+1/2}-v^{n+1}_{i,j-1/2}=0 \qquad (4)$$

U momentum:

$$\frac{u^{n+1}_{i+1/2,j}-u^{n+1}_{i-1/2,j}}{\Delta t}=-\left(\frac{1}{h}\left(u^2\right)^n_{i+1,j}-\left(u^2\right)^n_{i,j}+(uv)^n_{i+1/2,j+1/2}-(uv)^n_{i+1/2,j-1/2}\right)+ \qquad (5)$$

$$\frac{v}{h^2}(u^n_{i+3/2,j}+u^n_{i-1/2,j}+u^n_{i+1/2,j+1}+u^n_{i+1/2,j-1}-4u^n_{i+1/2,j})-\frac{1}{h}(P_{i+1,j}-P_{i,j})$$

V momentum:

$$\frac{v^{n+1}_{i,j+1/2}-v^n_{i,j+1/2}}{\Delta t}=-\left(\frac{1}{h}(uv)^n_{i+1/2,j+1/2}\left(u^2\right)^n_{i+1,j}-(uv)^n_{i-1/2,j+1/2}+\left(v^2\right)^n_{i,j+1}-\left(v^2\right)^n_{i,j}\right)+\frac{v}{h^2}(v^n_{i+1,j+1/2}$$

$$+v^n_{i-1,j+1/2}+v^n_{i,j+3/2}+v^n_{i+1/2,j-1/2}-4v^n_{i,j+1/2})-\frac{1}{h}(P_{i,j+1}-P_{i,j})$$

(6)

Solution Algorithm

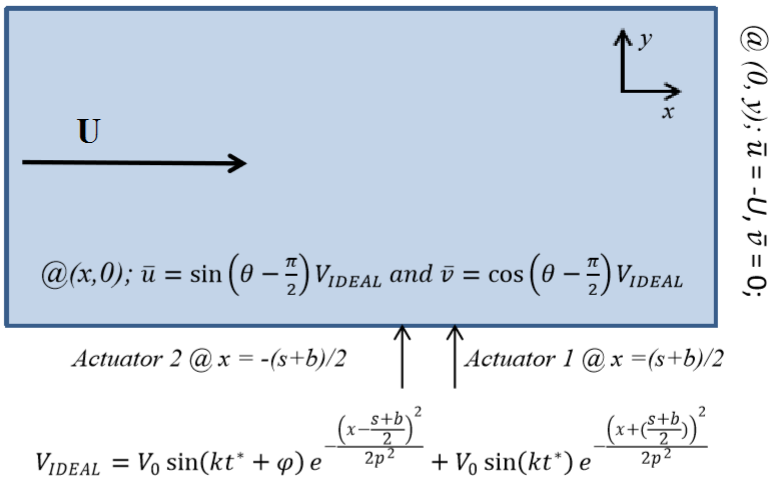
The resulting finite difference set of algebraic equations (4 - 6) were solved as follows

i. 'u' and 'v' momentum equations were first solved on an intermediate time level using the advection and diffusion terms only.
ii. Find the pressure needed to make velocity field incompressible.
iii. Correct the velocity by adding the pressure gradient.
iv. Solve Poisson equation for pressure using SOR method.
v. The algorithm continued for a longer time till the solution were converged.

Boundary Condition

Consider a two dimensional flat plate problem with cross-flow, the boundary condition were specified as below:

Fig 1. Boundary Conditions with two actuators



Results and Discussion

Equations (4 - 6) were solved for various Reynolds numbers on two dimensional flat plate with actuators as a suction and ejection placed at the bottom of the plate. The results were shown in figures ().

In figure (2) streamlines and velocity vector were plotted for Reynolds number 100. It was shown that the streamlines were converged at the actuators and were remained live even for a longer time with a total number of iterations 10,000.

In contest, figure (3), was shown that for Reynolds number 1000 the vortices were vanished gradually due to the effect of actuators at time 0.3 seconds. The same behavior was found in figure (4) for Reynolds number 10,000 and the vortices were vanished more rapidly at time of 0.2 seconds.

Figures (5 - 6) were a vector plot for Reynolds number 1000 and 10,000 also shown the recirculation of flow near the actuators.

Figure (7) was a plot of time of vanishing vortices vs Reynolds numbers. It was shown that the vortices at high Reynolds numbers vanished more quickly. It was concluded that the vortices created close to the actuators were died down before reaching to the trailing edge which controlled the cross flow condition. It was suggested that if an array of actuators were placed in proper positions on a flat wing would control cross flow condition quite efficiently. The same observation would be validated by performing an experiment by placing actuators on an airplane wing. It was further concluded that the result would be better if we considered a three dimensional case in which the bottom surface would be considered for actuators in an array.

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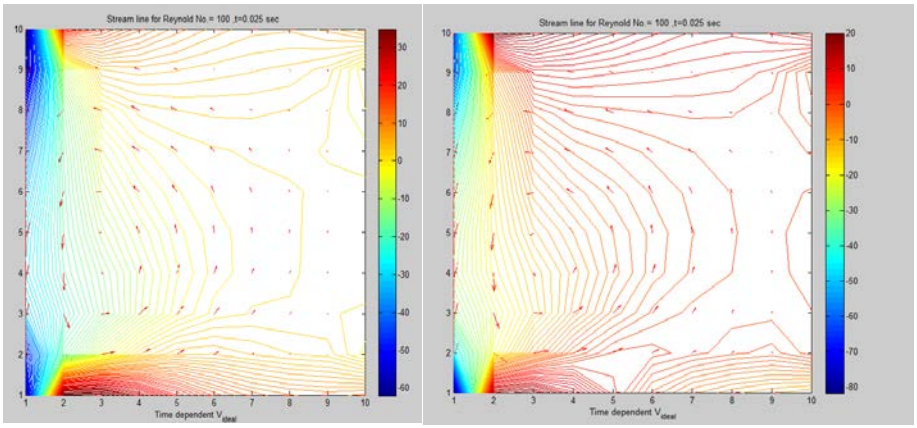

Fig 2 Streamlines for Reynold no.100 at t=2.5 sec and t=250 sec

Reynolds No	Time of vanishing Vortices (sec)
170	2
200	1.075
250	0.62
300	0.55
400	0.45
1000	0.3
10000	0.2

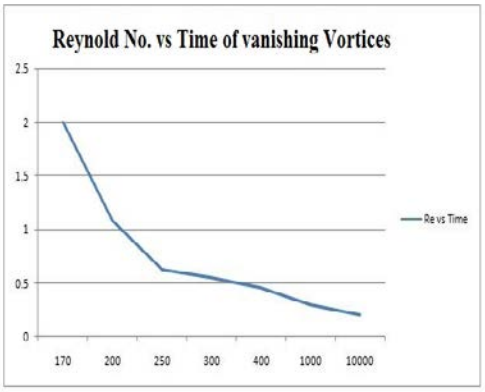

Fig 3 Table and Graph of Reynolds No. vs Time Vanishing Vortices

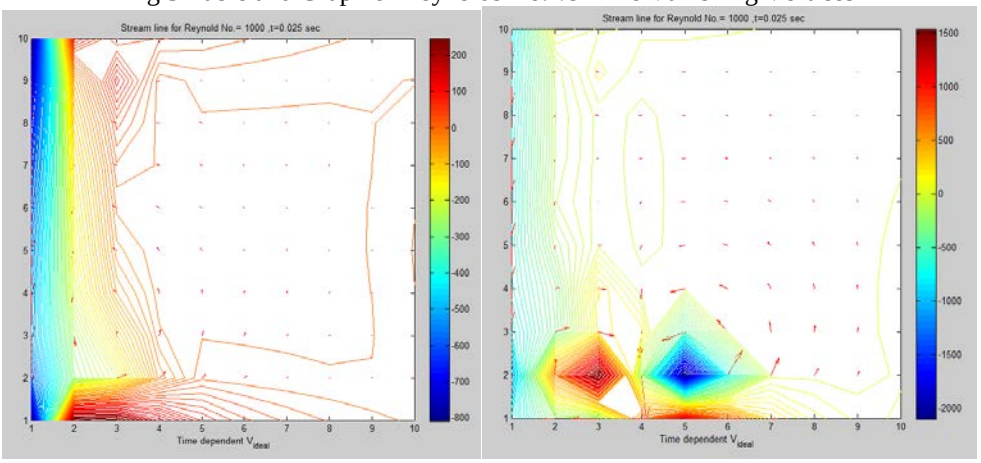

Fig 4 Streamlines for Reynold no. 1000 at t=0.125 sec. and t=0.25 sec.

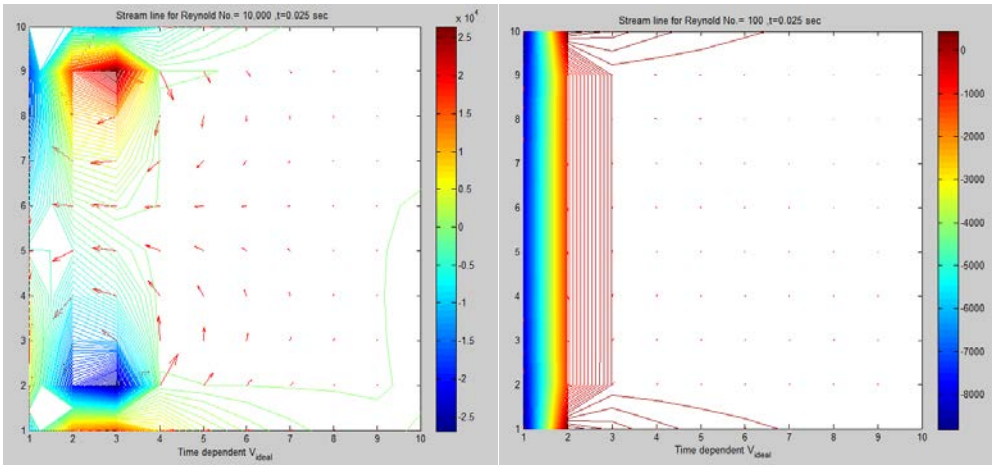

Fig 5 Streamlines for Reynold no. 10,000 at t=0.075 sec and t=0.125 sec.

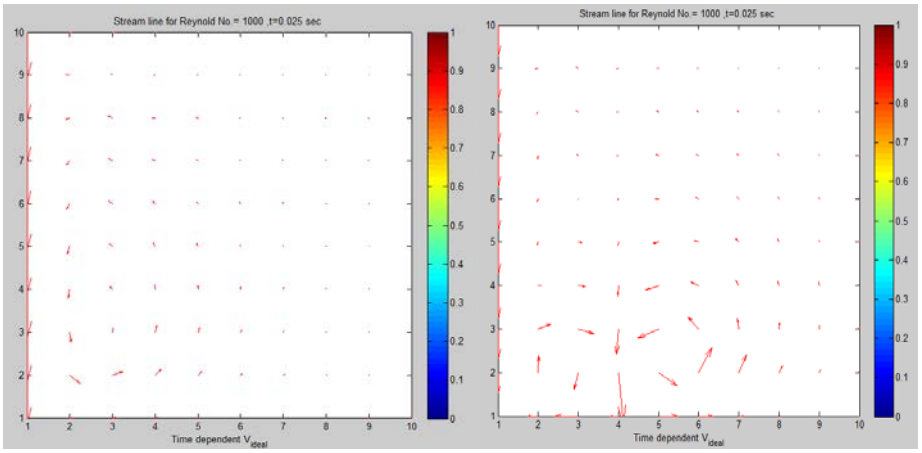

Fig 6 Vector plot for reynold no 1000 at t=0.125 sec and t=0.25 sec

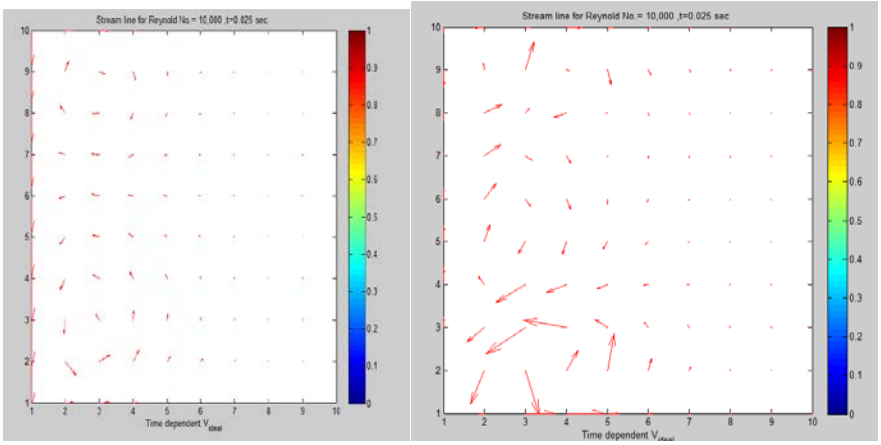

Fig 7 Vector plot for reynold no 1000 at t=0.075sec and t=0.25sec.

REVIEW PAPER ON DWDM TECHNOLOGY

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Abstract

DWDM system and the need of this system is discussed along with the operation of each component. The increasing demands of bandwidth lead to the enhancement in DWDM. The components of DWDM system are individually discussed. Various advantages and disadvantages of DWDM technology are discussed. The maintenance of optical signal quality and the factors that is important while the design and operation of DWDM are seen. The advantages of DWDM make this technology ideal for communication and other applications.

Keywords: DWDM, WDM, TDM, EDFA, ATM, IP, SONET, LASER, OSNR

Introduction

A transmission technique used in fiber optics in which light wavelengths are used to transmit data either parallel by bit or serial by character is known as Dense Wavelength Division Multiplexing. Here dense means that the wavelength channels are very close to each other. The increasing demand of consumers lead to increased bandwidth and this is possible using DWDM. The data from various different sources is put together on optical fiber in which each signal travels at same speed on its own light wavelength. At the receiver end every channel is demultiplexed into original source therefore different data formats with different data rates such as Internet (IP) data, Synchronous Optical Network data (SONET), and asynchronous transfer mode (ATM) data can be transmitted together at the same time through optical fiber. Thus DWDM increases the network capacity and makes efficient use of bandwidth. The capability of transmission of DWDM is 4 to 8 times of TDM and here EDFA (Erbium doped optical amplifier) are deployed as these amplifiers boost the strength of signal and the signal need not be regenerated again and again. The signal can be transmitted to more than 300km before regeneration[1].

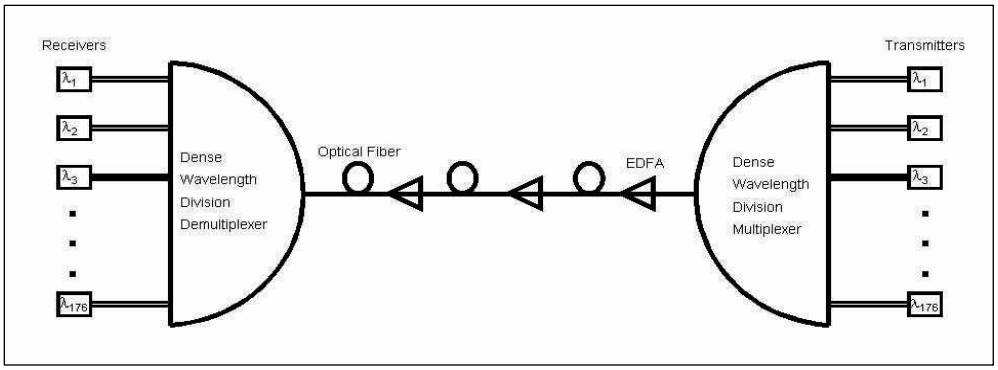

Fig 1: Block diagram of DWDM system

Bandwidth Demand

With the increasing applications like data transferring, media interactions, internet and other digital services the demand of bandwidth has also increased. The three possible solutions for the increasing bandwidth demand are:

1. Installation of new fibers.
2. New TDM technology in order to get high bit rates.
3. Use of Dense Wavelength Division Multiplexing.

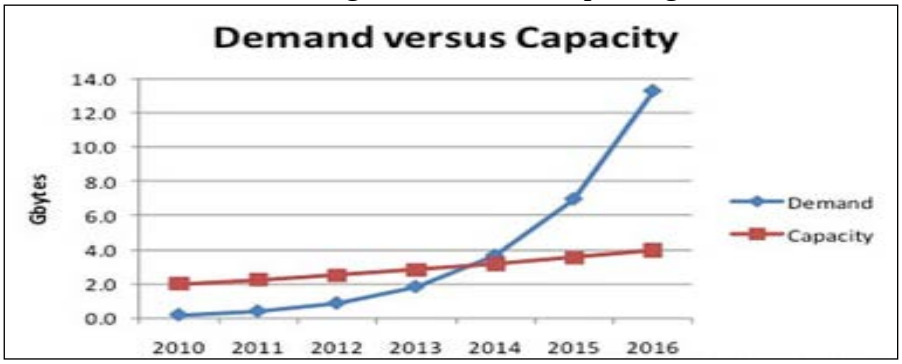

Fig 2: Increase in Demand of Bandwidth

Installation of new fibers is difficult and costly. The estimated cost of deploying additional fiber cables is about $70,000 per mile [2]. The cost may vary from place to place but it is impractical to do so and there are various issues related to the use of new TDM technology. Thus the last possible solution is use of DWDM. The DWDM system uses a fiber pair, one for transmission and other for reception. Also a single fiber is used for bidirectional traffic. DWDM combines and transmits multiple signals on a same fiber simultaneously in a dense wavelength grid and thus increases the bandwidth capacity. DWDM can handle high bit rates at lower cost.

DWDM System

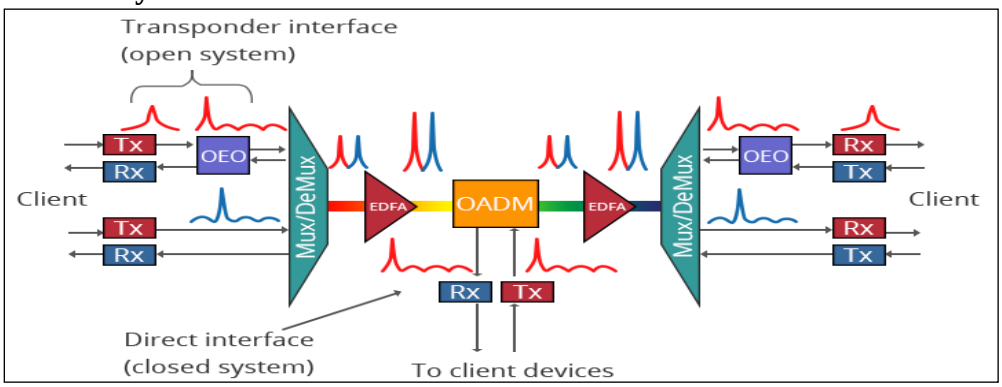

Fig 3: Block diagram of DWDM system

The input signal from input source i.e. laser is fed to the transponder which converts it to DWDM wavelength. This DWDM wavelength is multiplexed with signals to form a composite signal. This signal is then amplified and fed to fiber. OADM is used to add/ drop bit streams of particular wavelength. Before the signal reaches the de-multiplexer it is again amplified. This signal is then de-multiplexed to DWDM wavelengths. Thus the signal is fed to client end.

In case of dense wavelength division multiplexing the light travelling through the fiber is divided into wavelengths. A certain range of frequencies called window, are kept in mind while choosing the wavelength. DWDM basically does not increase the speed of travelling of data rather it sends the data in parallel in dedicated lanes. Each lane is independent from each other and thus traffic can travel at different speed. DWDM is capable of carrying 24 channels but in future the capacity is expected to increase to 128 channels in a single fiber.

A basic DWDM system consists of following components :

1. Transmitters/ Receivers: DWDM transmitters consist of a large number of transmission LASERs are multiplexed into a single fiber. A large number of individual lasers with different wavelengths are used to create individual channels of DWDM system [3]. Pulses of light are created by laser and each pulse has a particular wavelength (known as LAMBDA). A physical layer device is used to convert the incoming electrical signal to light signal. These pulses propagate through fiber using the phenomenon of total internal reflection. At the receiver end the light signal is converted to the electrical signal using an optical sensor called photodiode.
2. Optical amplifiers: The optical signal (light) can be amplified directly using optical amplifiers without first converting it to the electrical signal. These amplifiers add gain or boost the amplitude of optical signals by simulating the photons of signal with extra energy. EDFA are the optical

repeaters that amplify the optical signal. The silica based optical fibers are doped with erbium to improve the power of wavelength.[4]

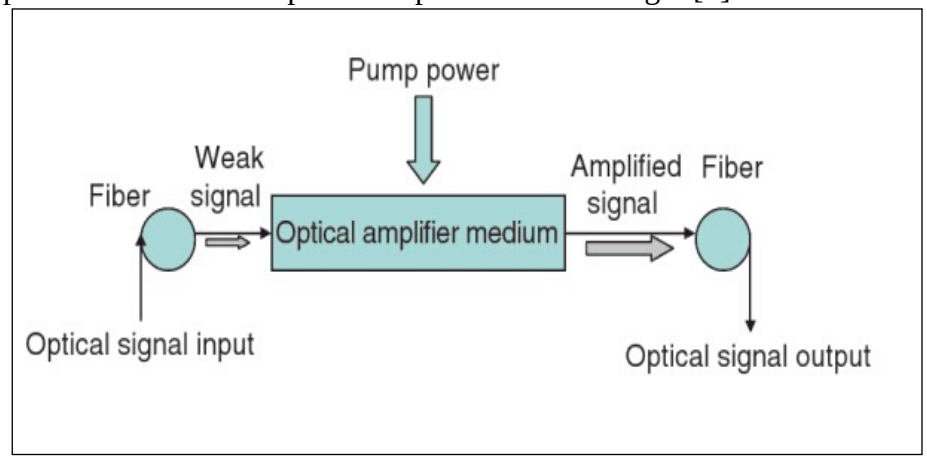

Fig 4: Optical Amplifier

3. Optical Add/Drop multiplexers: The figure represents the operation of one channel OADM. Here OADM is designed to add or drop signals with particular wavelength.

ADD means the capability of device to add new wavelength channel to existing multi wavelength signal. DROP means to remove channel passing signal to another path. The incoming signal is broken into two components i.e. drop and pass through. The signal that is dropped is passed to the receiver of client device and the pass through signal is multiplexed with new signal stream. [5]

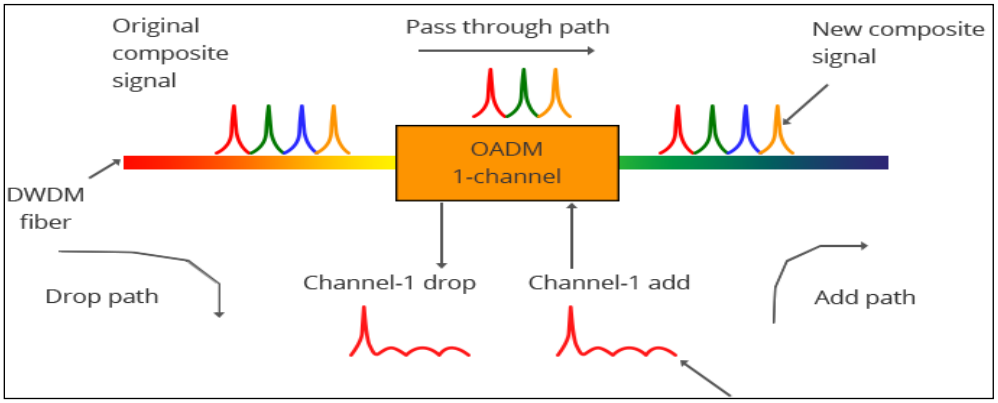

Fig 5: OADM

4. DWDM Multiplexers / De-multiplexers: Multiple wavelengths are combined to be transmitted on one fiber and these form a composite signal. At the receiver end this composite signal is again separated into individual wavelengths using de-multiplexer. Optical multiplexer and de-multiplexer

are passive components. Since the process of this multiplexing and de-multiplexing is optical thus there is no need of external power source.

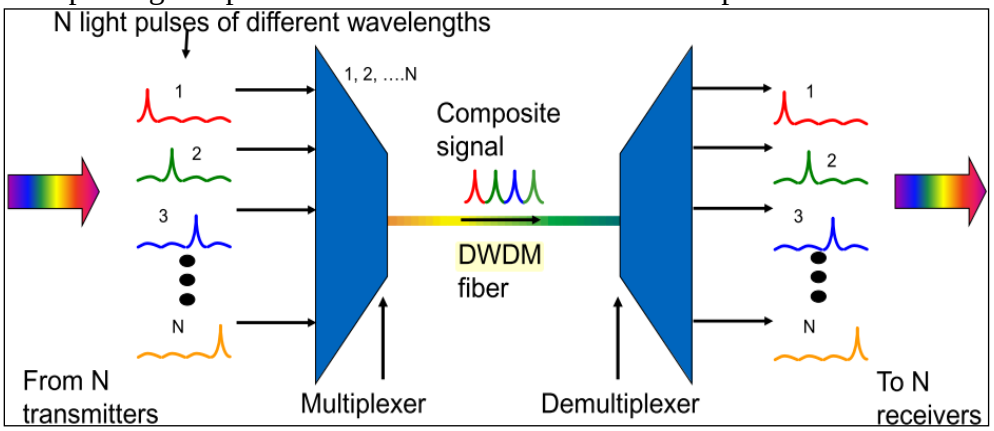

Fig 6: DWDM multiplexers and de-multiplexers

5. Transponder (wavelength converter): Transponder is a device that is used to send and receive signals from fiber and these are used to convert full duplex electrical signal to full duplex optical signal. These convert optical signal of one wavelength to optical signal of another wavelength suitable for DWDM applications. These are also known as optical –electrical-optical (O-E-O) wavelength converters. Thus these are useful for optical communication but these are bulky and consume more power.

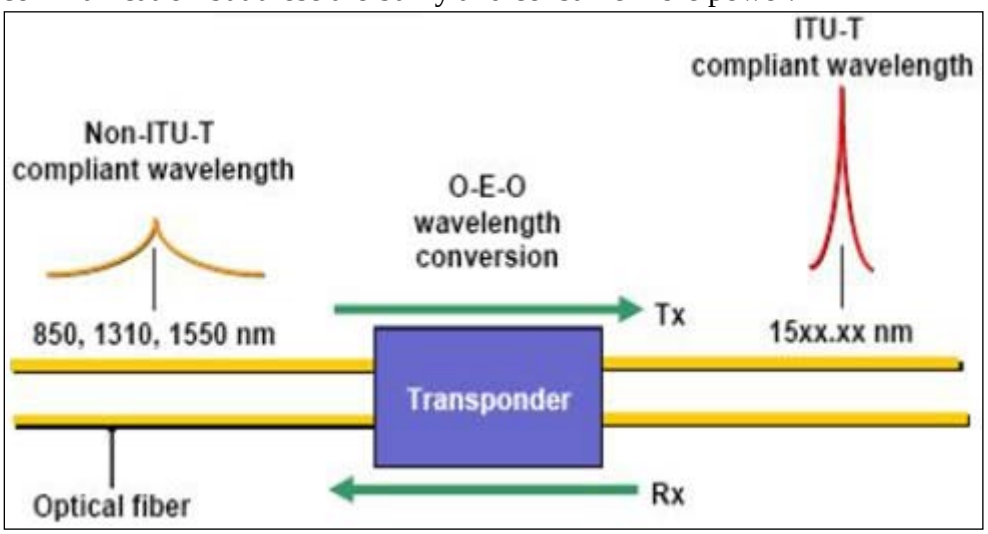

Fig 7: DWDM transponder

4.Advantages of DWDM:

Following are the advantages of DWDM:

1. It has unlimited transmission capacity due to multi data transmission network.

2. It is flexible as it is protocol and bit rate independent.
3. It is expanded at any node very smoothly.
4. Data transparency and high reliability.
5. It is suitable for long haul transmission.
6. Continuous data regeneration is not required.

5. Disadvantages of DWDM:

Following are the disadvantages of DWDM:

1. Amplifiers are used to improve power and gain thus system becomes expensive.

2. Attenuation loss due to impurities in core or cladding of fiber.

3. Since multiple optical signals are multiplexed together thus insertion loss occurs.

4. Splicing and connector losses are also observed which affect the system performance.

5. Loss due to chromatic dispersion and polarization dispersion also affect the system.

6. Applications of DWDM system:

1. DWDM has capability to expand capacity and can serve as backup bandwidth without a need to install new fibers thus it is ready made for long distance telecommunication services.
2. DWDM can also be used in various networks like sensor networks, remote radar networks, tele spectroscopic process control network and many more networks.[6]
3. By the use of only two fibers 100% protected ring with 16 separate communication signals, can be constructed deploying DWDM terminals as these are self healing rings. [6]
4. In order to meet the demand in fast growing industrial base DWDM system can be used for existing thin fiber plants as these plants cannot support high bit rates.

7. Conclusion: DWDM and the system components have been discussed. It is clear that DWDM will definitely reshape the future communication network as it has bandwidth availability which is the need of hour. Various advantages of DWDM make it ideal technology for communication systems. The losses that occur in this system like attenuation loss can be overcome using optical amplifiers but it may result in OSNR problems. Dispersion losses can also be overcome thus increasing transmission distance. So in all DWDM is worthwhile and can be base for future communication.

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PARENTAGE OF OVERLAPPING OFFSPRING OF AN ARBOREAL-BREEDING FROG WITH NO NEST DEFENSE: IMPLICATIONS FOR NEST SITE SELECTION AND REPRODUCTIVE STRATEGY

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Abstract

Overlapping offspring occurs when eggs are laid in a nest containing offspring from earlier reproduction. To unveil the parentage between overlapping offspring and parents is critical in understanding oviposition site selection and the reproductive strategies of parents. Amplectant pairs of an arboreal-breeding frog, *Kurixalus eiffingeri*, lay eggs in tadpole-occupied nests where offspring of different life stages (embryos and tadpoles) coexist. We used five microsatellite DNA markers to assess the parentage between parents and overlapping offspring. Results showed varied parentage patterns, which may differ from the phenomenon of overlapping egg clutches reported earlier. Parentage analyses showed that only 58 and 25% of the tadpole-occupied stumps were reused by the same male and female respectively, partially confirming our prediction. Re-nesting by the same individual was more common in males than females, which is most likely related to the cost of tadpole feeding and/or feeding schemes of females. On the other hand, results of parentage analyses showed that about 42 and 75 % of male and female respectively bred in tadpole-occupied stumps where tadpoles were genetically unrelated. Results of a nest-choice experiment

revealed that 40% of frogs chose tadpole-occupied bamboo cups when we presented identical stumps, without or with tadpoles, suggesting that the habitat saturation hypothesis does not fully explain why frogs used the tadpole-occupied stumps. Several possible benefits of overlapping offspring with different life stages were proposed. Our study highlights the importance of integrating molecular data with field observations to better understand the reproductive biology and nest site selection of anuran amphibians.

Keywords: Amphibian, nest-site selection, overlapping offspring, parentage

Introduction

Overlapping offspring is an interesting phenomenon that occurs more commonly than originally thought, but the patterns, causes, and ecological and evolutionary consequences are not fully understood. When sites are reused for reproduction, the sites may be empty (if previous offspring have left) or may contain offspring from earlier reproduction. If offspring from previous reproduction remain, this results in two overlapping cohorts.

The parentage between overlapping offspring and nest users could lead to differences in reproductive strategy and nest site selection. When an adult reuses a nest occupied by a conspecific, it may contain genetically related or unrelated offspring. The former could be a case of nest-site fidelity (Hoover, 2003; Vergara, Aguirre, Fargallo, & Davila, 2006) whereas the latter could be a case of oviposition site selection could be a case of the saturation of breeding sites that force breeding pairs to oviposit in an occupied site (Doody, Freedberg, & Keogh, 2009) or of conspecific attraction because the presence of conspecifics may represent the quality of breeding resources (Doligez, Danchin, & Clobert, 2002; Mokany & Shine, 2003; Rudolf & Rodel, 2005).

In this study, we used a Taiwanese frog (*Kurixalus eiffingeri* (Anura: Rhacophoridae)) that breeds in water-filled bamboo stumps as a model animal to study the parentage between overlapping offspring and its ecological consequence on reproductive strategy and nest site selection. Specifically, we used (1) five microsatellite DNA markers to analyze the parentage of adults and tadpoles and (2) paired bamboo cups with and without tadpoles to study the nest choice of frogs and to reveal the possible causes of nest reuse.

Materials and methods

We conducted experiments in the bamboo forests at Chitou in Nantou County, Taiwan. From March – August 2007-2009, we conducted field surveys to collect adults (males and/or females) and overlapping offspring

(eggs and tadpoles) for parentage analyses. We captured and toe-clipped attending male and feeding female frogs and preserved the tissue individually in 95% ethanol.

In the laboratory, we incubated egg clutches separately on moist substrates until hatching. We reared tadpoles in beakers (ca. 1 L water) and fed them with chicken egg yolk once every 4 days until they reached metamorphosis. When tadpoles reached Gosner stage 40, we clipped a distal portion of tadpoles' tail (i.e., 10% or less of total tail length) and preserved tissues in 95% ethanol for parentage analyses.

We conducted genetic analyses on the parentage of tadpoles and adults. Detailed methods on parentage analyses were reported by Chen et al (Y.-H Chen, Cheng, Yu, & Kam, 2011). The likelihood-based, COLONY 2 program (Wang, 2004) was used to analyze genetic relationships between the attending males, feeding females and the offspring in the nests. Based on the results of the parentage analyses, we deduced the mating pattern of frogs and further assessed whether individuals that breed earlier in a stump would reuse the same stump again.

From April 17 to August 15, 2013, we also conducted a manipulated experiment where paired bamboo cups, with and without tadpoles, were set up to investigate nest choice of frogs. We randomly designated one cup as the control and the other as the experimental group. A control group contained water only but the experimental group contained water and 5 tadpoles (Gosner stage 28-35). We surveyed the paired-bamboo cups every 4 days to determine which cup was oviposited.

Results and discussion

COLONY deduced eight different types of parentage among overlapping offspring. The most common parentage among overlapping offspring was partially the same father and different mothers (N= 8), followed by different parents (N = 7). The former is a case when a male frog was involved in matings that sired offspring in the early- and late-laid clutches, and at least one of the clutches was either synchronous polyandry or sequential multi-mating events that included other male frogs, which resulted in multiple paternity. In contrast, the latter is a rather simple case where two different pairs of frogs produced the two cohorts of offspring. The remaining types of parentage among overlapping offspring occurred at much lower frequency: same male and female (N=1), same male and partially the same female (N =1), same male and different female (N =3), paritally the same male and female (N =1), different male and same female (N =2), and different male and partially the same female (N =1).

Based on results of parentage among overlapping clutches, we found that a total of 14 stumps were reused by the same male frogs but 10 stumps

were not, and the proportion of stump use is statistically similar (G test, G = 0.670, *P* = 0.413). On the other hand, a total of 6 stumps were reused by the same female frogs but 18 stumps were not, and the proportion of stump use was statistically different (G test, G = 6.279, *P* = 0.012).

We conducted 28 surveys, checking a total of 1862 cup pairs from April to August and found that 57 egg clutches were deposited during the study period (Table 2). Most egg clutches were found between May to July when the breeding activity peaked. A total of 34 and 23 egg clutches were laid in control and experimental bamboo cups, respectively, and the egg placement was independent from cup treatment (G test, G = 2.136, *P* = 0.144). During this three month period (May to July), 40, 31, and 52% of egg clutches were laid in the experimental cups in the respective months. Clutch size of eggs laid in control cups (45.3 $\pm$ 18.4 eggs, *N* = 24) was not different from that of experimental cups (42.8 $\pm$ 19.4 eggs. *N* = 17; Wilcoxon rank sum test, W = 229.5, *P* = 0.508).

The casual mechanism(s) of the varied patterns of parentage in overlapping offspring in this study are yet to be clarified and are expected to be more complicated than that of overlapping egg clutches reported earlier. We speculate that the varied parentage patterns can at least be associated with two ecological factors: a lack of nest defense and limited breeding resources. *Kurixalus eiffingeri* has a unique "sequential" form of parental care: male frogs guard eggs during embryonic period, and female frogs feed tadpoles alone during larval period; however, there is no evidence of nest or mate defense. Nest defense is a common parental behavior among insects (Gruter, Karcher, & Ratnieks, 2011), fishes (Knouft & Page, 2004), salamanders (Bachmann, 1984; Forester, 1979, 1983), frogs (Wells, 1977, 2007), and birds (Campobello & Sealy, 2011; Redmond, Murphy, Dolan, & Sexton, 2009; Westmoreland, 1989) and functions to protect valuable resources inside (e.g., mates, offspring, food, even the nest site itself (Gruter et al., 2011)). In birds, the increased frequency of extra-pair mating or paternity has been associated with a lack of territorial or mate-guarding behavior (Ewen, Armstrong, Ebert, & Hansen, 2004; Macdougall-Shackleton, Robertson, & Boag, 1996; Moller, 1990; Rowe & Weatherhead, 2007). This may also be true in *K. eiffingeri* in that a lack of mate and nest defense opens possibilities for a male or female frog to mate with others and utilize the tadpole-occupied nests to breed again. Furthermore, the quality and availability of water pools in stumps vary in time and space (Lin, Lehtinen, & Kam, 2008). As the reproductive season progresses, more and more of the arboreal pools may already have been used for breeding by other individuals (Lin et al., 2008). The competition for stumps (empty or tadpole-occupied) for breeding is heavy, which inevitably results in the reuse of

tadpole-occupied stumps. This likely leads to a diverse pattern of parentage in the overlapping offspring.

Our findings that 58 and 25 % of *K. eiffingeri* males and females respectively reused the same stump to breed partly agreed with our prediction. Earlier studies have reported site fidelity in stream-dwelling frogs which probably are able to obtain sufficient ecological necessities such that moving away from a site is not required (Daugherty & Sheldon 1982; Kam & Chen, 2000; Tessier, Slaven, & Green, 1991). In this study, the lower rate of reusing the same nest by females can probably be explained by the high cost of tadpole feeding.

On the other hand, results of parentage analyses showed that about 42 and 75 % of males and females respectively bred in tadpole-occupied stumps where tadpoles were genetically unrelated, which leads to the following question: why did frogs breed in the tadpole-occupied stumps of others? One explanation is that amplectant pairs may be forced to lay eggs in tadpole-occupied nests when most suitable breeding habitats are already used later in the breeding season (i.e., the saturated habitat hypothesis) (Doody et al., 2009). However, in the nest choice experiment, when we presented identical cups, without or with tadpoles, 40% of frogs still chose tadpole-occupied cups, suggesting that the habitat saturation hypothesis does not fully explain why frogs used the tadpole-occupied stumps. We conted that even though the quality of tadpole-occupied stumps is discounted due to inter-clutch tadpole competition, they are still as good as, if not better than, the remaining unoccupied stumps (Lin et al., 2008).

There are several possible benefits of reusing tadpole-occupied stumps. First, the presence of early-clutch tadpoles may serve as a cue for the high quality of the stumps, such as the availability and persistence of the water resource, which is particularly critical for offspring living in container habitats like tree holes and stumps which are prone to desiccation (Kitching, 2000; Rudolf & Rodel, 2005; Srivastava et al., 2004). Second, the coexistence of two cohorts of tadpoles reduces the probability of smaller tadpoles (i.e., late-laid clutches) being eaten not only because of the attack abatement effect but also because they are less conspicuous due to small size when compared to larger tadpoles (i.e., early-laid clutch) (Doody et al., 2009). Third, coexisting tadpoles in stumps could potentially be fed by two females which reduces the probability of catastrophic nest mortality. Earlier studies on *K. eiffingeri* have reported nest failure (~30%) which is due to nest abandonment by females and/or death of female frogs, mostly by snake predation (Y.-H. Chen, Su, Lin, & Kam, 2001; Chiu & Kam, 2006; Kam, Lin, Lin, & Tsai, 1998b). Since females cannot discriminate kin from non-kin (Kam, Chen, Chen, & Tsai, 2000), if a nest is used by two females (i.e.,

multiple feeders effect), the tadpoles would still be fed if one of the mothers deserts the nest or is eaten.

Conclusion

In conclusion, integrating parentage into the discussion of nest site selection can lead to new insights into the reproductive strategies and sexual selection of animals. This is particularly true in the studies of reproductive behavior of externally fertilizing animals such as anuran amphibians and fishes because many species have complex reproductive behavior that cannot easily be detected in the field (Avise et al., 2002; Cheng, Chen, Yu, Roberts, & Kam, 2013; DeWoody & Avise, 2001; Laurila & Seppa, 1998; Vieites et al., 2004). In this study, *K. eiffingeri* may oviposit in egg- or tadpole-occupied stumps, both resulting in overlapping offspring. However, parentage data and field evidence suggest that oviposition in stumps occupied by either eggs or tadpoles should be seen as two different reproductive phenomena, most likely with different causal mechanisms. Oviposition in egg-occupied stumps is mostly initiated by attending males which probably attempt to compensate for the loss of reproductive opportunities while attending eggs. On the other hand, based on the results of the nest choice experiment in the field, the occurrence of oviposition in tadpole-occupied stumps cannot be fully explained by the habitat saturation hypothesis. We propose several hypotheses to explain the potential adaptive values of overlapping offspring. However, additional studies are necessary to fully understand the patterns revealed by this study.

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COMPLEX DI-HYDRATE CALCIUM PHOSPHATE - GLUTARALDEHYDE: FORMULATION MECHANISM

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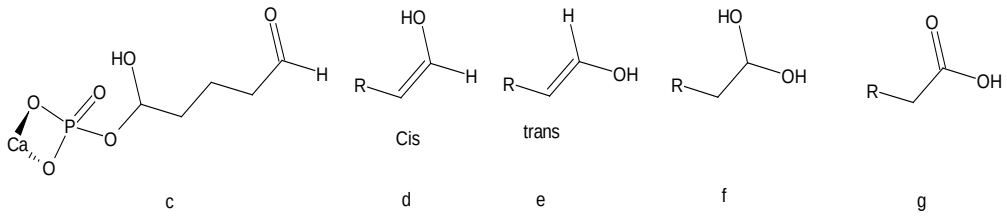
Abstract

The di-hydrate calcium phosphate $CaHPO_4$, H_2O (DCPD) reacts with glutaraldehyde $OCH - (CH_2)_3 - CHO$ (GL) in an aqueous solution to give the complex $OCH - (CH_2)_3 - CH(OH) - O - PO_3Ca$ (DCPD-GL). In the solution, the complex appears in the form of hydrates (enolic stabilized by intramolecular isomery d, e, f and as the corresponding carboxylic acid g). In the solid state it is the enolic form wich dominates (cis and trans).



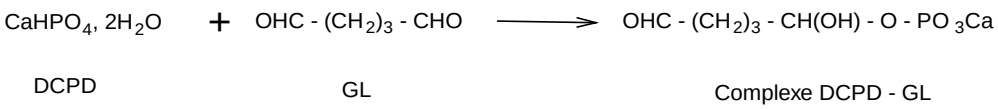
c d e f g

Keywords: Complex di-hydrate calcium phosphate, Glutaraldehyde, Mechanism

Introduction

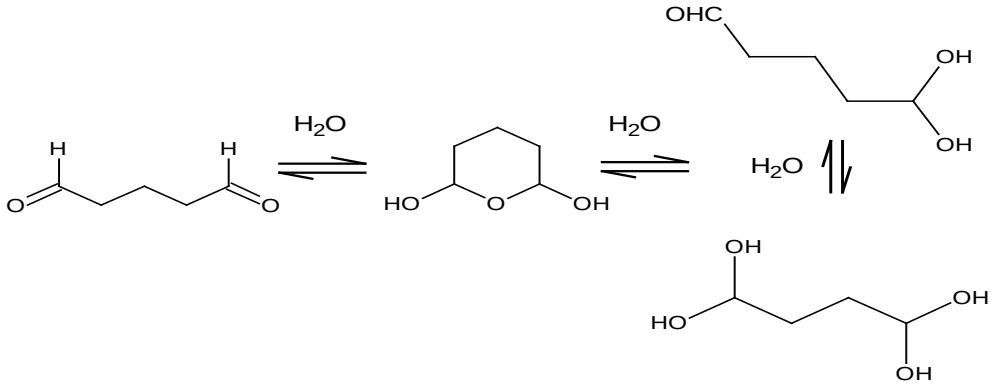
The 1.5-dipentanal is a compound of great importance in cytochemistry, immunochemistry, microscopy, RX, as a fixer of protein, glycogen and phospholipid (Hopwood D, 1972 ; Sabatini D D et al 1963 ; Rechards F M et al 1968 ; Hopwood D., 1967). The glutaraldehyde reacts

with the calcium phosphate to give the complex DCPD – Gl (Schéma 1) (Bouzid M et al 2013) with good yield.



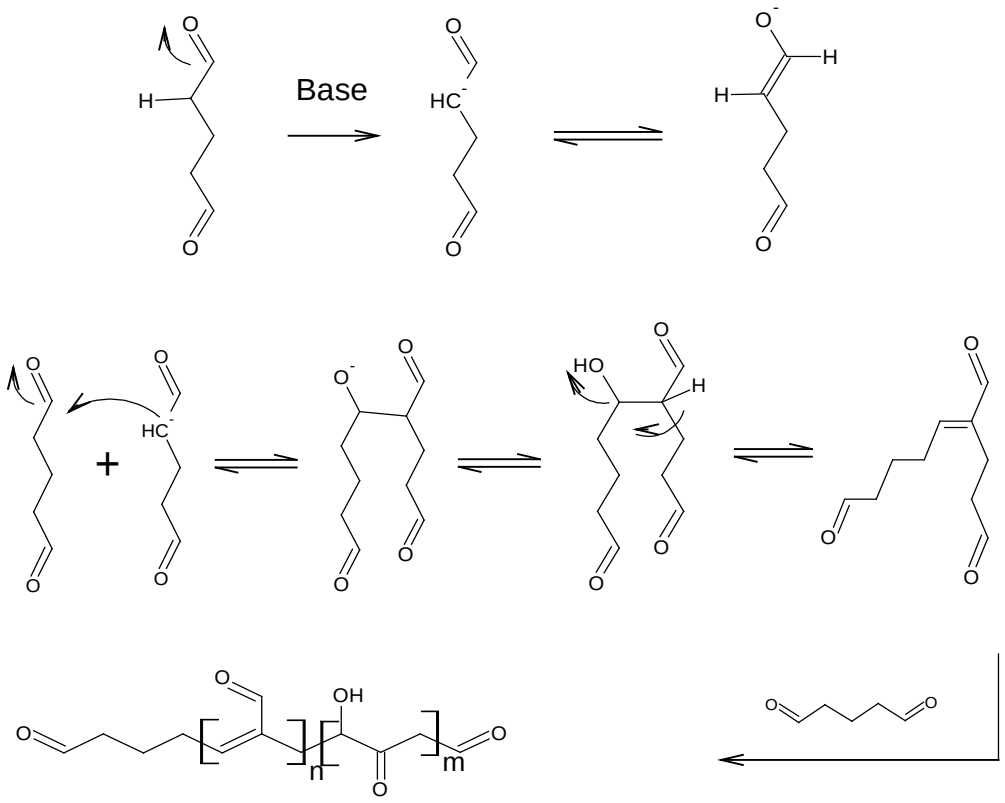
Schema 1: Complexation reaction DCPD-GL

The spectral study of 1,5-dipentanal in solution should enable to elucidate the behavior of the molecule in an aqueous solution in order to suggest the mechanism of this reaction. The literature does not solve the problem. The 1,5-pentanal behaves in an acidic medium as an equilibrium with linear and cyclic hydrates (P. M. Hardy et al., 1969) (schema 2).



Schema 2: GL in acidic aqueous solution (P. M. Hardy et al., 1969)

In a basic medium, the literature (N. R. Kildeeva et al., 2009) reports the condensation of the aldehyde according to schema 3.



Schema 3: Mechanism of the aldol condensation reaction in a basic medium (N. R. Kildeeva et al., 2009)

Based on a spectral literature magazine, we propose a mechanistic configuration of the reaction (schema 4).

Materials and methods

Absorption spectroscopy Ultra-Violet Visible

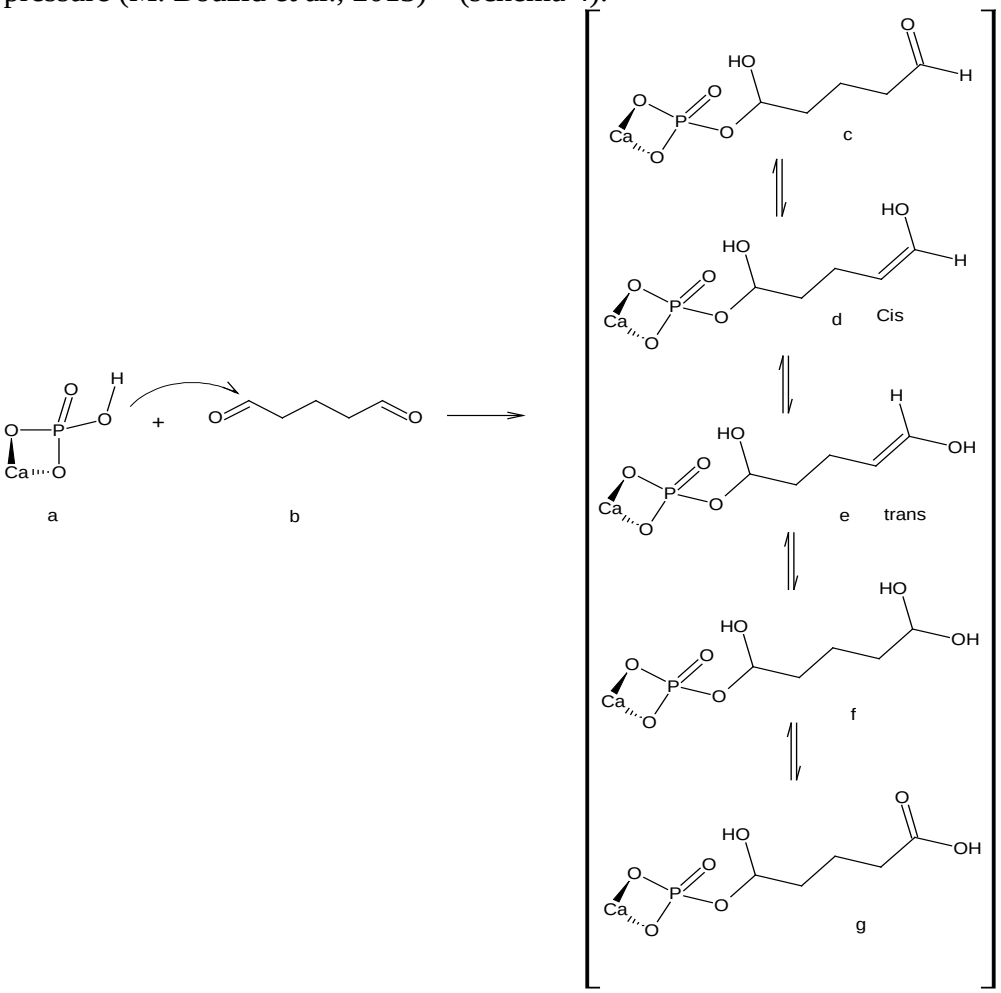
The UV-visible analysis is performed with a spectrophotometer (Lambda EZ210). The scanning between 190 and 1100 nm of infinitely dilute solutions used to determine the absorption band of the products.

Infrared Absorption Spectroscopy

The infrared absorption spectrophotometry is carried out using a spectrometer Nicolet Type 5700 series on pellets formed of 1 mg of product dispersed in 300 mg of KBr.

Results and discussion

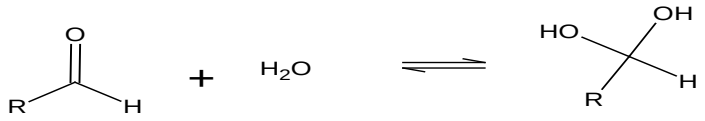
The di-hydrate calcium phosphate reacts with glutaraldehyde in an aqueous solution to give the complex DCPD-GL with a good yield. The brick-red compound is stable under normal conditions of temperature and pressure (M. Bouzid et al., 2013) (schema 4).



Schema 4: Reaction of DCPD with GL

Studies conducted by Hardy et al (P. M. Hardy et al., 1969) and confirmed by (E.B. Whipple et al., 1974), (P. Monsan et al., 1975) based on NMR study, UV-Visible consider that the unsaturated forms other than dialdehydes present only a minor constituent. They attribute the spectra obtained to the presence of linear and cyclic hydrates in solution. The UV-Visible spectrum of glutaraldehyde reveals two responses at 235 nm and 285 nm (Figure 1). The intense band at 235 nm corresponds to the residue of GL with a polymeric nature and double bonds designated by (S.Margel 1980),

the poly-glutaraldehyde (PGL). The band at 285 nm corresponds to the monomer GL. It has been noted that the peak at 235 nm varies according to pH (Maximum at 12.3) (S.Margel 1980). These data are in contrast with the batochrome effect. The absorbance at 285 nm is due to aldehyde groups, the concentration of which should decrease during the aldol condensation reaction. However, the experience shows that this is not the case. The peak at 285 nm increases during the polymerization. This situation can be explained by the displacement of equilibrium between hydrated and non-hydrated forms of GL (Schema 5). On the basis of UV-Visible spectral studies, the author considers the equilibrium of the reaction as a cause of spectral changes.



Schema 5: Balance aldehyde – hydrate

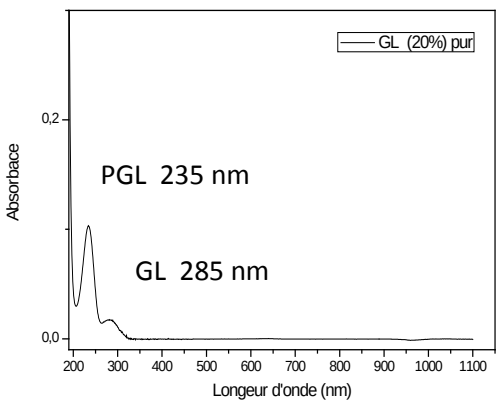


Figure 1: UV-Visible spectrum of GL (2%)

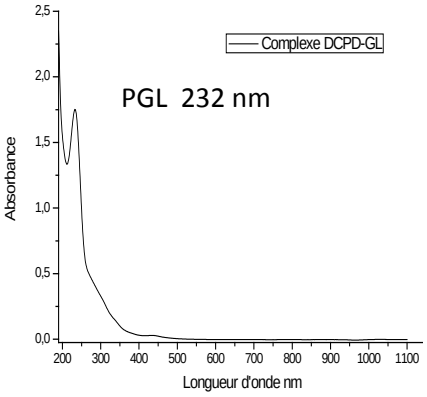
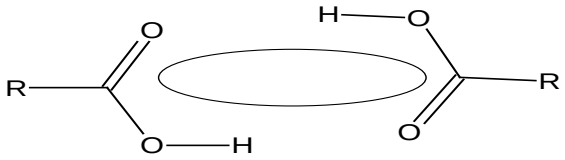


Figure 2: UV-Visible spectrum of DCPD - GL (2%)

Kawahara et al., 1992, resume the study of the structure of 1,5-dipentanal in solution by UV - Visible. They conclude that the GL solution contains up to 70% of polymer entities with semi cyclic acetal structures. The dilution of the solution converts 100% of the polymer into monomer with pH between 3 and 8. The DCPD- GL complex shows a peak at 232 nm, it shows also the peak displacement initially at 285 nm to the low absorbance as a shoulder. It is to be noted that the complexation reaction can be easily followed by UV - Visible. Moreover, the glutaric acid (232 nm) was quoted as a by-product of glutaraldehyde in an aqueous solution (S Margel et al.,

1980 ; TAPAS MITRA et al., 2014). H. T.Flakus et al 1999, show the difficulty in interpreting the Infrared spectra. Apparently the phenomenon is governed by the binding (- OH) and the different bridges which may give in solution according to operating conditions (- O - H ... O = C -.). M A Benmalti et al., 2009 report the theoretical study on υ plug (O - H) of the glutaric acid and the cyclic dimer centroid generated system. The study by infrared boils down to the result of the behavior driven by the system (- O - H ... O = C -.) in liquid phase (Figure 3). In the solid phase, the movement of molecules allows only the most stable configurations (Figure 4) with much more explicit spectra.



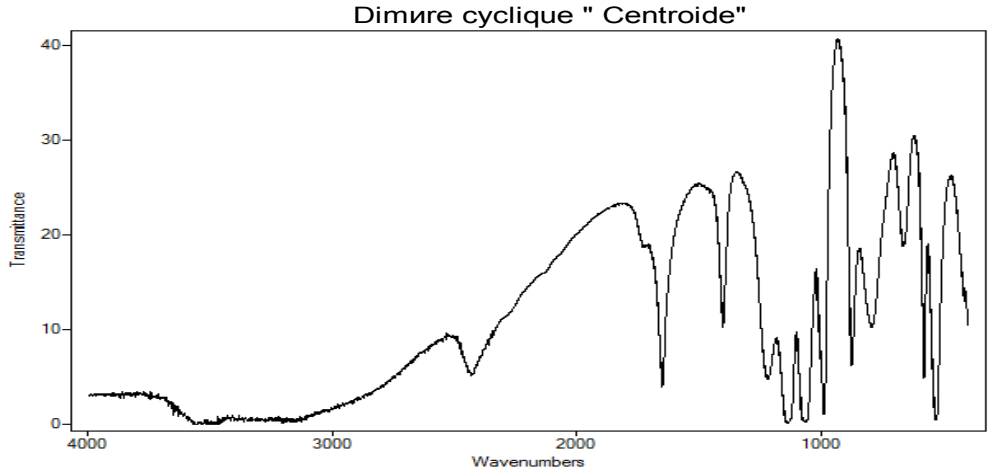


Figure 3: FTIR spectrum DCPD - GL solution H_2O

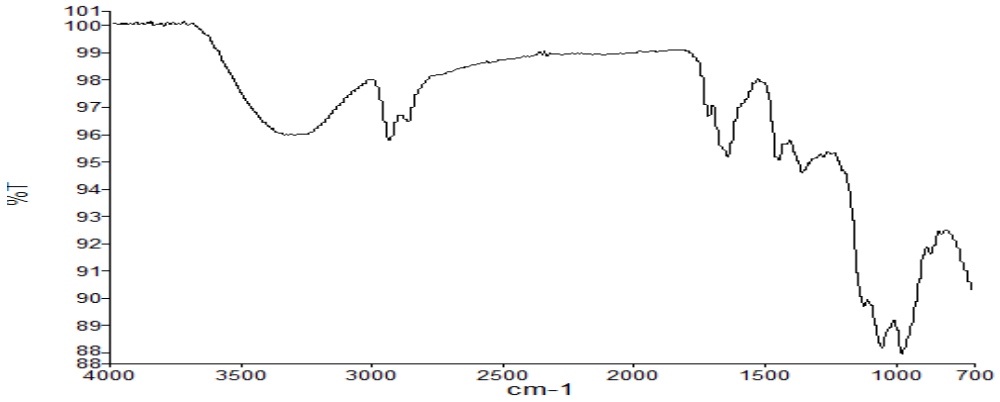


Figure 4: Specter of DCPD IRTF - GL crystal

In the solid phase, the stretching vibration of (- OH) appears near 3400 cm^{-1}. This value is a characteristic of (- OH) stabilized by the environment (RV.J. Mulley et al., 1970 ; JW. Xu et al., 1999), compared to 3600 cm^{-1}: case of free (- OH) (A. Kirmann Monographie). The aliphatic part (- (CH 2) 3 -) offers strong anti-symmetric vibrations at 2920 cm^{-1} and symmetric at 2850 cm^{-1}. The massif between 2850 and 2950 cm^{-1} is a characteristic of the aliphatic chain. In solution, there is a wide shoulder that begins around 2700 cm^{-1} and reaches the vibration group of H_2O around 3500 cm^{-1} and 3600 cm^{-1}. However it should be noted that in this area of 2800 cm^{-1} to 2900 cm^{-1}, there are lower additional bands, active in infrared. This corresponds to harmonic bands or combination of modes of internal deformation of methylenes. It should be noted as well that intramolecular vibrations, (O - H ... O = P) of chilates forms, and / or enol) of groups (OH) in their molecular configuration, exist (Buzon J. et al, 1970 A.. El Hamidi et al., 2012). What is also to be noted is the existence of several equilibrium positions of the hydrogen atom in the system (- O - H ... O = C -.). Several authors agree (Ref A. Kirmann Monographie) to say that at this level, the potential energy curves can then have different unidentical minima. The same authors, interpret the absorption massif between 2700 cm^{-1} and 3500 cm^{-1} as a characteristic of the cyclic dimer of carboxylic acid. In general, in the solid and liquid states, the carboxylic acids do not have the stretching vibration band of the group free (- OH), because of hydrogen bonds established between the (- OH) and the (CO). In our study, it appears clearly on the IR spectra (Figure 4) that the DCPD-GL complex in the solid state, has an alcohol function. The (CHO) function appears mainly in an enolic form. The band at 1400 cm^{-1} characteristic of the double bond (C = C) confirms the proposed mechanism reported in the literature in the case of conjugated aldehyde functions (J. Buzon et al., 1970 ; A. El Hamidi et al 2012). Contrary to the solid state, the band (C = C) splits, which suggests the enol configuration with a mixture of cis and trans.

Conclusion

In solution, DCPD - GL complex can appear in the enol form (cis and trans) and in the carboxylic acid form with the structures of dimer type. In the solid state, the enol form dominates (cis and trans).

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EFFECT OF PULSED GALVANIC ELECTRO STIMULATION AND ULTRASUONBD ON BURN HEALING. A RANDOMIZED CLINICAL TRIALS

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Abstract

The goal of this study is to evaluate the effect of pulsed galvanic electro stimulation of high voltage and ultrasound on the healing of induced burn applied on rats.

48 rats (Sprague Dawley), mass between 300g and 400g, age between 3 months and 4 months. These rats are putted and the same experimental conditions of alimentation and hygiene. Rats are divided into 3 groups of 16 rats each. Each rat was induced to a uniform burn of second degree by a specific device fabricated specially to this study.

Group ES undergoes a treatment of electro stimulation by a pulsed galvanic current of high voltage for 10 min daily during 2 weeks.

Group US undergoes a treatment of pulsed ultrasound of 1w/cm² for 2 minutes daily during 2 weeks

Group control GC undergoes placebo treatment.

Measure are done by digital camera, results are analyzed by specific program (AutoCad) on computer.

Wound healing between the three groups are different and statistical tests (T-tests and ANOVA) done between the two groups US and GC show no significant difference in the reduction of the surface of healing between them ($\alpha>0.05$), whereas the comparison between ES group and the two others group was significant ($\alpha<0.05$).

At the end of the second week of treatment, the best healing was presented in ES group where the wound was healed by 61.4 % whereas the groups GC and US were 11.9 % and 14.9 % respectively.
Therefore the ES group have the best results between than others groups (GC and US).

Keywords: Skin healing, burn healing, galvanic electro stimulation, ultrasound,

Introduction

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Methodology:

Our study aims to compare the effect of pulsed galvanic current of high voltage and pulsed ultrasound in the acceleration of wound healing on induced burn on rats.

Hypothesis:

There is no significant difference in the level of wound healing of induced burn between the 3 groups (ultrasound, electro stimulation and control group) during the first and the second week.

Population:

48 rats (16males and 32 females) are selected randomly to this experiment, they have been selected from the lab of AUB (American Lebanese University) of same specie (Sprague Dawley). Their mass vary between 300g and 400g, age between 3 months and 4 months. These rats are putted and the same experimental conditions of alimentation and hygiene. Also the sequence of 12 hours in light and 12 hours in darkness was respected during the experiment.

The 48 Rats are divided into 3 groups of 16 rats each, randomly selected:

- Group ES: 16 rats undergoes a treatment by electrostimulation.
- Group US: 16 rats undergoes a treatment by ultrasound.
- Group CT: 16 rats control group.

Tools:

Dynatron 850 plus

Sonopuls 590

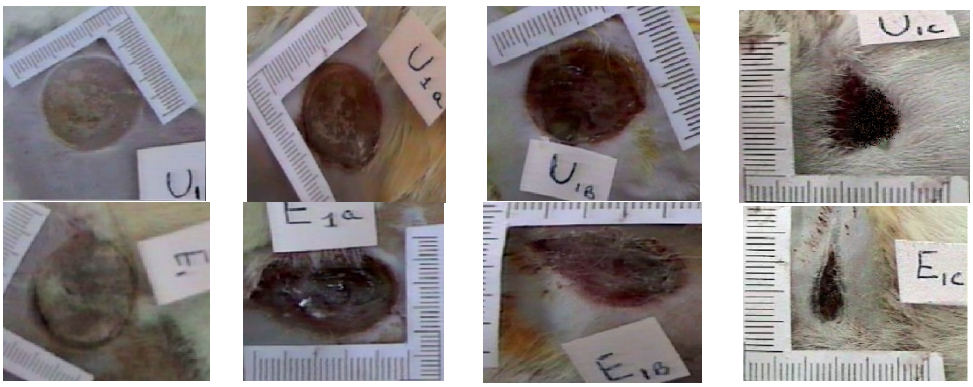
Specific device constructed specially to induce burns

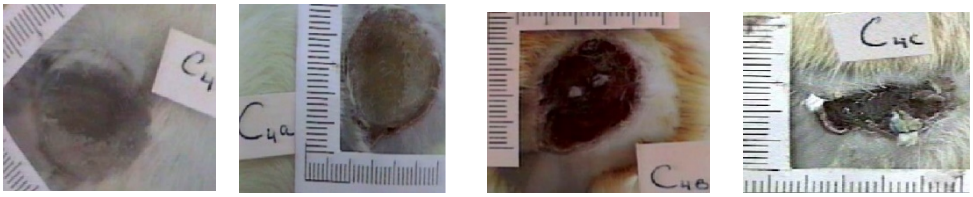
Procedure of burn:

- The 48 rats are anesthetized by Kitamine intra muscular by a Veterinarian, each dose respect to the mass of each rat.
- The lateral part of the hip is well shaved.
- Burn is produced perpendicularly. Temperature 95 degre, time 20 seconds producing a burn of second degree.

Procedure of measure:

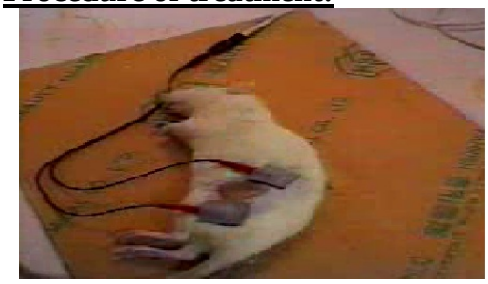
- Photos are taken directly after burn, in day 1, day 8, day 14 and day 21, with a scale to calculate the surface.
- Surfaces are calculated by AUTOCAD.





Figures showing the difference between burns healing in the 3 groups during the 2 weeks.

Procedure of treatment:



Treatment with electro stimulation **Treatment with ultra sound**

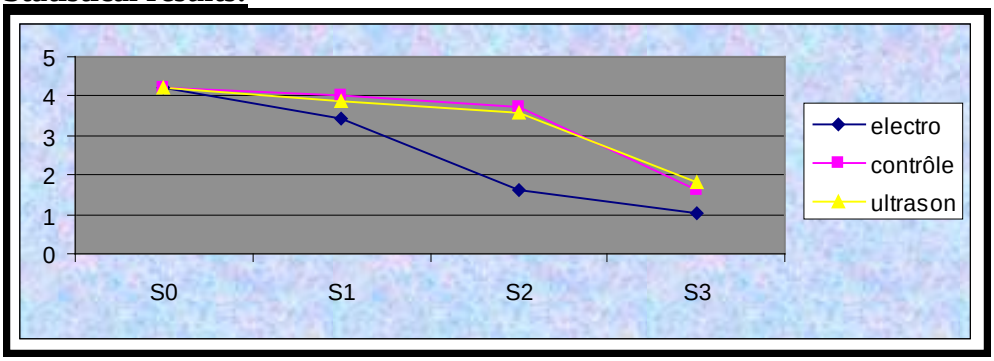
Parameters:

ES group: pulsed galvanic current, high voltage applied 10 min around the burn for 2 weeks.

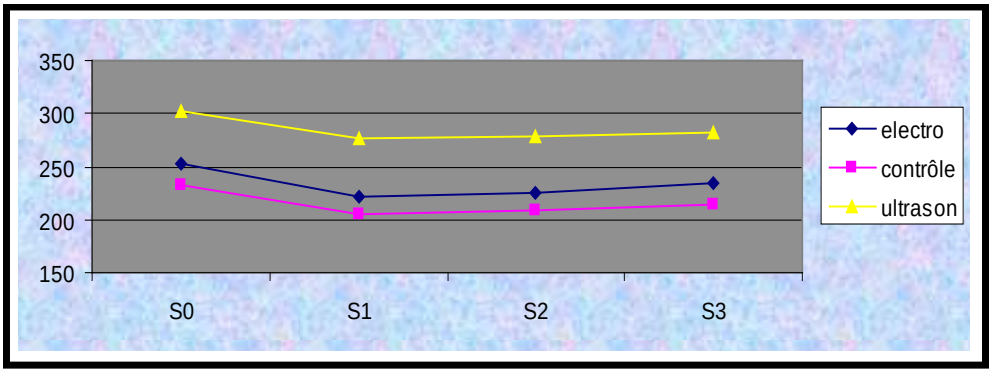
US group: 1 MHz, pulsed 20% , 2 ms , 100 Hz , 1 W/cm², surface of the head 0.5 cm².

There was no treatment applied during the third week.

Statistical results:



Variation of the mean of the surfaces (in cm²) between the 3 groups during the 3 weeks.



Variation of the mean of the mass (in g) between the 3 groups during the 3 weeks.

		Sum of squares	Df	f	P
ES	Between groups	9.332	2	17.203	0.000
	Within groups.	10.566	39		
US	Between groups	21.972	2	70.044	0.000
	Within groups.	7.058	45		
CT	Between groups	33.586	2	75.577	0.000
	Within groups.	9.555	43		

ANOVA between the surfaces of the 3 groups during the 3 weeks

Discussion of the results

Group US did not represented any significant difference in the reduction of the surface of lesion in compare with the control group. The results may be caused by:

- High intensity (1W/Cm²).
- Application of the head around the lesion.
- Frequency 1 MHz.
- Short duration for 2 weeks only.
- Histological effect of ultra sound.

Group electro stimulation present a significant difference in the reduction of the surface of lesion in compare with control group.

- Best result was between week 1 and week 2 .
- Polarity of the wound was negative.
- Direct effect.

Recommendation

- Trying to apply the treatment to patients suffering from burns by galvanic pulsed current at high voltage to reduce surface of lesion.
- Application of 10 minutes was sufficient.
- It is not recommended to use pulsed ultra sound with intensity 1 W/Cm² in the treatment of burn.

Conclusion

The application of pulsed galvanic current of high voltage in the treatment of burn increase the healing process.

The application of pulsed ultra sound in the treatment of burn has no significant effect in the reduction of the surface of lesion.

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BLOOD LIPID DISORDER IN MEN WITH INCREASED WAIST CIRCUMFERENCE COMPARED TO MEN HAVING NORMAL WAIST CIRCUMFERENCE WITHIN THE SAME CATEGORY OF BMI

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Abstract

Background: No local studies have been performed yet to investigate the influence of central or abdominal obesity on serum lipids in men having increased Waist Circumference (WC) compared to men with normal Waist Circumference values within the same BMI (Body Mass Index) category.

Objective:To examine whether the prevalence of dyslipidemia, (defined as Hypercholesterolemia (Total Cholesterol level ≥240 mg/dl), high LDL-C level (≥160 mg/dl), low HDL-C level (<35 mg/dl), or Hypertriglyceridemia (TG level ≥200 mg/dl)), is higher in men having high Waist Circumference compared to others with normal WC values within the same BMI category.

Methods: The study was conducted between September 2013 and July 2014. Eighty-eight overweight men (BMI = 25-29.9) were grouped by WC as follows: 28 with high values (>102 cm) and 60 with normal values (≤ 102cm). Blood samples were drawn and assayed for total cholesterol, triglyceride, HDL-C, and LDL-C,at the department of Laboratory in the Faculty of Public Health, Lebanese University. All assays were performed by enzymatic colorimetric methods using Hitachi-704.

Results: Overweight men with high WC values (according to cutoff points internationally adopted) were the most likely to have dyslipidemia with its subsequent increased health risk compared with those having normal WC values.

Conclusion: we showed in this study that the prevalence of dyslipidemia in men with high WC values is greater compared to those with normal WC values within the same BMI category. This finding leads us to the importance of the incorporated evaluation of WC in addition to the BMI in clinical practice.

Keywords: Waist circumference (WC), waist to hip ratio (WHR), World Health Organization (WHO), cholesterylester transfer protein (CETP).

Introduction

Obesity is defined as an excessive accumulation of energy in the body in the form of fat and can lead to many illnesses. Those are classified using three factors: fats' amount in the body, fats' distribution and presence of other risk factors.

To start with fat distribution, modern medicine uses the "terms central" and "peripheral" to describe the models of obesity(other names might be used such as Apple shaped obesity to describe the central obesity and Pear shaped to describe peripheral obesity). Other criteria like the waist circumference (WC), waist to hip ratio (WHR), CT scans, and magnetic resonance were recently added to estimate the proportion and shape of this

distribution besides the BMI. The two models are different in the pattern of distribution of accumulated fat, and in the adipose modality itself. In central obesity, metabolically active brown adipocytes prevail over while in peripheral obesity less metabolically active white adipocytes form the majority. In addition, many studies have confirmed that there is a direct relation between central obesity and insulin resistance, blood lipid disorders, hypertension, heart disease and atherosclerosis.

There have been several hypotheses which attempted to explain these results noting that some of them are connected with the increased secretion of several Mediators from brown adipocytes (Leptine and TNF) or the increased rate of fat hydrolysis inside the brown abdominal adipocytes to the hyper flow of free fatty acids to the liver. These mediators may cause a decrease in the sensitivity of peripheral tissues to insulin, and the free fatty acids can lead to decrease the hepatic uptake of insulin and decrease hepatic glucose production. It also affects the sensitivity of peripheral tissues to insulin. The sharp decrease in the level of leptin following liposuction operations of accumulated fats in the subcutaneous tissue of the abdominal area supports this interpretation. We should also shed light on the role of some abnormalities in the gene responsible for the formation of β adrenergic receptors located mainly on the surface of the brown adipocytes (abdominal) causing obesity, specifically central obesity.

Table 1: World Health Organization (WHO) classification of obesity according to BMI and WC and associated risks, as shown by the following table:

Class	BMI Kg/m2	Obesity degree	Risk factor (WC)	
			<or=102cm	>102cm
Underweight	<18.5		-	-
Normal	18.5-24.9		-	-
Overweight	25-29.9		increased	High
Obesity	30-34.5	I	high	Very high
	35-39.9	II	Very high	Very high
Severe obesity	>40	III	Extremely high	Extremely high

Assessment of central obesity

1. Measuring waist circumference: at the horizontal level above the upper iliac spine in the thinnest region of the trunk, at the end of normal exhalation when the patient has an empty stomach.

2. Measuring hip circumference: at the horizontal level and in the largest area of the hips and buttocks taking into consideration the ratio (WHR); If> 1 in men then it is a masculine (Android) body fat distribution called central obesity, and according to the WHO classification :

Table 2 WHO classification of the highest level of WC

Highest WC value in men				
	Level 1 (warning level)		Level 2 (indication for intervention)	
	BMI>25	1>WHR≤ 0.95	30≤ BMI	WHR>1
WC	94 cm≤		>102cm	

Studies also suggest that the risk of disease is lower in men with WC than 94 cm compared to others with WC ranges between 94 and 102 cm.

- Pathophysiological disorders of blood lipids in the case of insulin resistance (such as Central obesity):

- Introduction: The cycle of the metabolic obesity is the same in the case of insulin resistance.

IAF → Insulin Resistance ↑ FFA → ↑ Apo B ↑ Hepatic Lipase → ↑ TG ↑Small, dense LDL ↓ HDL

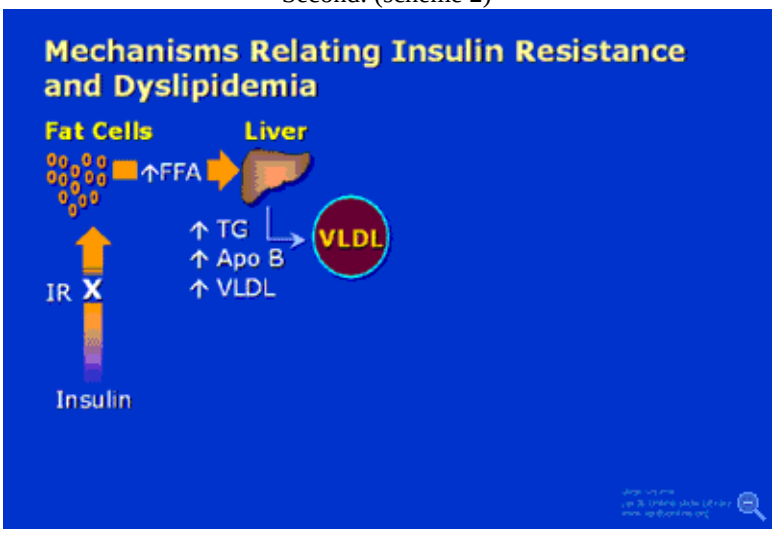
Obesity is considered another form of insulin resistance, such as high blood pressure, high fasting blood sugar, and blood lipid disorders (high triglycerides TG, and the presence of small and dense LDL particles). The excessive lipids in the body have several consequences on health, which are worse and clearer when that fat is accumulated in the abdominal area (Intra-abdominal).

Pathogenesis: shown in the four slides.

First: (scheme 1)

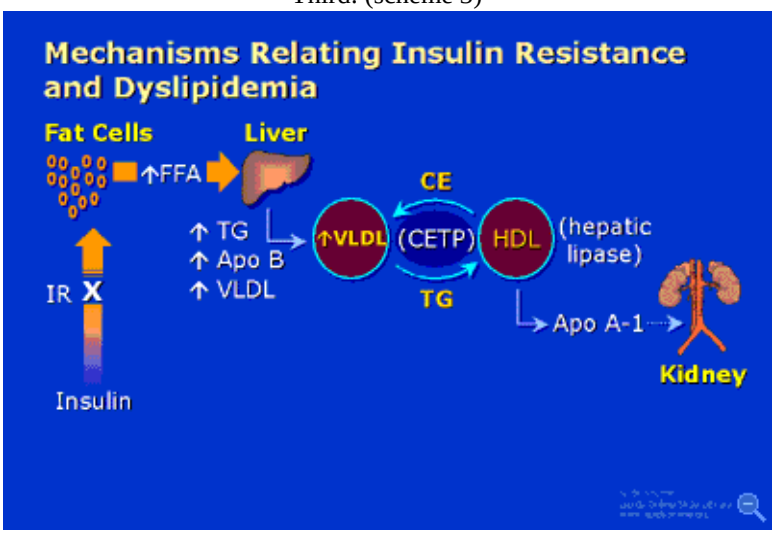
We notice that the insulin resistant adipocytes (especially distributed in the abdominal area) break down its content of triglycerides giving larger amounts of free fatty acids which lead in turn to increase the rate of hepatic uptake, and later converted into TG.

Second: (scheme 2)



The existence of a high level of TG stimulate the production and secretion of Apo-B and VLDL and the result is an increased level of VLDL particles and high levels of plasma TG.

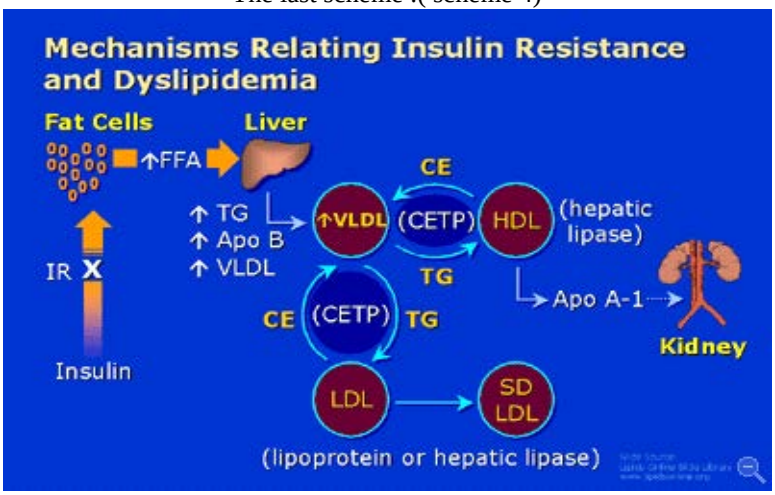
Third: (scheme 3)



The increased level of plasma VLDL with normal levels of Cholesterylester transfer protein (CETP) activates the exchange between TG

of VLDL and the HDL cholesterol, where the molecule of VLDL gets rid of the TG molecule to HDL in exchange with Cholesterylester molecules. This leads to two outcomes: (1) the remnants of VLDL rich in cholesterol predispose to the occurrence of atherosclerosis. (2) HDL molecule rich with TG and poor with cholesterol submit additional TG hydrolysis by liver lipase, leading to its separation from surfactant protein (ApoA-I) so it is filtered faster in the plasma, and one of this filtration has place in the kidneys. This leads to a decline in the proportion of HDL-C and the amount of ApoA-I and the number of particles of HDL.

The last scheme :(scheme 4)



This slide shows a similar phenomenon leading to the formation of small and dense LDL particles and the presence of high levels of TG within the VLDL predispose the transfer of TG to inside the LDL and the exit of cholesterolester out of them (in the presence of CETP). The LDL rich in TG will be exposed later to several hydration reactions by hepatic lipase (HL) or (LPL), leading to the formation of small dense LDL particles poor in cholesterol or fat in general.

Materials & methods

This research was conducted on a sample of 88 overweight men with overweight (25<BMI≤30), apparently being healthy who referred to the medical analyses center in the Faculty of Public Health, Lebanese University, for several chief complaints that do not affect the results, between the month of September 2013 and July of 2014.Results were classified according to waist circumference WC where the number of men with high WC (greater than 102 cm) is 28 men, and the number of men with normal WC (less than or equal to 102 cm) is 60 men described far ahead.

Blood samples withdrawal in dry tubes after a fasting period of at least 12 hours, taking into consideration all the recommendations of the NCEP Adult Treatment Panel III, 2001 then serum analysis for blood sugar, TG, total cholesterol, LDL-C, HDL-C, uric acid, blood urea, creatinine, and albumin. Assays were done by color enzymatic colorimetric assay device (Hitachi 704).

Test	Target		
Total cholesterol	<200mg/dl	200-239	≥240
LDL-C	<130mg/dl	130-159	≥160
HDL-C	>35		
TG	>160	161-200	>200

Table (3) the used criteria (according to the recommendations of the NCEP)

As for the uric acid, urea, albumin, creatinine, we used a special laboratory measurements of the Central sympathy marginal standards.

And the number 102 cm was considered a Cutoff Point for waist circumference knowing that it is considered as high risk if the patient had a higher value.

Results

After collecting the results of the study and dividing them into two groups depending on the measurement of WC, the statistical results appeared as follows:

- Prevalence:

WC	High total cholesterol(≥240mg/dl)	Low HDL-C (<35mg/dl)	High LDL-C (≥160mg/dl)	High TG (≥200mg/dl)
Normal(≤102cm)	17.24%	24.13%	15.5%	24.13%
High risk(>102cm	42.3%	46.15%	38.4%	46.2%

Table (4) the spread of blood lipid disorders rate with the WC

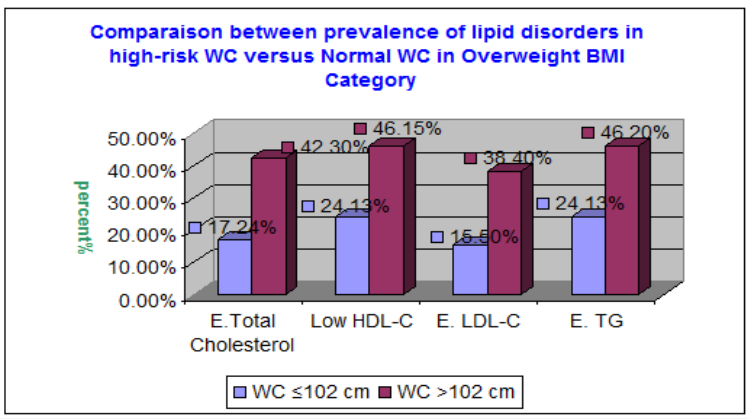


Chart (1) the prevalence of blood lipid disorders in high WC men compared to normal WC in Overweight BMI category

According to the mean value of the results:

WC	Total cholesterol (mg/dl)	HDL-C (mg/dl)	LDL-C (mg/dl)	TG (mg/dl)
Normal (≤102cm)	*41.4±204.73	*10.3±47.25	*39.2±129.24	*67.6±164.49
High risk (<102cm)	*38.8±233.25	*7±41.62	*36.2±152.7	*77.9±212.49

*Mean ± SD

Table (5) changing levels of serological lipids with the WC

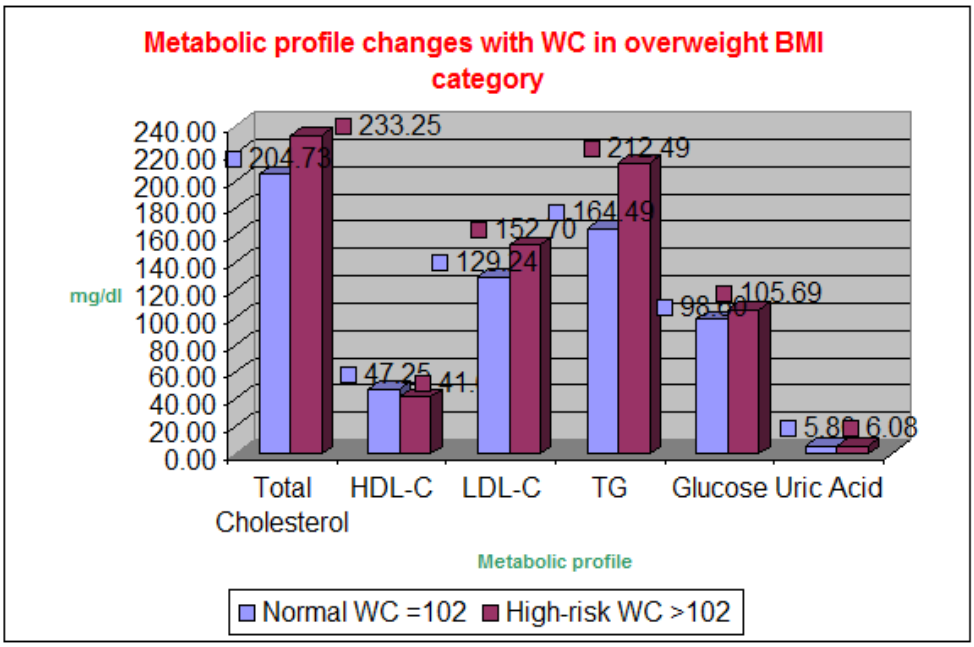


Chart (2) alterations serum lipid levels with the WC.

Interpretation of the results:

The previous two tables show that the prevalence of disorders in blood lipid disorders or Dyslipidemia (known as high blood cholesterol (TC level ≥ 240 mg / dl), high LDL-C serum level (≥160 mg / dl), low serum level HDL-C (<40 mg / dl), or high blood TG (≥240 mg / dl)) were higher in men with waist circumference (WC >102 cm) than in the other category (WC ≤ 102 cm); the average lipid profile was obviously abnormal showing a clear difference in numbers between the two categories.

By applying statistical Paired t-test on the previous results, we have in the table (5) a difference that is considered to be statistically significant in lipid serological levels between the two groups: total cholesterol was P = 0.0001, the HDL- C was P = 0.0197, the LDL-C was P = 0.0002, the TG was P = 0.039.

This indicates that the risk is higher in people with central obesity (i.e., waist circumference is greater by 102 cm) than the other group (i.e.,

waist circumference is less or equal to 102 cm) recording the obvious difference and meaningful numbers in serum levels of lipids and lipoproteins.

Comparison studies

A large study conducted by the endocrinology and metabolism department of faculties of medicine and health and physical education at Queen's University, Ontario, Canada, and published in 2002.

Results of the study:

	BMI	
	Overweight category	
	WC normal (n=2230)	WC high (n=851)
The average serology values		
Total cholesterol (mg/dl)	*40±203.3	*42.7±213.7
(LDL-C (mg/dl	*34.6±130.5	*36.2±138.5
(HDL-C (mg/dl	*12.9±44.9	*11.2±42.0
TG (mg/dl)	*108±155.4	*124.8±194.5
% ,Prevalence		
total high cholesterol	17.2	26.2
LDL-C high	19.3	27.2
HDL-C low	35.5	49
TG high	21.7	36.3

Table (6): comparison of metabolic variables and the prevalence of blood lipid disorders among men with normal WC vs. WC in the Overweight BMI Category

Discussion of the study results and comparing them to the results obtained:

The findings of the universal study carried out by a large number of men and women have shown that people with central obesity among the three categories of the BMI ratio were diagnosed with high blood pressure, diabetes type II, and blood lipid profile disorders higher compared to normal numbers for WC. The differences between the serum levels of lipids and lipoproteins between the two categories of the WC were clear, where the P Value was less than 0.05. Comparing these results to the results of our study, we found that the numbers we have obtained regarding the category Overweight BMI was convergent with those of the universal study.

Conclusion and Recommendations

Previous study concluded that central obesity has an important and independent role in the growing proportion of the health risks such as blood lipid disorder regardless of the degree of obesity.

And as a result of this research, the National Institutes of Health are recommended with the following:

1. Assess central obesity by measurement of waist circumference WC along with BMI and consider it as an Independent High-risk Factor.
2. Use Cutoff Points adopted by the NIH (National Institutes of Health).
3. Preserve a normal WC and try to have an optimal one to avoid all the health risks associated with abdominal obesity and exercise regularly knowing that it has an important role in getting rid of abdominal obesity.

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THE ROLE OF SOME OBESITY-RELATED BIOCHEMICAL PARAMETERS IN THE INCIDENCE, DIAGNOSIS, AND PROGNOSIS OF POSTMENOPAUSAL BREAST CANCER

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Abstract

Aim: To figure out the association of insulin resistance, serum resistin, insulin, SHBG, and free estradiol with the etiology, diagnosis, and the prognosis of postmenopausal breast cancer. **Subjects and Methods:** Serum levels of resistin, insulin, SHBG, free E2, glucose, and albumin were assayed in a case-control study of 40 obese postmenopausal breast cancer females and 40 apparently healthy obese postmenopausal controls. **Results:** Serum levels of resistin, insulin, and free E2 were significantly elevated in breast cancer patients (9.89±0.49, 23.68±2.95 and 9.34±3.02, respectively) compared with controls (8.24±0.63, 13.55±1.31 and 1.01±0.23, respectively). Insulin resistance (IR) was significantly greater in breast cancer patients (7.33±0.95) than controls (3.46±0.37). However, serum SHBG levels were significantly declined in breast cancer patients (42.93± 2.52) compared with controls (64.2±4.89). Serum free E2 had the greatest significant area under the ROC curve, followed by insulin resistance, insulin, SHBG, and resistin. The odds ratio of serum resistin was 4.33 (95% CI=1.69 – 11.06, P=0.002), insulin was 3.66 (95% CI=1.41 – 9.46, P=0.006), insulin resistance was 3.56 (95% CI=1.39 – 9.08, P=0.007), SHBG was 0.25 (95% CI=0.092-0.67, P=0.005), and free E2 was 5.21(95% CI=1.86 –14.52, P=0.002) in breast cancer patients. **CONCLUSIONS:** From this study, it

could be concluded that although insulin resistance, serum resistin, insulin, SHBG, and free E2 may have a role in the incidence and diagnosis of obese postmenopausal breast cancer females, these biochemical parameters cannot be used for the prognosis of these patients. Serum free E2 was the most superior diagnostic marker followed by insulin resistance, insulin, SHBG, and resistin.

Keywords: Breast cancer, resistin, insulin, insulin resistance, SHBG, free estradiol, incidence, diagnosis, prognosis

Introduction

Breast cancer is the most frequently diagnosed cancer and the leading cause of cancer death among females worldwide. [1] In Alexandria (Egypt) 2010, it accounted for about 47 % of all malignancies in females. Obesity is a worldwide epidemical that continues to grow at an alarming rate. [2] Moreover, obesity has been associated with the development of several malignancies, particularly hormone-dependent cancers such as ovarian, endometrial, and breast cancer. [3]

In addition, Adipose tissue has been recognized as an endocrine organ that plays a pivotal role in insulin resistance and glucose homeostasis by secreting signaling molecules known as adipocytokines such as resistin. The exact role of adipocytokines in glucose metabolism and their physiological functions in humans remains under investigation. However, adipocytokines which is directly synthesized in adipose tissue may influence mammary tumorigenesis by impacting both circulating and locally produced levels of the estrogen. [4] Resistin gained interest in correlation with cancer, and was strongly associated with tumors of gastrointestinal system and hematological system. [5]

Although insulin is involved primarily in the regulation of carbohydrates, lipids, and proteins metabolism, it also has a significant role as a growth factor. Thus, it stimulates cell mitosis and migration, and also inhibits apoptosis. These effects may actually be increased under conditions of insulin resistance and consequent impairment of insulin-regulated metabolic pathways. [6] Some studies have also demonstrated that elevated insulin levels and hyperinsulinemia are associated with poor prognosis in patients with breast cancer. Consequently, insulin resistance and alterations in levels of adipocytokines are associated with an increased risk of developing pre and postmenopausal breast cancer. [7]

SHBG has been found to function as an active regulator of the steroid-signaling system in target tissues. In breast cancer cells, SHBG through its specific membrane receptor (SHBG-R) and second messenger system (cyclic AMP and protein kinase A), has not only effectively inhibits

estradiol induced cell proliferation, but also controls progesterone receptor expression at both the mRNA and protein levels. In addition, it has influences its function. [8]

Estradiol has been tied to the development and progression of breast cancer, ovarian cancer, and endometrial cancer. Estradiol affects target tissues by interacting with two nuclear hormone receptors called estrogen receptor α (ERα) and estrogen receptor β (ERβ). One of the functions of these estrogen receptors is gene expression. Once the hormone binds to the estrogen receptors, the hormone-receptor complexes then binds to specific DNA sequences causing an increase in cell division and DNA replication. [9] However, this study was carried out to investigate the role of serum resistin, insulin, insulin resistance, SHBG, and free estradiol in the incidence, diagnosis, and prognosis of breast cancer in postmenopausal females.

Subjects and Methods

Subjects

Eighty postmenopausal obese females were enrolled in this case-control study. Females were divided into two groups: **Group I (Obese control group)** included 40 apparently healthy obese women clinically free from any disease. Thus, their mean age and BMI were 58.43±1.13 years and 35±1.2 kg/m2, respectively. They were chosen from the staff members of the Medical Research Institute of Alexandria University (Egypt) and their relatives. **Group II (Obese patient group)** included 40 obese females having breast carcinoma of clinical stage II or III (10]. However, their mean age and BMI were 56.13±1.26 years and 36±1.5 kg/m2, respectively.

This study was approved by the Ethical committee of the Medical Research Institute, Alexandria University, Egypt. Thus, informed consent was signed by each subject. All subjects were recruited from the Experimental and Clinical Surgery, and the Cancer Management and Research Departments, Medical Research Institute, University of Alexandria within the period from June 2011 to October 2011. Consequently, all patients had primary invasive breast carcinoma, with no clinical manifestation of infection, not receiving immunomodulating agent or blood transfusion for 3 weeks recently. Also, all patients and controls with diabetes, hypertension, hormone replacement therapy, and hypo or hyper-thyrodism were excluded from this study.

Methods

To all patients, the following investigations were done: full history recording, thorough clinical examination, routine laboratory investigations including complete blood count, bleeding and coagulation times, mammography of breast and ultrasonography of abdomen, radiological

investigations including x-ray chest, CT scan and bone scan when needed, and preoperative fine needle-aspiration cytology (FNAC) of the breast mass to establish the pathological diagnosis.

All patients had undergone modified radical mastectomy [11]. The clinicopathological data of tumor size, pathological grade, estrogen receptor (ER) status, progesterone receptor (PR) status, Her-2 expression, axillary lymph node involvement, and vascular invasion were collected from patients' data sheets. Each patient's clinical stage was determined by the oncologist according to the TNM staging system [12] [table I].

After modified radical mastectomy, all breast cancer patients received adjuvant combination chemotherapy (5-fluorouracil, adriamycin and cyclophosphamide [FAC]) [13] for six cycles. The patients were evaluated clinically in the laboratory, and radiologically after three and six cycles of chemotherapy to estimate the clinical response. They were followed up for 45 months of assessment of disease-free survival based on observation metastasis or local recurrence.

Table (I). The clinicopathological data of breast cancer patients.

Clinicopathological data		Number (n)	Percent (%)
Tumor Size (cm)	≤5	30	75%
	>5	10	25%
Patient's clinical Stage	II	22	55%
	III	18	45%
Tumor pathological grade	II	27	67.5%
	III	13	32.5%
Estrogen receptor status (ER)	-ve	3	7.5%
	+ve	37	92.5%
Progesterone receptor status (PR)	-ve	10	25%
	+ve	30	75%
Her-2 expression	-ve	40	100%
	+ve	0	0%
Axillary lymph node involvement	-ve	4	10%
	+ve	36	90%
Vascular invasion	-ve	7	17.5%
	+ve	33	82.5%

n: number of cases

Laboratory Assays

In the morning, 5 ml fasting venous blood samples were withdrawn from each subject participating in this study. Blood samples were allowed to clot for 30 minutes, and was centrifuged at 3000 rpm for 10 minutes to isolate serum. 10µl of serum were immediately used for assaying fasting glucose levels. The remaining serum was divided into aliquots and stored at -80^{o}C until it was used for measuring the levels of resistin, insulin, SHBG, albumin, and total E2. Therefore,

all of these laboratory investigations were carried out at the radiation sciences department, Medical Research Institute, Alexandria University, Egypt.

Determination of Serum Resistin Levels

Levels of resistin were determined using a ready-for-use enzyme-linked immunosorbent assay (ELISA) kit according to the manufacturer's protocol (BioVender, USA). Briefly, standards, quality controls, and samples were incubated in microplate wells pre-coated with polyclonal anti-human resistin antibody. After 60 minutes incubation and washing, biotin-labelled second polyclonal anti-human resistin antibody was added. After 60 minutes incubation and washing, streptavidin-HRP conjugate was added. Also, after 60 minutes incubation and washing, the substrate solution (TMB) was added. The reaction was stopped by the addition of acidic solution, and the absorbance of the resulting yellow product was measured at 450 nm. Serum resistin concentrations (ng/ml) were determined by referring to a standard curve.

Determination of Serum Fasting Glucose Levels

Levels of serum glucose (mg/dl) were determined using a ready-for-use colorimetric kit according to the manufacturer's protocol (Spinreact, Spain). Briefly, glucose is oxidized in the presence of glucose oxidase. The hydrogen peroxide formed reacts under catalysis of peroxidase with phenol and 4 – amino phenazone giving a red-violet quinoneimine dye. The intensity of the color is directly proportional to the glucose concentration in the samples. The absorbance of the sample and the standard were measured against the blank at 546 nm.

Determination of Serum Fasting Insulin Levels

Serum insulin levels were determined using a ready-for-use immunoradiometric assay (IRMA) kit according to the manufacturer's protocol (Izotop, Hangerian). Briefly, the 125I-labeled signal-antibody binds to an epitope of the insulin molecule spatially different from that recognized by the biotin capture-antibody. The two antibodies react simultaneously with the antigen present in standards or samples, leading to the formation of a capture antibody-antigen-signal antibody complex, also referred to as “sandwich”. During a 2-hour incubation period, immuno-complex is immobilized to the reactive surface of streptavidin-coated test tubes. Reaction mixture is then discarded, test tubes washed, and radioactivity is measured for 1 minute in a gamma counter (perkin Elmer, Finland). Thus, the concentration of antigen is directly proportional to the radioactivity measured in test tubes. By constructing a calibration curve, the unknown serum concentrations of insulin (μIU/ml) were determined.

Evaluation of Insulin Resistance Status

Serum fasting insulin levels together with serum fasting glucose levels were grouped into the homeostatic model assessment (HOMA) index to estimate insulin resistance status as follows:

HOMA-IR = [Fasting insulin (μIU/ml) x fasting glucose (mg/dl)] / 405 [14]

Determination of Serum SHBG Levels

Serum SHBG levels were determined using a ready-for-use IRMA kit according to the manufacturer's protocol (Izotop, Hangerian). The principle of the method was identical to that of insulin. By constructing a calibration curve, the unknown serum concentrations of SHBG (nmol/L) were determined.

Determination of Serum Albumin Levels

Serum albumin levels (g/dl) were determined using a ready-for-use colorimetric kit according to the manufacturer's protocol (Diamond, Egypt). Briefly, albumin, in the presence of bromeresol green at a slightly acidic pH, produces a color change from yellow-green to green. The intensity of the color formed is directly proportional to the albumin concentration in the samples. The absorbance of the sample was measured against reagent blank at 630 nm.

Determination of Serum Total Estradiol Levels

The levels of serum total E2 were determined using a ready-for-use radioimmunoassay (RIA) kit according to the manufacturer's protocol (Siemens, Germany). Briefly, 125I-labeled estradiol competes with estradiol in the sample for antibody molecules coated on the tube wall. After incubation, separation of bound from free radioactivity was achieved by decantation. The tube was then counted for 1 minute in a gamma counter (perkin Elmer, Finland). In addition, the levels (pg/ml) of total estradiol in the samples were determined by interpretation from a calibration curve.

Quantification of Serum Free Estradiol Levels

Serum free E2 levels were estimated using an equation based on the law of mass action. This is dependent on the total E2 concentration and the fraction of E2 bound to albumin and SHBG according to the following equation [15]:

$$E2 = [E2_F]\left(1 + K_E^A[A] + \frac{K_E^{SH}[SH]}{1 + K_E^{SH}[E2_F]}\right), \qquad (1.1)$$

Where [*E*2] is total E2 concentration, [*E*2*F*] is free E2 concentration, [*SH*] is SHBG concentration, [*A*] is albumin concentration, and *KE A* and *KE SH* are association constants for the binding of E2 to albumin and SHBG, respectively. Furthermore, we assumed the following values for the association constants: KE A = 6 x104 and KESH = 0.68 x 109. Then, we substituted it into equation 1.1. Serum free E2 levels were found by substitution in equation 1.1.

Statistical Analysis

Statistical analysis was performed using SPSS 11.5 software package. Quantitative data were represented as mean and standard error. The data were abnormally distributed. Thus, non-parametric tests were used. The non-parametric Mann-Whitney U-test was used for studying differences between obese control group and obese breast cancer group regarding serum resistin, insulin, insulin resistance, SHBG, and free estradiol. The non-parametric Spearman's correlation test was used for correlating studied serum parameters concentrations with clinicopathological data. In addition, the odd's ratio was used to determine whether the serum marker is risky or protective for breast cancer. The diagnostic value of serum resistin, insulin, insulin resistance, SHBG, and free estradiol were compared using the Receiver Operating Characteristic (ROC) curve analysis. The Kaplan-Meier disease-free survival curve was applied to study the role of each preoperative serum biomarker to predict the disease-free survival of breast cancer patients. Therefore, P-value < 0.05 was considered to be statistically significant.

Results

Anthropometric Measurements of Breast Cancer Patients and Controls

For the control group, the mean±SE age was 58.43±1.13 years, and the mean±SE BMI was 35±1.2 kg/m2. For the breast cancer group, the mean±SE age was 56.13±1.26 years, while the BMI was 36±1.5 kg/m2. Because the cases and controls were frequency matched for age and BMI, there was no significant difference in the distribution of age and BMI between cases and controls.

Serum Levels of Assayed Biochemical Parameters in Breast Cancer Patients and Controls

As shown in table II, the serum levels of resistin, insulin, and free E2 were significantly elevated in breast cancer patients (9.89±0.49, 23.68±2.95, 9.34±3.02, respectively) compared with controls (8.24±0.63, 13.55±1.31, 1.01±0.23, respectively). Insulin resistance (IR) was significantly greater in breast cancer patients (7.33±0.95) than in controls (3.46±0.37). However,

serum SHBG levels were significantly declined in breast cancer patients (42.93± 2.52) compared with controls (64.2±4.89).

Table (II). Mean±SE levels of assayed serum biochemical parameters in cases and controls.

Biochemical parameter	control group (n=40)	Breast cancer group (n=40)	P-value
Resistin (ng/ml)	**8.24±0.63**	**9.89±0.49**	**0.02***
Insulin (μIU/ml)	**13.55±1.31**	**23.68±2.95**	**0.003***
(HOMA-IR)	**3.46±0.37**	**7.33±0.95**	**0.001***
SHBG (nmol/L)	**64.20±4.89**	**42.93±2.52**	**0.003***
Free E2 (pg/ml)	**1.01±0.23**	**9.34±3.02**	**0.001***

SE: Standard Error n: Sample Size

*: Significance was compared with control group

Significance was considered at p-value <0.05

The Receiver Operating Characteristic (ROC) Curve Analysis for comparing the Diagnostic Value of the Assayed Biochemical Parameters among Breast Cancer Patients

The ROC curve analysis was used in the present study to evaluate and compare the diagnostic value of insulin resistance, serum resistin, insulin, SHBG, and free E2 depending on the area under the ROC curve (AUC). Consequently, the higher AUC corresponds to a better diagnostic test. As shown in table III and figures (1-3), serum free E2 showed a significant AUC (71.3%) (p=0.001), with sensitivity (60%) and specificity (82%) at a cut-off value (1.07pg/ml). Insulin resistance showed a significant AUC (70.8%) (p=0.001), with sensitivity (55%) and specificity (80%) at a cut-off value (4.9). Serum insulin showed a significant AUC (69.5%) (p=0.003), with sensitivity (55%) and specificity (75%) at a cut-off value (16.5 μIU /ml). Serum SHBG showed a significant AUC (69.2%) (p=0.003), with sensitivity (52.5%) and specificity (80%) at a cut-off value (56.55nmol /L). Serum resistin showed a significant AUC (65.1%) (p=0.02), with sensitivity (72.5%) and specificity (65%) at a cut-off value (8.35ng/ml).

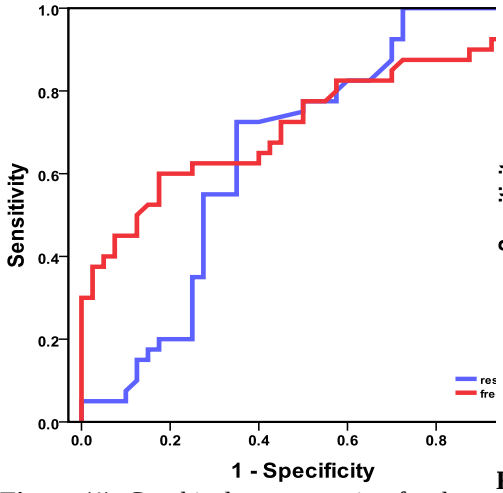

Figure (1). Graphical representation for the ROC curves of serum resistin and free E2.

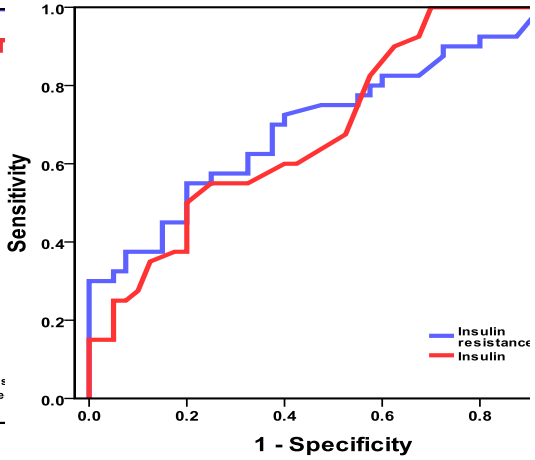

Figure (2). Graphical representation for the ROC curves of serum insulin and insulin resistance.

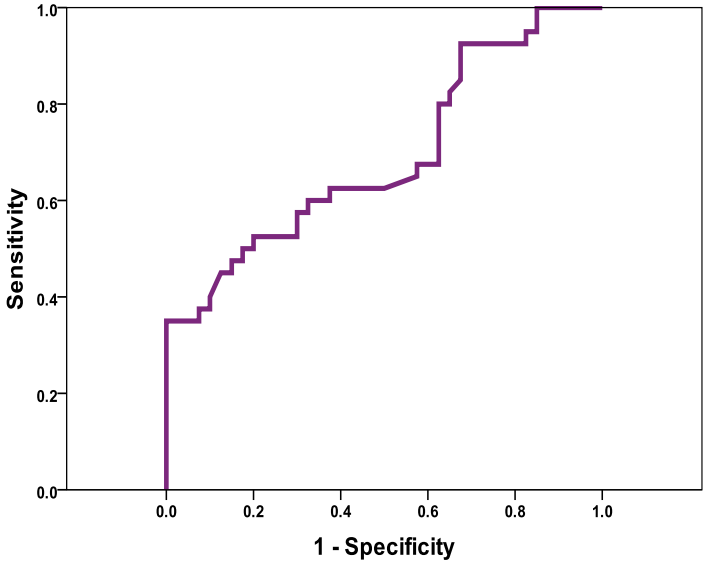

Figure (3). Graphical representation for the ROC curve of serum SHBG.

Table (III). The ROC curve-based characteristics for resistin, insulin, insulin resistance, SHBG, and free E2 in breast cancer group.

Serum biochemical parameter	AUC	p-value	Cut-off Value	Sensitivity %	Specificity %
Free E2 (pg/ml)	71.3	0.001*	1.07	60	82
Insulin resistance	70.8	0.001*	4.9	55	80
Insulin (µIU/ml)	69.5	0.003*	16.5	55	75
SHBG (nmol/L)	69.2	0.003*	56.55	52.5	80
Resistin (ng/ml)	65.1	0.02*	8.35	72.5	65

AUC: Area under the ROC curve *: Significance was considered at p-value <0.05

Correlation between the Studied Biochemical Parameters and Clinicopathological Data of Breast Cancer Patients before Surgery

None of the assayed biochemical parameters showed a significant correlation with any of the clinicopathological data of breast cancer patients (all P values >0.05).

The Association of Insulin Resistance, Serum Resistin, Insulin, SHBG, and Free Estradiol with Risk of Breast Cancer Incidence

According to table (IV), the odds ratio of serum resistin was 4.33 (95% CI=1.69 – 11.06, P=0.002), insulin was 3.66 (95% CI=1.41 – 9.46, P=0.006), insulin resistance was 3.56 (95% CI=1.39 – 9.08, P=0.007), SHBG was 0.25 (95% CI=0.092-0.67, P=0.005), and free E2 was 5.21(95% CI=1.86 – 14.52, P=0.002) in breast cancer patients.

Table (IV). The association of insulin resistance, serum resistin, insulin, SHBG, and free estradiol with risk of breast cancer incidence.

Biochemical parameter		Breast cancer group (n=40)	Control group (n=40)	Odds ratio (OR)	95% CI	p-value
Resistin (ng/ml)	< 8.35 ®	12	26	4.33	1.69 – 11.06	P=0.002 *
	≥ 8.35	28	14			
Insulin (µIU/ml)	< 16.5®	19	33	3.66	1.41 – 9.46	P= 0.006*
	≥ 16.5	21	7			
Insulin resistance	< 4.9®	17	29	3.56	1.39 – 9.08	P=0.007*
	≥ 4.9	23	11			
SHBG (nmol/L)	< 56.55	8	20	0.25	0.092 - 0.67	P=0.005*
	≥ 56.55®	32	20			
Free E2 (pg/ml)	< 1.07 ®	19	33	5.21	1.86 – 14.52	P=0.002 *
	≥ 1.07	21	7			

n= Sample Size; ® reference group; CI: Confidence Interval; *: Significance was considered at p-value<0.05.

Correlation between the Studied Biochemical Parameters and Disease-free Survival of Breast Cancer Patients before Surgery

In the present study, patients were followed up for 45 months after completing 6 cycles of chemotherapy to study the correlation of the assayed biochemical parameters and patients disease–free survival (DFS) based on observation of any metastasis or local recurrence. To study this correlation, the Kaplan-Meir disease-free survival (DFS) curves were constructed. As shown in Figures (4-8), Kaplan-Meir survival curves for breast cancer patients before surgery, revealed that the DFS of patients with elevated insulin resistance, serum resistin, insulin, and free E2 were non-significantly different from those with low levels of these biomarkers (P= 0.118, 0.872, 0.379 and 0.652, respectively). Also, the DFS of patients with low serum SHBG before surgery was non-significantly different from those with high levels of SHBG (P=0.389) (Table V).

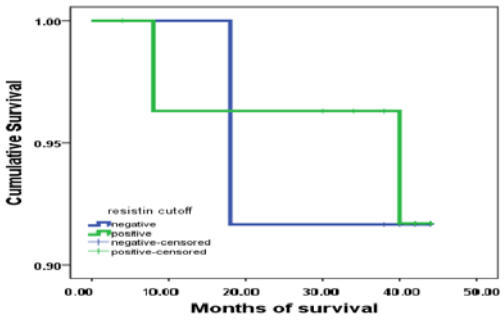

Figure (4). Kaplan- Meier DFS of breast cancer patients in relation to preoperative serum resistin levels.

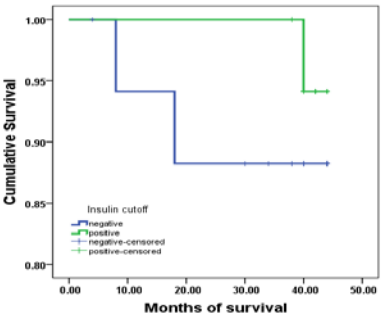

Figure (5). Kaplan- Meier DFS of breast cancer patients in relation to preoperative serum insulin levels.

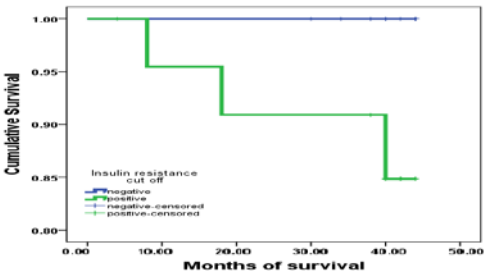

Figure (6). Kaplan- Meier DFS of breast cancer patients in relation to preoperative insulin resistance**.**

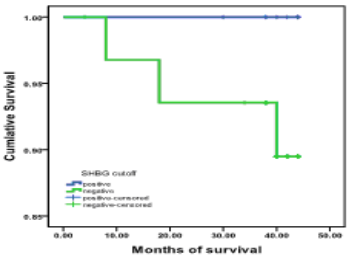

Figure (7). Kaplan- Meier DFS of breast cancer patients in relation to preoperative serum SHBG levels.

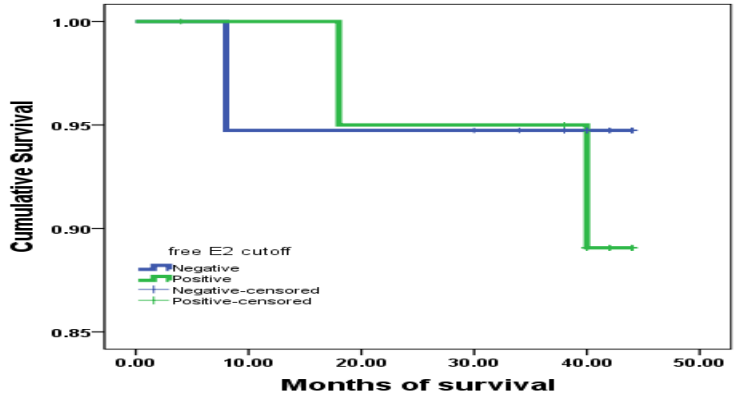

Figure (8). Kaplan- Meier DFS of breast cancer group in relation to preoperative serum free E2 levels.

Table (V). Correlation between preoperative insulin resistance, serum resistin, insulin, SHBG, and free E2 with DFS of breast cancer patients.

Biochemical parameters	Cut-off value	n	Metastasis		Non-metastasis		DFS (M± SE)	P-value
			No.	%	No.	%		
Resistin (ng/ml))	< 8.35 (-ve)	12	1	8.3	11	91.7	40.9±1.04	0.872
	≥ 8.35 (+ve)	28	2	7.1	26	92.9	41.24±0.66	
Insulin (µIU/ml)	<16.5 (-ve)	18	2	11.1	16	88.9	40.2±1.2	0.379
	≥16.5 (+ve)	22	1	4.5	21	95.5	41.9±0.1	
Insulin resistance	< 4.9 (-ve)	17	0	0	17	100	41.14±0.6	0.118
	≥ 4.9 (+ve)	23	3	13	20	87	40.05±0.22	
SHBG (nmol/L)	≥ 56.55 (-ve)	32	3	9.4	29	90.6	41.137±0.556	0.389
	< 56.55 (+ve)	8	0	0	8	100	40.047±0.95	
Free E2 (pg/ml)	< 1.07 (-ve)	19	1	5.3	18	94.7	41.05±0.9	0.652
	≥ 1.07 (+ve)	21	2	9.5	19	90.5	42.23±0.63	

DFS=Disease-free survival
n=Sample size
Significance was considered at p-value <0.05
M± SE: Mean± standard error

Discussion

Since the relationship of obesity with several forms of cancer has been known for a long time, researchers were trying to discuss the possible

role of adipocytokines in the regulation of carcinogenesis as another link between obesity and cancer. Resistin, an adipocytokine, recently gained interest in correlation with cancer and was strongly associated with tumors of gastrointestinal system and hematological system [16].

In the present study, there was a significant elevation in resistin levels in breast cancer patients compared to apparently normal controls. Our results were in agreement with Dalamaga et al [17] who found that hyperresistinemia is involved in the development of postmenopausal breast cancer. Also, it reflects changes during postmenopausal breast cancer progression and therefore could be used as a biomarker for postmenopausal breast cancer.

Consequently, resistin inhibition could be used as an effective therapeutic strategy in breast cancer. On the other hand, our results disagreed with Gaudet et al [18], who found non-significant difference between breast cancer patients and normal controls regarding serum resistin.

In the present study, serum resistin showed a significant odd's ratio of 4.33 (95% CI=1.69 – 11.06) which indicated that postmenopausal breast cancer females with serum resistin ≥ 8.35 ng/ml have 4 fold increased risk of getting breast cancer compared with those who have serum resistin < 8.35 ng/ml. Our results were in agreement with Dalamaga et al [17]. Di-Simone et al [19] found that resistin enhanced matrix metal-oproteinase 2 (MMP-2) mRNA expression and protein synthesis, significantly reduced TIMP-1 and TIMP-2 synthesis, and it increased trophoblast-like cell invasiveness. Additionally, resistin induced the production of vascular endothelium growth factor (VEGF), and stimulated the formation of endothelial cell tube *in vitro*. On the other hand, our results disagreed with that of Gaudet et al [18].

Because a previous study revealed that resistin is expressed not only from adipose tissue but also from monocytes and macrophages, and is correlated with C-reactive protein, soluble TNF-α, and IL-6 directly, the role of resistin as a marker of inflammation has received growing interest [20]. Chronic inflammation is known to be one of the causes of cancer development. Thus, the correlation between plasma resistin levels and breast cancer risk might be partly explained by inflammation [21]. These findings may strengthen and explain the risky role of resistin in carcinogenesis and progression of breast cancer. In view of this study, we can speculate that decreasing serum resistin levels may represent a therapeutic option for the reduction of breast cancer risk. This can be done via obesity control, increasing physical activity, and pharmacological intervention.

High insulin levels were most common in overweight women. Hyperinsulinemia induces proliferative tissue abnormalities because of the strong anabolic effect of insulin, which stimulates DNA synthesis and cell proliferation [22]. In the present study, serum insulin levels were

significantly elevated in breast cancer patients compared with apparently normal controls. Therefore, at the same time, serum insulin showed a significant odd's ratio of 3.66 (95% CI=1.41 – 9.46), which indicated that postmenopausal breast cancer females with serum insulin levels ≥16.5 µIU/ml have about 4 fold increased risk of having breast cancer compared with those who have serum insulin levels < 16.5 µIU/ml. Our results were in agreement with Chowdhury [23] who reported the involvement of high insulin levels in the promotional stage of breast tumorigenesis and progression to express the metastatic phenotype, rather than the initiation and neoplastic transformation of the breast epithelial cell. On the other hand, our results disagreed with Autier et al [24], who found non-significant difference between breast cancer patients and controls regarding serum insulin levels.

Insulin resistance is one of the most pronounced metabolic changes associated with obesity. Although insulin is most widely known for its metabolic effects, studies showing that insulin has mitogenic effects on both normal and malignant breast tissue provided the biologic basis for an association of hyperinsulinemia with breast cancer [7]. In the current study, we estimated insulin resistance status in both patients and controls using the homeostatic model assessment (HOMA) method [25]. The results showed that there was a significant increase in insulin resistance in breast cancer patients compared to apparently normal controls. Also, insulin resistance showed a significant odd's ratio of 3.56 (95% CI=1.39 – 9.08), which indicated that postmenopausal breast cancer females with insulin resistance ≥ 4.9 have about 4 fold increased risk of having breast cancer compared with those who have serum insulin resistance < 4.9. Our results confirmed the results of Al Awadhi et al [7] and Formica et al [26]. *Therefore, they found that* insulin resistance has causative and prognostic role in breast cancer development and progression in postmenopausal patients.

However, because obesity is often complicated with hyperinsulinemia and insulin could stimulate cellular mitosis, insulin resistance probably might be one of the mechanisms underlying the relationship between obesity and breast cancer risk. Various explanations have been proposed for the association of insulin and insulin resistance with breast cancer incidence in obese postmenopausal females as follows: **(a)** Chronic hyperinsulinemia in affected individuals may promote cancer as insulin can exert its oncogenic potential via abnormal stimulation of multiple cellular signaling cascades, enhancing growth factor-dependant cell proliferations, and /or by directly affecting cell metabolism. **(b)** Insulin increases bioactivity of IGF-1 by enhancing hepatic IGF-1 synthesis and by reducing hepatic protein production of the insulin–like growth factor binding protein-1(IGFB-P-1) and 2(IGFB-P-2) [27]. Therefore, although insulin can directly induce tumor growth, many of its mitogenic and antiapoptotic

effects are operating through the IGF-1 system as reported in individuals with high levels of circulating IGF-1, in which an increased risk of developing certain types of tumors, in particular breast cancer, has been documented [28]. **(c)** Insulin, by reducing SHBG levels, exerts a positive effect on estrogen bioavailability, therefore increasing the risk of breast cancer. **(d)** obesity, the most common cause of insulin resistance, is increasingly recognized as a low grade inflammatory state in which overproduction of certain molecules such as free fatty acids, IL6, adiponectin, TNF-α, plasminogen activator inhibitor-1, and monocyte chemoattractant protein (MCP-1) can play a role in malignant transformation and /or cancer progression. In this context, chronic hyperglycemia and increased oxidative stress may also contribute to increased cancer risk. However, these lines of evidence support the concept that a relationship exists between insulin resistance and cancer.

The s**ex hormone-binding globulin** (SHBG) **transport**s androgens and estradiol in blood and modulates their bioavailable fraction and access to target cells. Also, SHBG directly regulates the incidence of breast tissue [29]. In the current study, there was a significant decline in SHBG levels in breast cancer patients compared with apparently normal controls. Thus, serum SHBG showed a significant odd's ratio of 0.25 (95% CI=0.092- 0.67), which indicated that postmenopausal breast cancer females with serum SHBG levels < 56.55 nmol/ml have about 4 fold increased risk of having breast cancer compared with those who have serum SHBG levels ≥ 56.55 nmol/ml. Our results were in agreement with that of Woolcott et al [30].

The reduced levels of SHBG recorded in the current study is assumed to be due to higher circulating insulin concentration detected in obese breast cancer subjects, as basal secretion of SHBG by cultured human hepatoma cell line (HePG2) was greatly reduced by the physiological concentration of insulin [31]. Previous studies showed that *in vivo* diazoxide treatment, resulting in decreased insulin levels, produced a significant increase in SHBG [32]. Therefore, these intervention studies suggested that insulin negatively regulates hepatic production of SHBG.

Sex steroid hormones play a central role in the development of breast cancer. Collaborative analysis using individual data from prospective studies has demonstrated significant relationships between concentrations of endogenous sex hormones and breast cancer risk in postmenopausal women [33]. Sex hormones generally circulate bound to plasma proteins with only a very small fraction circulating unbound (between 1 and 5%). The majority of the protein binding to estradiol is provided by SHBG and albumin. Initially, it was hypothesized that it was only the free (unbound) fractions of sex hormones that were biologically active [15].

In the present study, there was a significant increase in the serum levels of free E2 in breast cancer patients compared with apparently normal controls. Serum free E2 showed a significant odd's ratio of 5.21(95% CI=1.86 – 14.52), which indicated that postmenopausal breast cancer females with serum free E2 levels ≥1.07 pg/ml have about 5 fold increased risk of having breast cancer compared with those who have serum free E2 levels <1.07 pg/ml. Our results confirmed those of Fourkala et al [34] who reported that the risk for breast cancer increased significantly with increasing concentrations of all sex hormones examined: total estradiol, free estradiol, non-sex hormone-binding globulin (SHBG)-bound estradiol (which comprises of free and albumin-bound estradiol), estrone, estrone sulfate, androstenedione, dehydroepiandrosterone, dehydroepian-drosterone sulfate, and testosterone. On the other hand, our results disagreed with Awio et al [35] who found non-significant difference between breast cancer and controls regarding serum free E2.

This estrogen excess is explained by over activity of aromatase cytochrome P450 enzyme which is expressed at high levels in white adipose tissue and is responsible for a key step in the biosynthesis of estrogen. Moreover, it is well known that SHBG through its specific membrane receptor (SHBG-R), cAMP and protein kinase A, inhibits the estradiol-induced cell proliferation. Accordingly, the decreased levels of SHBG observed in this study may be another contributing factor causing elevated levels of free estradiol [36]. It was reported that the effect of estradiol on breast cancer risk would be observed most strongly for the fraction of estradiol that is not tightly bound by SHBG. This is because this fraction of estradiol (which comprises of free and albumin bound estradiol) is readily able to enter cells, whereas SHBG-bound estradiol does not [37]. Our results supported this hypothesis.

In the present study, the receiver operating characteristic (ROC) curve analysis was used to compare the diagnostic accuracy of each biomarker based on the area under the curve (AUC) for each parameter. A marker having a greater AUC is a superior diagnostic marker to another marker having a smaller AUC. From the results of the present study, serum free E2 was the most superior diagnostic marker followed by insulin resistance, insulin, SHBG, and resistin. In the current study, all the AUCs were greater than 62%. Therefore, this means that each assayed biochemical parameter can be used as a diagnostic marker with an acceptable performance. Up to the best of our knowledge, this is the first study which evaluates and compares the diagnostic and values of insulin resistance status, serum levels of resistin, insulin, SHBG, and free E2 using the ROC curve analysis.

In the current study, insulin resistance status, serum levels of resistin, insulin, SHBG, and free E2 were non-significantly correlated with both clinicopathological features and disease-free survival of breast cancer patients. Therefore, this means that none of the assayed biochemical parameters can be used as a prognostic marker in obese postmenopausal breast cancer patients. Our result disagrees with the results of Gennari et al [38] and Assiri et al [39]. This contradiction between our results and previous ones may be due to the small sample size, short time follow up, and the conditions of the studies including the methodological differences.

Conclusion

From the current study, it could be concluded that: **(a)** all of these biochemical parameters can have a role in the etiology of postmenopausal breast cancer; **(b)** all of these biochemical parameters can be used to diagnose postmenopausal breast cancer patients with free E2 as the most superior diagnostic marker followed by insulin resistance, insulin, SHBG, and resistin; and **(c)** none of these biochemical parameters has a respectable prognostic role in postmenopausal breast cancer patients.

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EFFECT OF PULSED GALVANIC ELECTRO STIMULATION AND ULTRASUONBD ON BURN HEALING. A RANDOMIZED CLINICAL TRIALS

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Abstract

The goal of this study is to evaluate the effect of pulsed galvanic electro stimulation of high voltage and ultrasound on the healing of induced burn applied on rats.

48 rats (Sprague Dawley), mass between 300g and 400g, age between 3 months and 4 months. These rats are putted and the same experimental conditions of alimentation and hygiene. Rats are divided into 3 groups of 16 rats each. Each rat was induced to a uniform burn of second degree by a specific device fabricated specially to this study.

Group ES undergoes a treatment of electro stimulation by a pulsed galvanic current of high voltage for 10 min daily during 2 weeks.

Group US undergoes a treatment of pulsed ultrasound of 1w/cm² for 2 minutes daily during 2 weeks

Group control GC undergoes placebo treatment.

Measure are done by digital camera, results are analyzed by specific program (AutoCad) on computer.

Wound healing between the three groups are different and statistical tests (T-tests and ANOVA) done between the two groups US and GC show no significant difference in the reduction of the surface of healing between them ($\alpha>0.05$), whereas the comparison between ES group and the two others group was significant ($\alpha<0.05$).

At the end of the second week of treatment, the best healing was presented in ES group where the wound was healed by 61.4 % whereas the groups GC and US were 11.9 % and 14.9 % respectively.

Therefore the ES group have the best results between than others groups (GC and US).

Keywords: Skin healing, burn healing, galvanic electro stimulation, ultrasound,

Introduction:

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Methodology:

Our study aims to compare the effect of pulsed galvanic current of high voltage and pulsed ultrasound in the acceleration of wound healing on induced burn on rats.

Hypothesis:

There is no significant difference in the level of wound healing of induced burn between the 3 groups (ultrasound, electro stimulation and control group) during the first and the second week.

Population:

48 rats (16males and 32 females) are selected randomly to this experiment, they have been selected from the lab of AUB (American Lebanese University) of same specie (Sprague Dawley). Their mass vary between 300g and 400g, age between 3 months and 4 months. These rats are putted and the same experimental conditions of alimentation and hygiene. Also the sequence of 12 hours in light and 12 hours in darkness was respected during the experiment.

The 48 Rats are divided into 3 groups of 16 rats each, randomly selected:

- Group ES: 16 rats undergoes a treatment by electrostimulation.
- Group US: 16 rats undergoes a treatment by ultrasound.
- Group CT: 16 rats control group.

Tools:

Dynatron 850 plus

Sonopuls 590

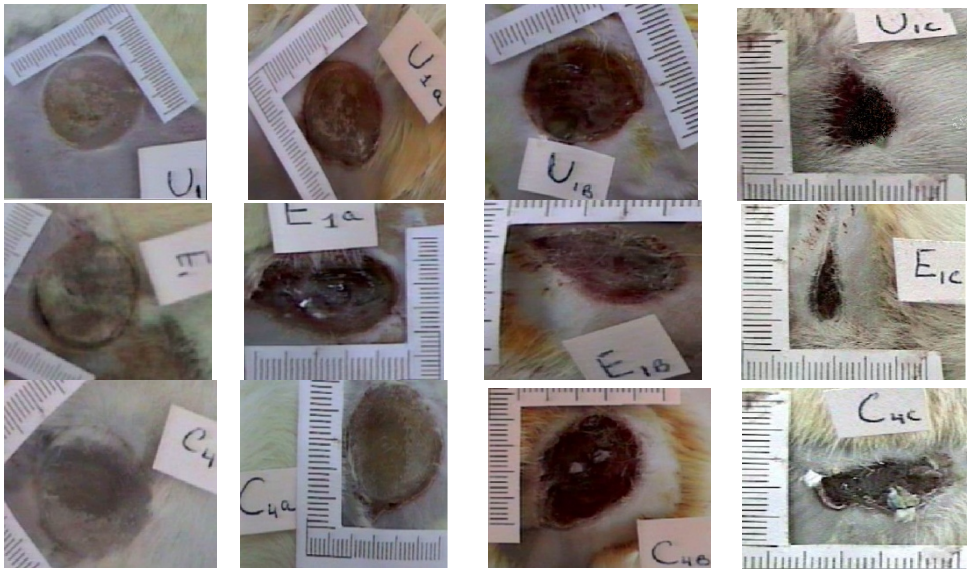
Specific device constructed specially to induce burns

Procedure of burn:

- The 48 rats are anesthetized by Kitamine intra muscular by a Veterinarian, each dose respect to the mass of each rat.
- The lateral part of the hip is well shaved.
- Burn is produced perpendicularly. Temperature 95 degre, time 20 seconds producing a burn of second degree.

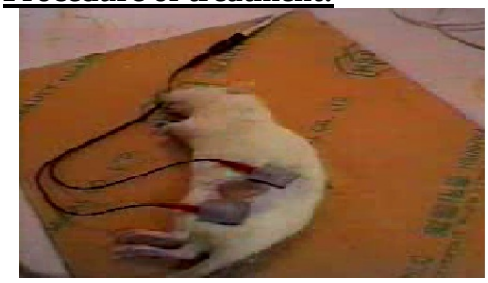
Procedure of measure:

- Photos are taken directly after burn, in day 1, day 8, day 14 and day 21, with a scale to calculate the surface.
- Surfaces are calculated by AUTOCAD.



Figures showing the difference between burns healing in the 3 groups during the 2 weeks.

Procedure of treatment:



Treatment with electro stimulation

Treatment with ultra sound

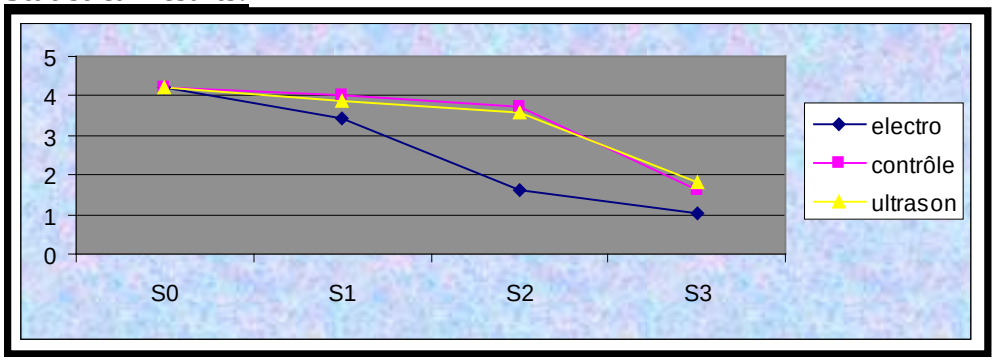
Parameters:

ES group: pulsed galvanic current, high voltage applied 10 min around the burn for 2 weeks.

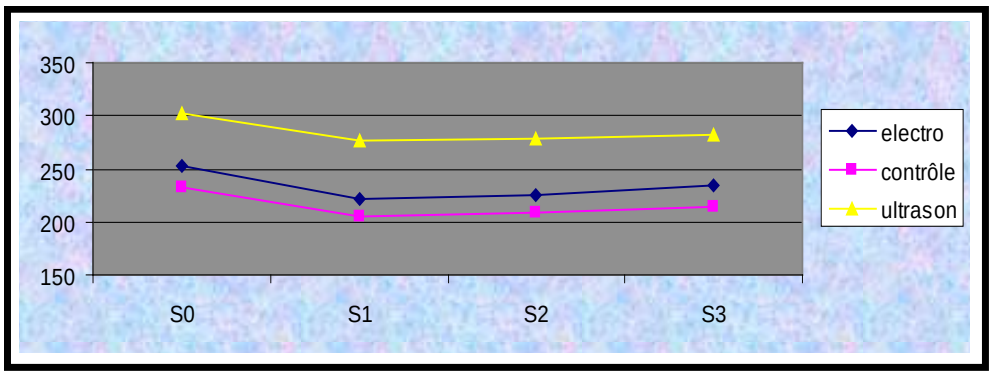
US group: 1 MHz, pulsed 20% , 2 ms , 100 Hz , 1 W/cm², surface of the head 0.5 cm².

There was no treatment applied during the third week.

Statistical results:



Variation of the mean of the surfaces (in cm²) between the 3 groups during the 3 weeks.



Variation of the mean of the mass (in g) between the 3 groups during the 3 weeks

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		Sum of squares	Df	f	P
ES	Between groups	9.332	2	17.203	0.000
	Within groups.	10.566	39		
US	Between groups	21.972	2	70.044	0.000
	Within groups.	7.058	45		
CT	Between groups	33.586	2	75.577	0.000
	Within groups.	9.555	43		

ANOVA between the surfaces of the 3 groups during the 3 weeks

Discussion of the results:

Group US did not represented any significant difference in the reduction of the surface of lesion in compare with the control group. The results may be caused by:

- High intensity (1W/Cm²).
- Application of the head around the lesion.
- Frequency 1 MHz.
- Short duration for 2 weeks only.
- Histological effect of ultra sound.

Group electro stimulation present a significant difference in the reduction of the surface of lesion in compare with control group.

- Best result was between week 1 and week 2 .
- Polarity of the wound was negative.
- Direct effect.

Recommendation:

- Trying to apply the treatment to patients suffering from burns by galvanic pulsed current at high voltage to reduce surface of lesion.
- Application of 10 minutes was sufficient.
- It is not recommended to use pulsed ultra sound with intensity 1 W/Cm^2 in the treatment of burn.

Conclusion:

The application of pulsed galvanic current of high voltage in the treatment of burn increase the healing process.

The application of pulsed ultra sound in the treatment of burn has no significant effect in the reduction of the surface of lesion.

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THE EFFECTS OF FUNGAL MEDIUM ON HATCHING RATE OF BITING MIDGE

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Abstract

The little black mosquitos, *Forcipomyia taiwana*, bite human and become one of the most annoying pests in Taiwan. Recently, the population of *F. taiwana* increases and invades urban and countryside. In order to effectively prevent the harassment of *F. taiwana*, develop control strategy is urgent and necessary. Our study found that the fungal medium influenced the length and width of the *F. taiwana* eggs. It also significantly decreased the hatching rate of *F. taiwana*. Besides, this artificial diet was more non-toxic and environment-friendly than general chemical pesticides. Thus, this study provided critical information to develop potentially useful bait of *F. taiwana* in the future.

Keywords: Artificial diet, bait, biting midge, hatching rate

Introduction

Forcipomyia taiwana (Diptera: Ceratopogonidae), known as little black mosquito, is annoying blood-sucking pests in Taiwan and Southern China (Perich et al., 1995). In recent years, the population of this pest increases shortly and harasses human recreational and outdoor activities (Chuang, Lin, Wang & Yeh, 2000). One of common control methods to decline the pest hazard is chemical pesticides (Mishra et al., 1987). It is necessary to seek for alternative strategy. Trap bait system is an efficient way to attract, trap and monitor pest problems (Kline, 1999; Müller, Kravchenko & Schlein, 2008). Four chemicals, octenol, lactic acid, acetone, and carbon dioxide are assessed for *F. taiwana* attractiveness. The result shows that Octenol is the most effective chemical to lure *F. taiwana* (Liu, Lee & Yang, 2009). However, no study focuses on the influence of bait on

the fitness of *F. taiwana*. Therefore, investigating an effective bait to decrease the fitness of *F. taiwana* is urgent and necessary.

Nutrition source and energy content often impact the fitness of insects. Both the parasitoid's longevity and fecundity are usually affected by the energetic limitation or carbohydrate source. However, one kind of sugar, rhamnose, declines the survival of *Cotesia glomerata* (Leatemia, Laing, & Corrigan, 1995; Wäckers, 2001). Furthermore, the amino acid also plays a key role to influence the reproduction and lifetime of insects (O'Brien, Boggs, & Fogel, 2003). In addition, carbohydrate and amino acid are two abundant components of nectars (Baker & Baker, 1973; Dupont, Hansen, Rasmussen & Olesen, 2004). Therefore, the fitness of these sugar-feeding insects may be regulated by the components in nectar. Many studies indicate that the adults of *F. taiwana* eat nectar as their nutrition (Chen, Lien, Lin & Hsu, 1981). There is no study to explore the influence on of yeast extract as food on the fitness of *F. taiwana*. Our study used fungal medium as diet to feed the female adults of *F. taiwana* and evaluated whether it affects the hatching rate of this pests.

Material and methods

Female adults of *Forcipomyia taiwana* were collected from Changhua County, Taiwan. Their were attracted and captured by human bait method. All the captured female adults were full-blooded and then deposited in containers used for oviposition. There were about 10 individuals in each container.

In the control group, 200 μl of algae suspension and sterilized water were added respectively at first day as a nutrient resource while 200 μl of algae suspension and YPD medium (1 % yeast extract, 2 % peptone, and 2 % dextrose) were added in the experimental group. Then, half of the amount of the food was added after the second day. The eggs would hatch about 4 days after they were laid (Yeh & Chuang, 1996). Therefore, the eggs hatching rate was calculated at fifth day, and each group had six repeats. The greatest length and width of each unhatched egg were measured.

Results

The eggs color of the experimental group, light red and transparent, was obviously different from the control group, black and opaque (Fig. 1). The average length and width of eggs were 269.20 ± 10.92 and 82.67 ± 7.01 μm (Fig. 2) in the control group, and 242.12 ± 32.53 and 70.89 ± 7.39 μm (Fig. 2) in the experimental group, respectively. Both of the length and width in these two groups had significant difference ($p<0.01$), while the width divided by the length was similar (0.31 ± 0.02 and 0.30 ± 0.09 of control and experimental group) (Fig. 2).

The hatching rate of *F. taiwana* was calculated based on the hatching eggs divided by the number of total eggs in each container at fifth day (Fig. 3). The egg number in control group was 483, and 466 in experimental group. The average hatching rate in the control group was 35.64% ± 19.91% (mean ± SD). However, the average hatching rate was significantly decreased, and all the eggs were not hatch in the experimental group. The results showed that the female adults of *F. taiwana* were fed with fungal medium and lay the immature eggs.

Discussion

In this study, we found the female adults of *F. taiwana* fed with fungal medium influenced their eggs hatching rate. The fungal medium is composed of yeast extract, peptone, and dextrose. The latter two components are the most important factors in insect development and fitness (Beenakkers, 1969; Tsiropoulos, 1983; Jacob & Evans, 1998). The amino acids composition impacts the fitness of many insects, eg. *Myzus persicae*, *Macrosiphum euphorbiae*, *Ceratitis capitata*, and *Araschnia levana* (Douglas, 1993; Karley, Douglas & Parker, 2002; Chang, 2004, Mevi-Schütz & Erhardt, 2005). It is worth to study further if the peptone used in this study resulted in the decreasing egg hatching rate of *F. taiwana*.

Sugar supplements are regarded as a role to impact parasitic wasps oviposition (Heimpel & Collier, 1996; Lee & Heimpel, 2008). Sugar utilization in parasitoids also promotes its longevity. The longevity is significantly increased when parasitoid wasp, *Cotesia rubecula*, fed with higher sugar concentration (86%) (Siekmann, Tenhumberg & Keller, 2001). Moreover, it is well-known that glucose is one of the prevalent sugars in nectars and honeydews (Baker & Baker, 1983; Koptur, 1992; Dupont et al., 2004). However, there are little studies indicate the role of glucose in nectar to the sugar-feeding insects. In our study, the dextrose (glucose) in fungal medium may impact the egg development of *F. taiwana* and cause the eggs unhatched.

In this study, it is the first time found the fungal medium effectively decrease the egg hatching rate of *F. taiwana*. This artificial diet is more non-toxic and easy-decomposable than pesticides in the wild. The study provides useful information that can be used in the development of control strategy in the future.

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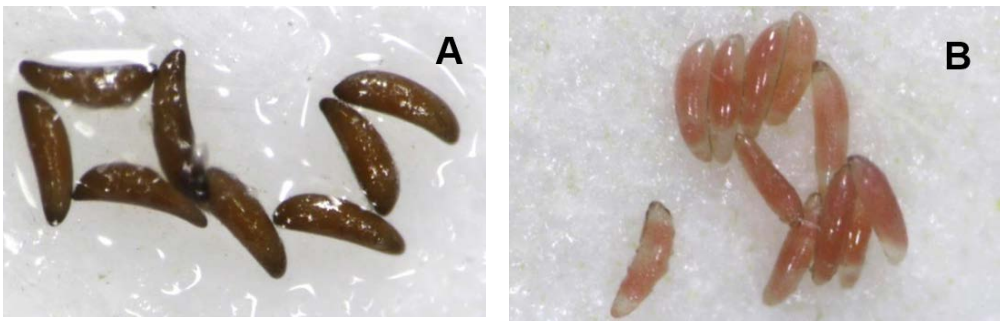

Figure 1. Effects of fungal medium on egg morphology. (A) The eggs were black and opaque in control group. (B) The eggs were light red and transparent in experimental group.

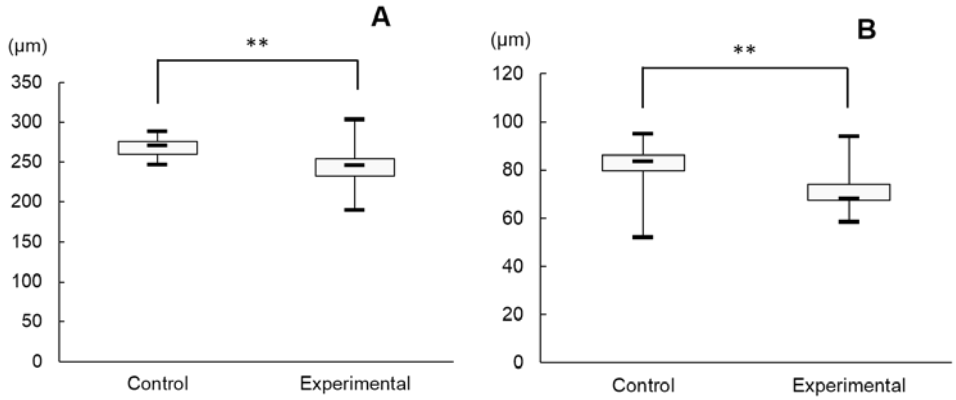

Figure 2. Effects of fungal medium on the length and width of egg. Box plot representing length and width of eggs in control and experimental group. (A) The length of eggs was showed in each group. (B) The width of eggs was showed in each group. The significance of differences between groups was determined using Student t tests and analyses of variance. **p<0.01.

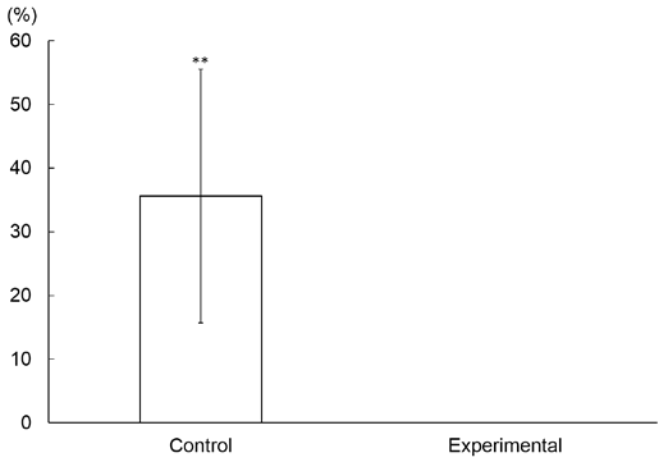

Figure 3. Effects of fungal medium on egg hatching. The egg hatching rate was calculated by the formula: hatching eggs/total laid eggs. Data show mean ± standard deviation (SD) from six containers in each group. In control group, the egg hatching rate was 35.64% ± 19.91% and 0% in experimental group. The significance of differences between groups was determined using Student t tests and analyses of variance. **p<0.01.

INFLUENCE OF PRACTICAL LEVEL ON DECISION MAKING IN HANDBALL

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Abstract

Various studies on cognitive expertise have developed a new approach to describing the superiority of experts on novices as a benefit of directory knowledge acquired at the heart of practice. This study had as its main objective to confirm the superiority of cognitive performance sports experts. Indeed, the interaction of conceptual knowledge (treatment level) and perceptual knowledge (low-level processing) optimizes performance through a rapid recall and recognition memory knowledge among experts. It does not reach this performance was achieved in the novices. The results confirm that a large repertoire of knowledge acquired through practice facilitates the response to the demands of sporting tasks.

Keywords: Decision Making, Cognitive Expertise, Simulation, Handball

Introduction

The purpose of this study was to test the influence of the level of expertise on enabling knowledge base implementation in a decision-making task on static images of game situation simulated attack handball, depending on the complexity of the situation. According Baratgin et al, (2003) activation knowledge base is not the same, different levels of activation require different temporal and cognitive resources, on the other hand the theory of knowledge bases (Chase & Simon, 1973b) argues that the expert is equipped with its own knowledge domain (solutions) ready to use quickly. In contrast, the helpless novice knowledge must treat all information in the situation. Hence the decision time is more important, since it uses more expensive general knowledge about temporal. Following these two assumptions we expect superior performance in the expert in terms of time and relevance of the decision, given its specific knowledge base, rich and

accessible than the novice.

To test this hypothesis, we used a forced-choice task (decision) several alternatives (see task), similar to the task used by (Zoudji & Thon, 2003), the level of complexity of the situation is handled by the number of players in the game situation, attackers and defenders involved and the type relevant to the tailback action (keep, pass or shoot for goal) for each situation.

Methodology

Participants

Twelve handball players (mean age: 25 years; σ: ± 3.05 years) participating in the National Handball Championship practicing since more than 12 years age group component "practitioners", twelve coaches (mean: 35 years; σ: ± 5.07 years), graduated from a state certificate 1st, 2nd and 3rd degree, specialty handball in the group "coaches" and twelve novice subjects (mean age: 25 years; σ: ± 2.90 years) n who has never practiced a collective sport club in the group "novice", the subjects of the three groups of male, volunteered to participate in the experiment. Players and coaches are considered experts therefore they practiced handball competition for over ten years and that this practice is deliberate (Ericsson & Lehmann, 1996). The choice of coaches was justified by their practical and theoretical dual expertise in the business, we believe that their business coach has led them to develop more declarative knowledge of game situations that players.

Procedure and Equipment

Ninety-six handball game situations were selected and randomized in this study. These differ in their level of complexity situations: number of offensive players (A) and human (D) participating in each game situation [4 players (2A against 2D, 5 players (against 3A 2D) 6 players (against 3A and 3D (4A against 2D) 7 players (4A against 3D)] and the type of "action" optimal for the ball carrier (keep, pass and shoot at goal).

Task

The subject's task is to respond as effectively and as quickly as possible to the appearance of the game situation, indicating what situation he would choose if he was running back (keep, pass, shoot at goal). Each test is conducted as follows: a signal preparation (more) of 1000 ms indicates on an image will appear. This signal is followed by the presentation of the image of the game situation latter remains on the screen until the subject's response. To give its response, the subject must press with one of three fingers on one of the three keys associated with the response. Once the subject responds a plus sign (+) appears for 2500 ms on the screen corresponding to the interval

between tests. (See Figure 1)

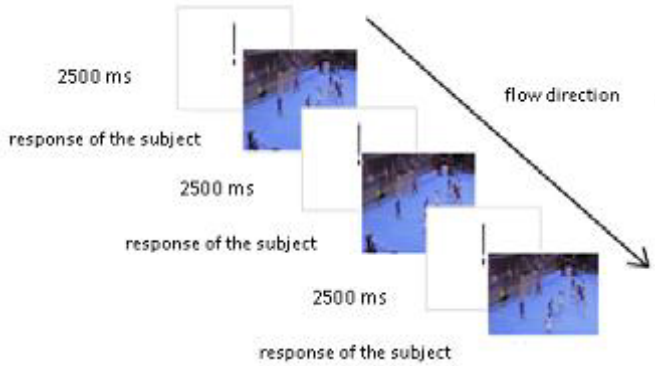

Fig 1. Illustration of the procedure for the task of decision making.

Results and Discussion

The data are processed through multiple analysis of variance (ANOVA). For both dependent variables, response time and pertinence of responses, analysis of variance was performed. The analysis plan includes a factor "group" (3 modalities: novices, practitioners, coaches) and two-factor repeated measures "complexity" (4 ways: 4 players, 5 players, 6 players, 7 players) and "type of action" (3 ways: keep, pass and shoot).

Relevance Answers

At each of the situations presented, is more relevant than the other two action. We recall that the most appropriate action was defined by an independent group of expert coaches who have not participated in the first study. If the subject's response is identical to that action, the score of 1 assigned, otherwise the score is zero.

Analysis of variance showed a main effect of "group" of good responses [F (2,33) = 3.77, p <04729]. The post hoc results indicate a significant difference in correct responses between the group of practitioners and novices (p <.00001) and this group and the coaches (p <.001), and finally a significant difference between the group e practitioners and the group of coaches (p <.0001). However, it should be noted that the rate of correct responses in the group of novices exceeds the threshold of chance.

Table 1. Means and standard deviations of the percentage of correct responses in each group during the presentation of the image.

Group	Mean	standard deviations
Novices	0.51	0.08
Practitioners	0.56	0.12
coaches	0.52	0.12

Analysis of variance indicated a main effect of "complexity" [F (3,99) = 5.28, p <, 0020]. The post hoc results showed significant differences in rates of correct responses between situations involving six players and situations involving four players (p <.001). A difference was also observed between situations involving six players and situations involving five players (p <.001). In both cases, the subjects are more efficient when the situation has only 6 players. It is also apparent differences between situations involving six players and situations with 7 players (p <.0001). The other results are not significant, the best performances are recorded for situations involving six players. The worst scores of correct answers correspond to situations involving seven players.

The analysis does not show, however, the interaction between the factors "group" and "complexity". The analysis revealed a main effect of the factor "type of action" [F (2,66) = 20.53, p <, 0000]. The post hoc test showed differences in rate of correct responses between the actions "pass" and "pull" (p <.0001) and "pass" and "keep" (p <.0001), by cons there is no difference between "pull" and. "keep the best performances correspond to action" pass "with an average rate of correct responses of 0.69 (σ: ± 0.24), then the action" pull "with a rate of 0.48 (σ: ± 0.27) Finally, the poor performance was observed in the action "keep" with an average score of 0.43 right answers (σ: ± 0.23.

It should be noted the lack of interaction between the factor "type of action" and the factor "group". However, the factor "type of action interacts with the factor" complexity "[F (6,198) = 5.57, p <, 0000]. The post hoc test showed no significant difference in correct answers on the action "move", whatever the number of players in the situation except for the situation involving four players. For this action, the correct answer rate is highest. Regarding the action "keep" post hoc test showed no significant difference between situations involving 4 players, 5 players and 6 players. However, these three types of situations with significantly different situations with 7 players (p <.01), performance issues are lowest for these situations. Finally for action "pull" the post hoc test showed a significant overall difference between the correct answers situations involving six players and other situations (p <.01). The results indicate better performance for situations involving six players. We did not observe significant differences between the situations with 7 players and situations involving four players against by

significant differences between these two situations and situations involving five players (p <.05). The lower performance rates of correct answers are for situations involving five players. (See graph No. 1).

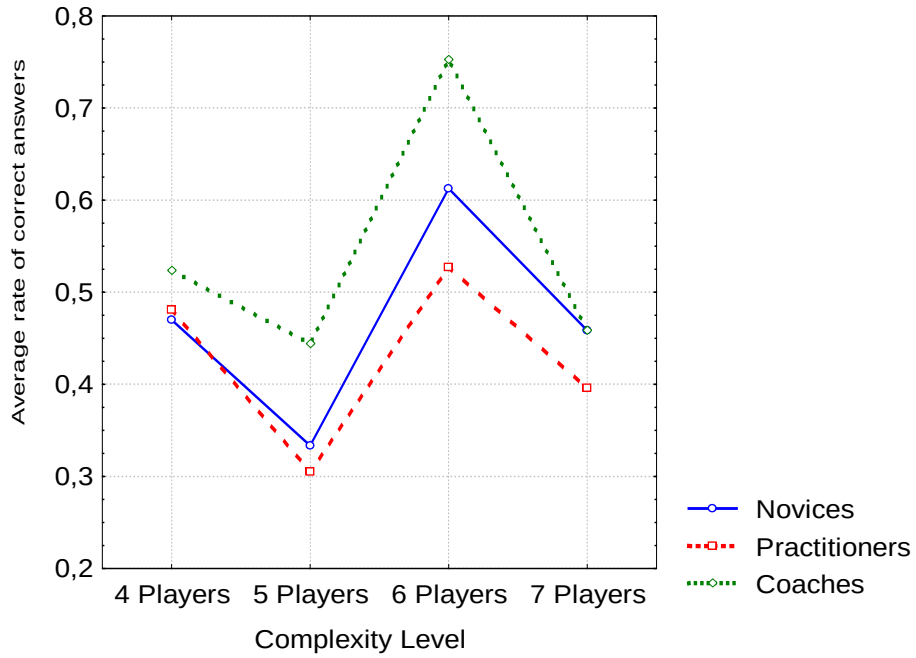

Fig 1. Average rate of right answers depending on the complexity of the situation and the group.

In general, one can observe that the rate of correct answers for action "pass" is independent of the complexity of the situation except for situations involving four players. By cons, for action "keep", the correct answer rate tends to decrease with complexity. The same be done for the action "Pull".

Response Time

Analysis of variance showed no main effect of the factor "group". However, the average time recorded responses indicate superiority experienced subjects (coaches and Practitioners) to novices.

Table 2. Mean and standard deviations of the mean times of correct responses for each group.

Group	Medium	standard deviations
Novices	5797	1499
Practitioners	5215	1118
Coaches	5333	731

In contrast, we observe a significant effect of the factor "complexity" [F (3,99) = 3.68, p <, 0017]. The post hoc results revealed significant differences between the situations involving five players and other situations

involving simultaneous 4, 6 and 7 players (p <.05). The best performances are recorded for situations involving five players, the lowest performance are listed for all other remaining situations, without differences between these situations.

In general, we observe a tendency to decrease the duration of the response time with the complexity of the game situation. The interaction between the factors "group" and the factor "complexity" is not significant (p <.05). In contrast, the main effect of the factor "type of action" is significant [F (2,66) = 5.42, p <, 0066]. The post hoc test showed differences in response time between actions "pass" and "pull" (p <.001), "go" and "keep" (p <.0001) and "pull" and "keep" (p <.001). The Best performance is observed in the action "pass" with an average time of 5009 ms (σ: ± 735) followed by action "pull" (5239 ms; σ: ± 1497). Finally the time the longest answers correspond to action "keep" with an average of 5883 ms (σ: ± 1888). The factor "type of action" factor interacts with the "complexity" [F (6,198) = 2.81, p <.001]. The post hoc test showed no significant difference in mean time of correct answers on the action "move", whatever the number of players present in the situation. For this action, the average time of correct answers are highest. About the action "" pull "the post hoc test showed significant differences between the situations involving players 7 players and other situations, for these past situations times correct answers are the best, other differences are observed ENTERED situations involving six players and situations involving 4 and 5 players, situations involving five players have the lowest scores. (see graph No. 2).

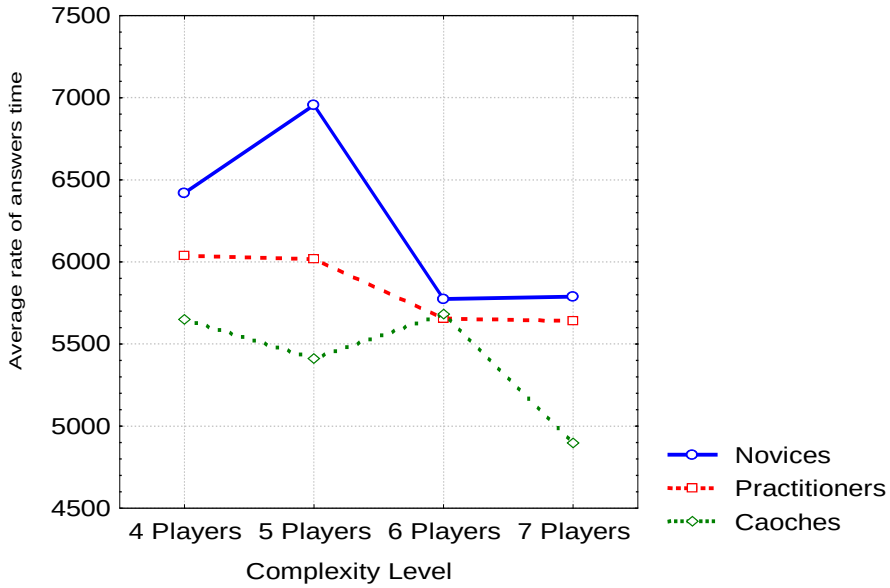

Fig 2. Average response time, in milliseconds, depending on the complexity of the situation and the group.

Table 3. Summary of results for the two variables, relevant and time right answers, when images are shown for the first time in the different groups.

	Correct answers	**Response time**
Group (G)	p <.05	NS
level of complexity (NC)	p <.001	p <.001
Action (A)	p <.0000	p <.005
G * NC	NC	NS
G * A	NS	NS
G * N * A	NS	p <.01

Conclusion

The results for the influence of practice handball on enabling knowledge bases show that experts subjects (players and coaches) are more relevant than novices answers. These results are consistent with the hypothesis of knowledge bases assuming the acquisition of specific expert knowledge, rich and structured response to many years of practical knowledge, which allow them to recognize situations (Zoudji & Thon, 2003). These results confirm, however, the results obtained in similar studies (Allard, Graham, & Paarsalu, 1980; Zoudji & Thon, 2003; Baratgin, Ripoll, Courrieu, & Laurent, 2003).

The response times are similar for all three groups of subjects. Thus, the time required for decision making is not influenced by the level of practical subjects. Similar results were also reported by Zoudji & Thon (2003).

The results reveal an influence factor "level of complexity" (number of players involved in the situation) variable relevance and response time. Performance expert topics are best in terms of relevance of responses and especially when they are difficult (large number of players in the situation). On the response time, if at first glance, the time was similar, in some situations the subjects 'behavior is consistent with the hypothesis that time the experts' answers are significantly shorter than those of novices. This is the case of the action "happen." By cons, in situations "pull" and "keep" the three groups perform the same response time.

Equal time scores between experts and novices may be due to the attitude of the player incitatrice rusher in certain situations (the ball carrier shows the action to be implemented). We also think that all subjects, including experts were familiar with the experimental situation; the conditions are far from those encountered in real game situations, which may explain the relatively long response times of the participants.

These results are identical to those obtained in explicit tests of recall or recognition usually explained by the theory of working memory to long-term proposed by (Ericsson & Kintsch, 1995) which posits that expertise on a combination of information from the domain retrieval cues domain experts. These indices are encoded and stored quickly in long-term memory.

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PROFESSIONAL COMPETENCE REQUIREMENTS: THE VIEWS OF SEVERAL PHYSICAL AND SPORTS EDUCATION TEACHERS (CASE IN MOSTAGANEM PROVINCE, ALGERIA)

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Abstract

The purpose of this study was to identify the opinions of Physical and Sports Education (PSE) teachers regarding professional competence and the specific requirements of the work. A questionnaire was drawn up and sent to 85 PSE teachers in secondary schools based the Mostaganem "Wilaya" or Province in Algeria. The findings indicate that this group of teachers could not clearly define general or specific competence. However, they largely agreed that the teacher/coach plays a very important role in establishing the professional competence of trainees. Competence that is specific to PSE is described in studies as "how to apply competence by competence the approach to teaching PSE" and "knowing how to apply legislation". None of the teachers responding cited a basic competence in the professional sphere, described in the literature: sound knowledge of legislation and administrative procedures. In addition, the findings show that the teachers are not satisfied

with the training they received and that it does not enable them to reinvest their training in their professional role. From the opinions expressed by the population studied, their training does not encourage professionalism. This finding is also confirmed by research by Laroua et al (2014).

Keywords: Competence, Professional Competence, PSE, Algeria, Mostaganem

Introduction

Competence is defined in terms of "knowing how to act and react" and is not reduced to applying or carrying out rules, but goes beyond that which is stipulated (Le Boterf, 2001). The competent person knows how to choose, organise, and mobilise certain resources (knowledge, expertise, qualities, culture, documentary networks, expertise networks, etc.) in order to manage situations in professional practice (Le Boterf, 2002a).

Training for a Master in PSE at the Physical and Sports Education Institute of Mostaganem, Algeria, has been carried out since 2004 through a programme set up by a committee specialising in teaching motor skills in physical education.

Several study courses are taught at the Institute: Sports Coaching "ES", Human Movement and Motor Skills "MHM", Adapted Physical Activity "APA", and Sports and Health "SH". In our study, interest focused on MHM training, which equates to training formerly known as "EPS" or PSE. This training gives students the possibility of entering the teaching profession and applying for a teaching post within the National Education system through a mark attributed following an interview and a review of their university file. The graduates are appointed as trainee teachers for a nominal three-year period. They must undertake a nine-month training programme in the difficulties that may be encountered in practice as a prerequisite to applying for a permanent post (CAPEPS). This training is an obligatory stage required by the State Administration.

In addition, the Mostaganem Province education management uses a form of nomenclature and classification of teachers relating to their number of years teaching experience and also to successfully passing an evaluation test before being allowed to move on from one status to another. Several teacher grades have been established: trainee, permanent teacher, principal teacher and coach. Coach is the highest grade and once attaining this level a teacher may apply for the position of inspector of the various subjects taught.

The new LMD system (Bachelor, Master, PhD.), was established at Mostaganem University over 10 years ago and training is available in Science and Techniques of Physical Activities for the teaching profession, replacing the earlier training programme in Physical and Sports Education.

Few educational courses in Algeria are concerned with results of training and the quality and the competence of teachers. For this reason, several research studies have been carried out since 2011 to examine the issue.

Theoretical research into the question of competence was carried out by Laroua et al. (2013), with the aim of identifying competence in the teaching of PSE while at the same time attempting to design a curriculum for competence specific to the profession in Algeria. Various recommendations resulting from this work extensively explored the professional competence required by a PSE teacher based on practical experience of the activity (situated action) in order to obtain more precise results more in line with actual practice. In order to obtain greater objectivity it was decided to interview those principally concerned in this area of education: experts, novices, and inspectors, in order to obtain a better understanding of *practical competence* and *to draw up a grid of professional competence* to meet the requirements for teaching PSE under standard conditions.

Methodological approach

The method used to examine the professional competence required for the teaching of PSE is both descriptive and quantitative. The research study used closed and open-ended questions.

Number of teachers

Eighty-five PSE teachers contributed to the research. This number was provided by the Mostaganem Province education authorities as being as all teachers working mixed-sex secondary schools in Mostaganem Province in 2014. The categories of teachers represented included those under training having little experience thought to the most experienced holding the title of teaching coach.

Research tool

PSE teachers completed a questionnaire concerning the notion of competence in PSE teaching. The questionnaire included tabular forms with open-ended and closed questions, as well as questions open-ended and closed at the same time. The questions were intended to provide answers to the central question of identifying skills specific to practical teaching.

In order to test the objectivity and reliability of the research tool the first questionnaire established included several questions relating directly to the issue. The questionnaire was then assessed by specialists from the profession who adjusted and amended the questions taking the observations of experts into account. To test its reliability, seven PSE teachers chosen at random completed the questionnaire twice at a week's interval. The same

results were obtained both times, leading to the conclusion that the research tool had an acceptable level of objectivity and reliability.

Findings and discussion

In the study attention focused on analysing the replies of the PSE teachers in relation to teaching PSE *in situ.* Replies were coded in a computer data base and processed by **Sphinx v5** software. The results were analysed using the comparison test of two percentages was used as well as the $\square^2$ test.

Analysis of the findings

This part of the research study is devoted to analysing and discussing the findings obtained from replies. It throws light on the main observations from the research and analyses them within the framework of National Education in Algeria.

1- Are you a teacher?

Teacher under training – Teacher in a Permanent Post – Coach in a Permanent Post

	Number of teachers		
	Teacher under training	**Permanent teachers**	**Permanent Coach**
N° of teachers	**12**	**64**	**9**
%	**14.12**	**75.29**	**10.59**

Table No. 1 shows the grade distribution of PSE teachers

Table No.1 indicates a greater number of teachers with a university degree and from Physical and Sports Education teacher training institutes, with the overall total of 85 for Mostaganem Province in 2014. These teachers had obtained the level of experience which enabled them to move on to a higher status. Only 12 were under training, 14.12% of the group; 64 were PSE teachers in permanent posts, 75.29% of the group in this study. In addition, we identified nine PSE teaching/coaches, 10.59% of the group.

These findings show that the Mostaganem Province education administration uses a form of nomenclature and teacher classification based on their number of years experience in education and also on the evaluation test necessary for advancing from one status to another (e.g. from the status of principal teacher to that of teaching/coach). The results also show that most of these PSE teachers hold a permanent post.

The evaluation test for holding a permanent post consists of establishing the standards for permanent post teachers responsible for the subject matter and teachers under training. The permanent teacher coordinates the subject matter with other colleagues in the establishment, as well as the examinations and planning of the various tasks. Newly recruited teachers under training, with a three-year contract, have to wait in order to

take the CAPEPS examination within 9 months following their nomination, knowing that passing this test for a permanent post is essential after receiving their end-of-studies diploma organised by the education administration (training department).

This training is required by the State public service administration. Furthermore, during the study we observed that those teachers with the title of coach regularly work with subject matter inspectors, particularly in identifying and planning objectives for the training seminars organised regularly by the inspectors.

The status of coach can be obtained under certain conditions, which include the number of years spent teaching the subject as well as the result of the written test. The results also revealed that 72.41% of teachers have this type of professional experience in Mostaganem Province by comparison with experienced teachers having more than 10 years experience in education. In the latter case they comprise 25.28%.

Results vary between regions throughout the country. Research by A. Laroua (2011) shows that certain Provinces, such as Oran and Témouchent (in the west of the country) have older teachers with more than 10 years experience in teaching PSE. This difference in experience of pedagogical practice doubtless has an influence on the quality of teaching as well as on the level of competence attained by these "experts".

1-One question put to teachers was: how do you define the competence of a PSE teacher?

How do you define the competence of a PSE teacher?				
Replies	**R**	**%**	**K^2 (cal)**	**K^2 (tab)**
Considerable stamina and moral capacity[i].	**3**	**3.45**	**21.42**	**18,31**
The ability to obtain objectives with a minimum of energy.	**1**	**1.15**		
Great psychomotor and social abilities in individual and team disciplines.	**2**	**2.30**		
All the concepts and knowledge required for preparing a teaching session.	**5**	**5.75**		
The ability to prepare a PSE session in good conditions.	**12**	**13.79**		
The ability to find appropriate solutions for problems faced by a teacher during sports practice.	**20**	**22.99**		
Mastering TIC (information and communication technology).	**11**	**12.64**		
The ability to deal with pupils and to transmit information.	**15**	**17.24**		
The ability to carry out exercises and games correctly.	**12**	**13.79**		
A sound theoretical and practical knowledge.	**2**	**2.30**		
Cognitive, physical, and administrative competence	**4**	**4.60**		

Table N°2 showing competence definitions for a PSE teacher, according to the teachers themselves

Table N° 2 shows the range of replies from teachers on the definition of competence in PSE. Twenty teachers, 22.99%, define specific PSE competence as the ability to find appropriate solutions for problem situations faced by the teacher in a practical teaching situation. However, fifteen teachers, or 17.25%, have a different view: they emphasize sound control over the class and the way of transmitting information as a major competence element.

In addition, by combining two replies (TICE and knowledge of the activities), twenty-three teachers, 26.43%, define the competence specific to PSE as the ability to carry out exercises correctly and sound knowledge of TICE (information and communication technology in teaching). The others gave quite varied and less significant responses. A large group defined competence in PSE as prior knowledge of the concepts which facilitate the preparation of a teaching session, as well as sound theoretical knowledge and specific practice regarding PSE. The K^2 test shows that the calculated K^2 value ($K^2cal=21.42$) is greater than the K^2 value of the Table (K^2 Tab=18.31) where the degree of freedom of scope (N-1) is 10, and the level of significance is 0.05. This finding is a statistically significant increase, which explains the large difference in favour of the answer giving the greatest number of choices.

The findings show how various definitions of competence are formulated in PSE. Each teacher suggested their own version where they defined competence specific to PSE drawn from their own professional experience. However, compared to the propositions generally found in the literature on the subject, their definitions are incomplete and do not take into account the basic elements that define competence in PSE.

In fact, most of the teachers said that competence in PSE is directly linked to the speed of assimilating environmental information in order to react to problem situations encountered during a PSE session. Good class control and the quality of message transmission during the session, underscoring the value of professional gestures such as the use of guidance gestures during a session and including verbal and non-verbal communication.

Authors such as N. Chomsky (1973) and G. Le Boterf (1999), D. Delignières, C. Garsault (1993), and M. de Montmollin (1984), as well as O. Reboul (1980), have put forward many definitions for competence. Beyond the specificity of each of these definitions, certain points of agreement emerge. Competence or skill is a stable quality, acquired by apprenticeship, resulting in a set or group of elements in dynamic interaction. Knowledge is programmed, which supposes a power of action and/or understanding that can be applied to a category of actions relating to a common problem. In secondary school, skills “constitute knowledge allowing for a reaction

appropriate to a situation, or a group of situations presented by the teacher": they are cultural and methodological.

In every case, competence defines, in accordance with the regulations, the nature of the acquired knowledge: "apprenticeship in PSE leads to the acquisition of competence" (grade six programme, 1996).

Based on these definitions, it may be supposed that competence is the possibility of acting voluntarily and effectively in a range of situations. The aim of the PSE teacher is that the student acquires competence specific to PSE; the teacher observes the motor behaviour of the student and assists them in mobilising their motor, cognitive, emotional, and social resources.

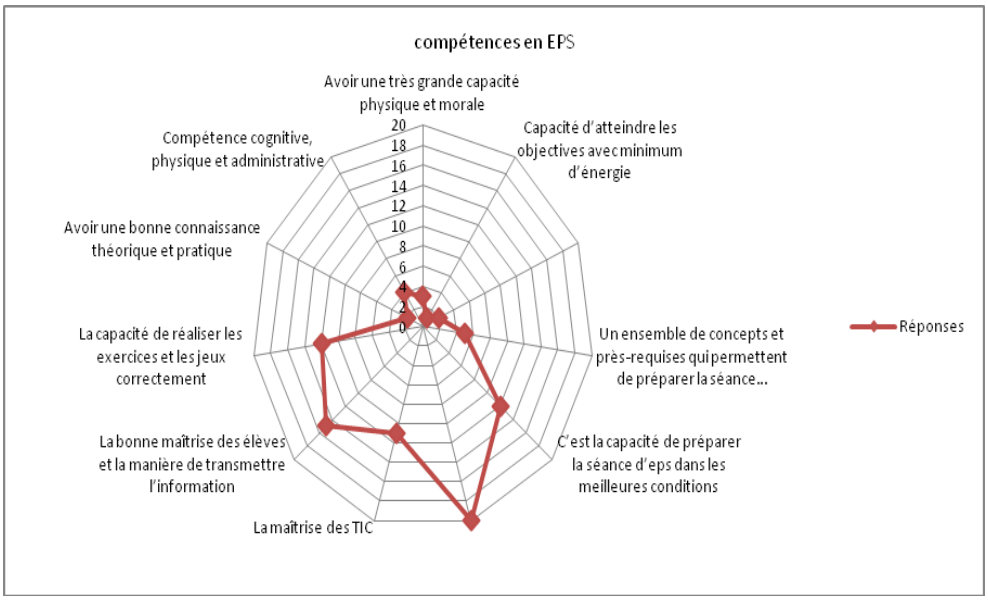

Figure N° 1 describing the definitions of the competence necessary for a PSE teacher according to the teachers themselves.

- According to you, what specialised competence is required for a PSE teacher?

Specialised competence required for a PSE teacher, according to the teachers themselves.				
Answers	R	%	K^2 (cal)	K^2 (tab)
Simple, short explanation of exercises.	**8**	**9.20**	**27.04**	**26.30**
Good positioning and use of the area allocated to pupils.	**8**	**9.20**		
Mastering TIC in education.	**8**	**9.20**		
Mastering the science associated to each discipline taught.	**6**	**6.90**		
A good relationship with colleagues and the administration.	**8**	**9.20**		
Ability to apply legislation.	**10**	**11.49**		

Ability to apply the approach by competence in PSE **teaching.**	**9**	**10.34**		
Good use of teaching material.	**7**	**8.05**		
The ability to teach efficiently.	**1**	**1.15**		
Sports activity continues in the establishment.	**1**	**1.15**		
Working methodically.	**3**	**3.45**		
Being exemplary at work.	**1**	**1.15**		
Sound mastery of teaching methods and styles.	**8**	**9.20**		
Experience in PSE teaching.	**2**	**2.30**		
Personally undertaking the physical activity.	**1**	**1.15**		
Having a correct view of the physical activity during practice.	**1**	**1.15**		
Being innovative at work.	**5**	**5.75**		

Table N°3 represents the specialised competence for a PSE teacher

The findings in table N°3 show how teachers perceive the specific competence that a PSE teacher should have. In fact, nineteen PSE teachers, 21.83%, gave two answers which represent for them the key specialised competence in PSE. This is the sound application of legislative texts supplied by the Algerian Minister of National Education.

In fact, teachers must abide by them, firstly since they are a guide to preparing classes, and secondly they provide the definition, objectives and purpose of PSE. The legislation clearly details the competence that should be acquired by the pupil at each of the three levels taught at secondary school. Competence is evaluated at the end of each trimester (basic competence), each year (final competence), and at the end of the three years of study (definitive and final competence).

In these same legislative texts there are the apprenticeship objectives for each discipline taught (collective and individual) relative to each level of teaching, including the various evaluation stages. Class preparation is clearly explained, giving models of technical sheets. In principle, the PSE teacher may not change the competence and objectives as defined in the Ministry's official textbooks.

The second competence raised by the teachers was the ability to efficiently apply the approach by competence in PSE teaching. An earlier study (Bensikaddour et al, 2013) shows that this was far from being the case for the group studied. Teachers under training have enormous difficulties in designing problem situations and in assisting pupils to find sound solutions (*ibid.*).

Furthermore, in this study show two replies have the same score. Eight PSE teachers, 9.20% of the group, gave an answer considered pertinent in the literature on the subject. This is the competence relative to mastering PSE methods and styles. The work of Bensikaddour (1995), Ataallah (2004), and Laroua (2009) match the findings of D. Banville (2004). They show that a great majority of teachers in Mostaganem Province, as in Western Algeria

and Canada do not master all the various teaching methods available to them for a PSE session. Described among others by Muska & Ashworth (1994), translated by Cothranet (1999), are eleven teaching methods; Practice, Command, Guided Discovery, Reciprocity, Divergent Production, Inclusion, Self-verification, Convergent Discovery, Individual Programme, Self-teaching, and Pupil Initiative.

In the group taking part, a second group of sixteen PSE teachers, 18.40%, raised two types of competence specific to PSE: competence and professional gesture relative to teaching. They involve a simple short explanation of the exercises, and good positioning with good use of the area allocated to pupils.

The study by Laroua et al (2013) - whose purpose was to identify competence by using a grid for analysing professional gestures - has three major aspects: verbal gestures, non-verbal gestures, and positioning in the field. Findings show that the competence described by teachers was used during sessions in verbal teaching practices while adding other gestures such as voice modulation.

Eight teachers, 9.20%, mentioned mastering TICE in teaching PSE. This innovative finding, insofar as it was not cited in previous years, is today a teaching requirement. On the contrary, as TIC gradually invades all disciplines, a major change to references in professional competence is occurring with ever-increasing significance. Numerous research papers emphasize the complexity of analysing the teaching changes resulting from the integration of TIC (Levin, Ammon, 1996; Mangenot, 2000). In the framework of teacher training the complexity of such an analysis is amplified by the fact that it covers both training programmes in junior and secondary schools, where teachers under training are appointed.

In fact, in spite of integrating TIC in teaching programmes, teachers have difficulties adjusting. A recent study carried out in Mostaganem Province shows that 65.21% of teachers, particularly teachers under training, do not understand TIC in education (Laroua et al, 2013).

Furthermore, eight teachers, 9.20%, mention as competence a good relationship with colleagues and the administration. No reference is made of this competence in the literature. After having used the K^2 test, the value of K^2 calculated ($K^2cal=27.04$) is greater than the value of K^2 in the tables (K^2 Tab=26.30) where the degree of scope (N-1) is 16, and the degree of significance is 0.05.

This result indicates a significant statistical value in favour of the most often mentioned answer.

Analysis of the findings shows that sound knowledge of legislation and legislative and administrative procedures is not mentioned. However, this competence theoretically enables the teacher to know their rights as well

as their professional duties and responsibilities while referring to public function law N° 06-03 of 2006 and employment law. This is not surprising inasmuch as, during training in PSE, students on the Master degree course in Human Movement and Motor Skills say the curriculum made insufficient provision for learning about legislation (Benchehida, 2014).

Analysis of the curriculum established for the Master degree in MHM confirms this finding. Without a doubt, this has a negative effect on teachers under training, in particular during their first months after being recruited. An assessment made by the trade union Cnapeste in Mostaganem Province in 2012 confirmed that nearly 80% of new teachers recruited in the education sector do not fully understand legislative aspects and are unable to intervene on an administrative question and exercise their rights. This is particularly so when seeking a solution to a particular problem or unexpected circumstance in the establishment. The education administration in Mostaganem often organises training sessions for newly recruited teachers on such subjects as psychology and educational methods as well as on legislation, but not to any depth. In fact, the most positive type of learning situation occurs when the teacher has a problem. Then the teacher must call on knowledge of legislation they acquired in training (Cnapeste, 2014).

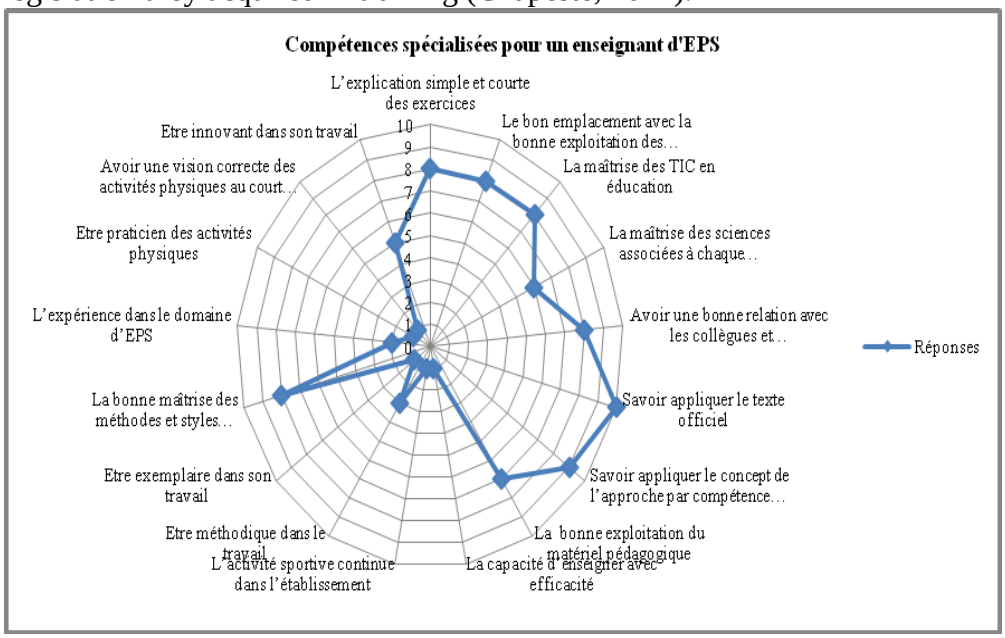

Figure N°2 showing the specialised competence that a PSE teacher should have, according to the teachers themselves.

Conclusion

The findings of this study indicate that the notion of competence is still far from clearly defined. They show that 65% of the teachers taking part cannot provide an accurate definition of competence, whether general or specific in relation to the literature on the subject.

Concerning the competence that a PSE teacher should have, several ideas have been formulated, such as “knowing how to apply the approach by competence in teaching PSE”, and “knowing how to apply the official legislation”.

On the contrary, none of the teachers taking part cited a basic competence considered fundamental to the profession in general and included in the literature on the subject: “sound understanding of legislation and administrative procedures”. This has led teachers under training to encounter major difficulties in their establishments as has been identified in other research (Laroua et al. 2013). This issue was also explicitly stated by the PSE inspector during an open-ended interview for research purposes.

Another finding concerns the training at the Mostaganem PSE Institute. In terms of the programmes and the formal curriculum training does not take into account the imperatives encountered in the field by the professional PSE teacher as stated by the teachers themselves.

Finally, from the findings of this study, discord is apparent regarding competence defined by different status PSE teachers and the training programmes of the Mostaganem Province PSE Institute (programmes studied in the form of a subject analysis of contents). The results of this study, listing 23 notions of professional competence necessary for PSE teaching do not comply with the formal training curriculum of the Mostaganem PSE Institute.

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THE CORRELATION BETWEEN THE METABOLIC DISORDERS IN OBESE MEN AND THE BODY MASS INDEX (BMI)

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Abstract

Background: The influence of body weight on serum lipids and uric acid is often overlooked in clinical practice.

Objective: To study the magnitude of metabolic disorders (dyslipidemia and hyper-urecaemia) in asymptomatic obese men and its relation to body mass index (BMI).

Methods: The study was conducted between September 2013 and July of 2014 at the medical analyses center in the Faculty of Public Health, Lebanese University. The weight, height, BMI, waist circumference (WC) uric acid, and lipid profile of 148 obese males, apparently healthy, compared with 80 males in a control group (BMI < 25 kg / m²), were investigated. Subjects were grouped by BMI and WC in accordance with the National Institutes of Health cutoff points. Within the normal-weight (18.5-24.9), overweight (25.0-29.9), and obese (≥ 30.0) BMI categories, we distributed the results of all the blood tests and we computed the prevalence of dyslipidemia and hyperurecaemia.

Results: The present work revealed that with increasing body weight, the mean total cholesterol, LDL-C, triglycerides(TG), and uric acid increased; while the mean HDL-C decreased. These changes were as follows: the means difference between the first and second group and between the second and the third group were 29 and 31 mg/dl respectively regarding total cholesterol; for TG, these were 47.5 and 53.4 mg/dl; for LDL-C, these were 12 and 29 mg/dl; for HDL-C, these were 3.6 and 3.5 mg/dl; for uric acid, these were 0.3 mg/dl as a common difference, P=0.0245).

Conclusion: Excess body weight is associated with deleterious changes in the lipoprotein profile and uric acid.

Keywords: Metabolic disorders, obesity, Bodi Mass Index

Introduction:

Obesity is an excessive accumulation of energy in the form of body fat which impairs health.The main cause of obesity epidemic is clear: overeating, especially that of foods, which are rich in fats, extracted sugars or refined starches. This combined with decline in physical activity results in an imbalance of intake and expenditure of calories, resulting in excess weight and eventually obesity. Co-morbidities commonly associated with obesity include diabetes,cardiovascular and respiratory disease, dyslipidemia, degenerative joint disease, stress incontinence and some form of tumors and other various diseases. Dyslipidemia is a widely accepted risk factor for coronary artery disease and is an important feature of metabolic syndrome. Obesity especially visceral obesity causes insulin resistance and is

associated with dyslipidemia, impaired glucose metabolism, and hypertension all of which exacerbate atherosclerosis. The primary dyslipidemia related to obesity is characterized by increased triglycerides, decreased high density lipoprotein levels and abnormal low density lipoprotein composition. Weight loss and exercise, even if they do not result in normalization of body weight, can improve this dyslipidemia and thus reduce cardiovascular risk. In addition, obese individuals needed to be targeted for intense lipid lowering therapy, when necessary(AK Singh, 2011), (Sharma S. K , 2011)(Misra A, 2008); (Gupta R, 2002), (Gupta R,, 2007)

Obesity is an increasing health issue worldwide and an economical burden, and as the hallmark of the metabolic syndrome the obese state is frequently associated with the development of chronic diseases, including type 2 diabetes (James WP,2008) ,(Wellen KE, 2005) .The association between the epidemics of obesity and diabetes has promoted research on the endocrine link between lipid and glucose homeostasis, demonstrating that adipose tissue is an endocrine organ releasing various adipokines. (SellH,2013).

Metabolic syndrome is defined as a group of coexisting metabolic risk factors, such as central obesity, lipid disorders, carbohydrate disorders, and arterial hypertension (M. Janghorbani,2012), (V. Altabas2012)

Those factors increase the risk of developing cardiovascular diseases of atherosclerotic etiology and diabetes mellitus type 2 ,which are the main cause of premature deaths among most of the European and US population (E.S.Ford, 2004)

Metabolic syndrome is defined as a group of coexisting metabolic risk factors, such as central obesity, lipid disorders, carbohydrate disorders, and arterial hypertension. (According to the 2005 IDF criteria, subsequently revised in 2009, abdominal obesity is identified as the waist circumference of ≥80 cm in women and ≥94 cm in men. It is responsible for the development of insulin resistance. The number of patients with metabolic syndrome increases with age. In the US population, the percentage of such patients above the age of 20 is approximately 23%, while the percentage of such patients above 60 is approximately 40%(M. Shields, 2012).Abdominal obesity is the major disorder constituting a base for the development of metabolic syndrome. BMI is the simplest, most practical, and most widely used system of indexing body weight. It is defined as body weight (in kilograms) divided by the square of body height (in metres).The index divides patients into appropriate categories: underweight, normal weight, overweight, and obese. Even though BMI is commonly used for monitoring the occurrence of obesity in the population, it has numerous limitations. It does not provide any information on the distribution of the adipose tissue in

the organism. BMI is a calculated statistical value which does not take into consideration physiological differences in the proportions between the adipose, osseous, and muscular tissues (M. Shields, 2012).Besides, its value is affected by sex,age, constitution, and training. Evidence from the conducted studies has revealed that abdominal obesity (assessed based on the waist circumference) plays a very important role in the development of metabolic disorders and in the assessment of cardiovascular risk. According to the 2005 IDF criteria, subsequently revised in 2009, abdominal obesity is identified as the waist circumference of ≥80 cm in women and ≥94 cm in men. It is responsible for the development of insulin resistance (Marcin Gierach, 2014). Obesity has become an increasing public health problem internationally (Obesity: World Health Organ Tech Rep Ser 2000).Attention has been given to the adverse health consequences of a moderate increase in body mass index (BMI) in different ethnic groups (WHO consultation. 2000); (Kumanyika SK.1993) .Several lines of evidence indicate that the distribution of fat is a major determinant of cardiovascular risk in both normal weight, overweight and moderately obese (Larsson B 1984), Schneider HJ(2010)Australia, Brazil, China, Mauritius and Western Samoa

Overweight and obesity are linked to a host of chronic disorders, including hypertension, hyperlipidemia, diabetes mellitus and osteoarthritis. The prevalence of overweight has been reported to be increasing in varying degrees, not only in the United States, but also in Britain and elsewhere in Europe, as well as in countries as diverse as Australia, Brazil, China, Mauritius and Western Samoa. (KM Flegal, 1998)

Aim of the work:

The aim of the present work was to study the correlation between the level of nutritional obesity represented by the body mass index (BMI) in adult men (18 year and above) and the serum levels for the total cholesterol(TC), triglycerides (TG), low-density lipopolysaccharide cholesterol (LDL-C), high density lipopolysaccharide cholesterol (HDL-C), fasting blood glucose and uric acids.

Material and methods:

The study was done at the department of laboratory in the faculty of public health, Lebanese university.

This study included 248 adult men divided into three groups according to their body mass index.

Group I: 80 normal weight men (BMI < 25 kg/m²) considered as Controls.

Group II: 88 overweight men (BMI between25 and 30 kg/m2).

Group III: 80 obese men (BMI ≥ 30 kg/m2).

Inclusion criteria: Persons above 18 year
Exclusion criteria:

- Persons with endocrine diseases as Cushing's syndrome.
- Persons with diabetes mellitus, or even those with Impaired Fasting Glucose (IFG) according to the classification of the American Diabetes Association (ADA) (fasting glucose 100-125 mg/dl).
- Persons with cardiovascular disease as ischaemic heart disease, hypertension or familial hypercholesterolaemia.
- Persons with renal diseases as Nephrotic syndrome or chronic renal failure.
- Persons with family history of blood lipids disorder, ischaemic heart disease, diabetes, hypertension or obesity.

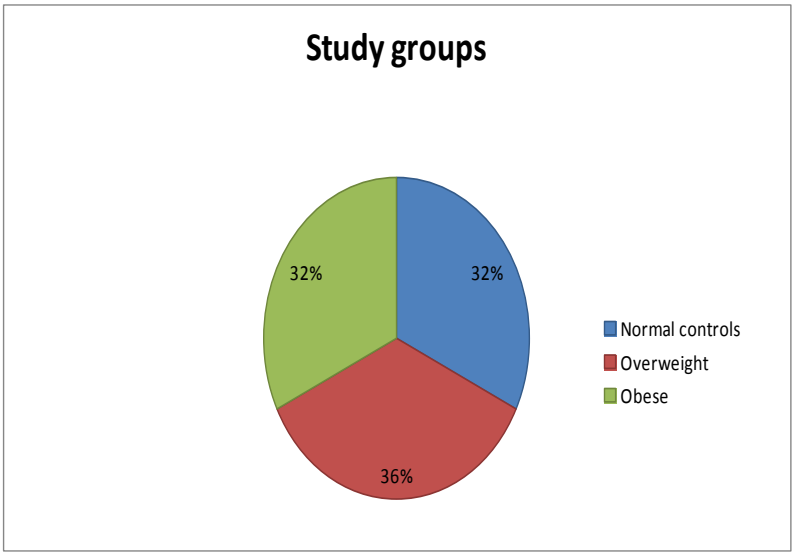


Chart 1: Distribution of the study groups

Venous blood samples were collected from each subject on an empty stomach after a fasting period at least 12 hours and after a rest period of more than 15 minutes. Then each sample is centrifuged to get the patient's serum and the samples were preserved frozen at-20 ° C for a period of less than two months (can be saved at -20 for a maximum term of three months) and then thawed to room temperature directly before the measurement.

Each person had the following measurements: the total cholesterol(TC), triglycerides (TG), low-density lipopolysaccharide cholesterol (LDL-C), high density lipopolysaccharide cholesterol (HDL-C), fasting blood glucose and uric acids.

The standards used in this study are those known universally and are outlined in the following table

Values in mg/dl	Normal	Limit	High
Total Cholesterol	< 200	200-239	≥ 240
LDL-C	< 130	130-159	≥ 160
HDL-C	< 35		
TG	< 160	160-200	> 200

Table 1: recommended world-wide standards according to the NECP

While the uric acid levels were considered high when the serum levels exceeded 6mg/dl.

Also fasting blood glucose were considered high when their level exceeded 126 mg/dl.

After getting the results of chemical analysis, we used statistical analysis software SPSS for the mean and the standard deviation of each of the variables examined in each group.

In addition to that the statistical Grubb' test was used to detect numbers far from mean values (Outliers) so as to exclude them before any statistical test.

A. Results:

The present study revealed the following results:

Table 1:

BMI (kg/m^2)	TC	HDL-C	LDL-C	TG	Uric acid
Normal weight (Mean± SD)	184±40	49.15±10.2	124.88±35	131.86±73	5.54±1
Overweight (Mean± SD)	213.5±45	45.5±9.7	136.5±39.75	179.35±74.6	5.9±1.6
Obese (Mean± SD)	244.27±43.51	41.93±8.7	165.5±33.43	232.75±98.8	6.2±1.34

1.Total cholesterol: Table I shows that the difference between the average values of total cholesterol is about 29 mg/dl higher in group II than group I and this difference is statistically significant ($P < 0.0001$); and 31 mg/dl higher in group III than group II which is also statistically significant difference ($P < 0.0001$).

This indicates that higher weight is associated with high serum level of total cholesterol.

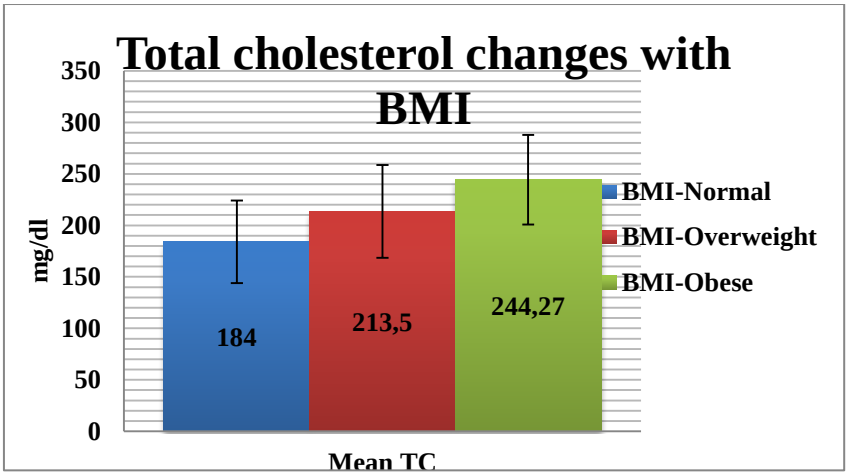


Chart …… : Total cholesterol changes with BMI

Triglycerides: Table I shows that the difference between the average values of triglycerides is about 47.5 mg/dl higher in group II than group I and this difference is statistically significant ($P < 0.0001$); and 53.4 mg/dl higher in group III than group II which is also statistically significant difference ($P < 0.0001$). This indicates that higher weight is associated with high serum level of triglycerides.

Comparing the means for trigycerides:

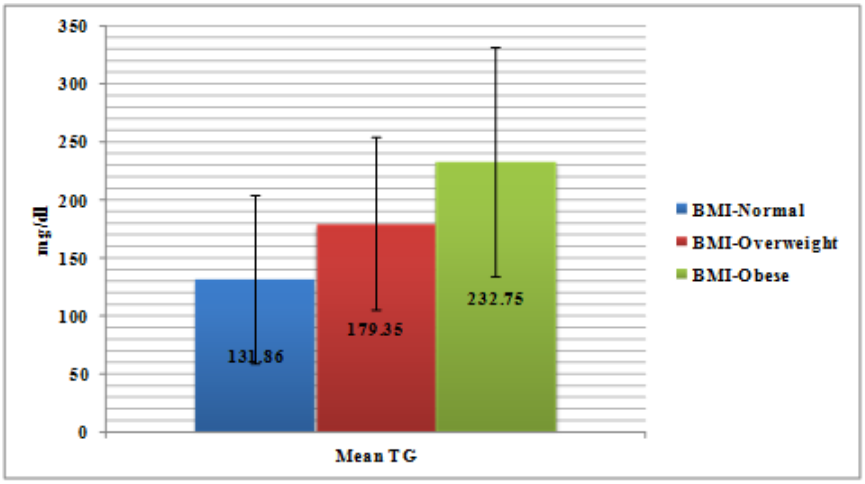


Chart …….: Total TG changes with BMI

3. low-density lipopolysaccharide cholesterol (LDL-C): Table I shows that the difference between the average values of LDL-C is about 11.6 mg/dl higher in group II than group I and this difference is statistically significant ($P<0.0469$); and and 29 mg/dl higher in group III than group II

which is also statistically significant difference (P < 0.0001). This indicates that higher weight is associated with high serum level of LDL-C.

Comparing the means for LDL-C

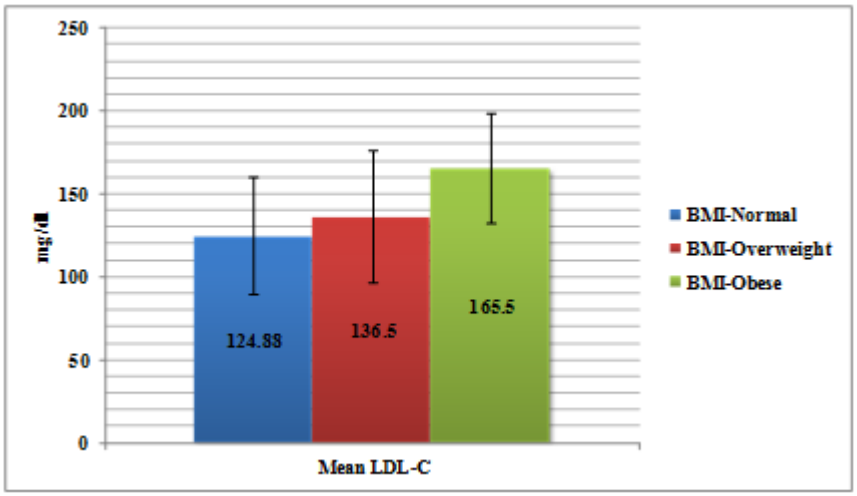


Chart …… : Total LDL-C changes with BMI

4. High density lipopolysaccharide cholesterol (HDL-C): Table I shows that the difference between the average values of (HDL-C) is about 3.6 mg/dl lower in group II than group I and this difference is statistically significant (P < 0.0168); and 3.5 mg/dl lower in group III than group II which is also statistically significant difference (P < 0.0133). This indicates that higher weight is associated with low serum level of HDL-C.

Comparing the means of HDL-C

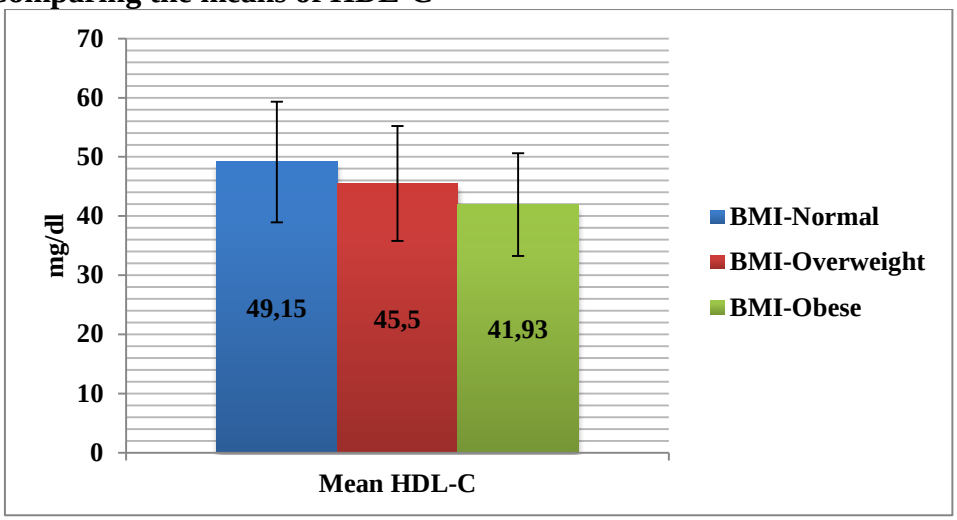


Chart3: Total HDL-C changes with BMI

5. Serum uric acid: Table I shows that the difference between the average values of uric acid is approximately 0.36 mg/dl higher in group II than group I and the difference is not statistically significant (P < 0.0857), and 0.3 mg/dl higher in group III than group II which is not also statistically significant (also P < 0.1919). This indicates that higher weight is associated with slight increase in the serum level of uric acid, without statistical significance.

Comparing the means for Uric acid

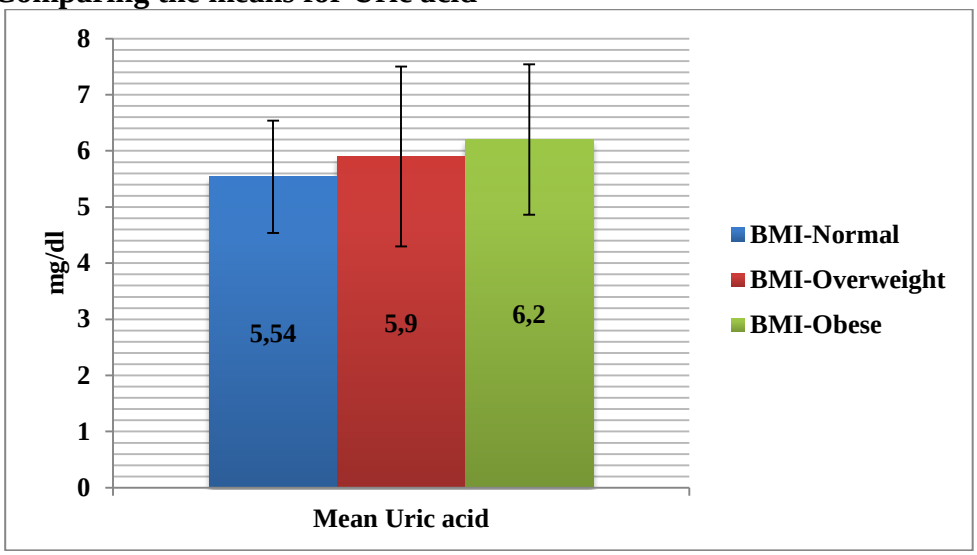


Chart6: Total uric acid changes with BMI

1. Comparison of metabolic disorders prevalence rates between the three groups:

By calculating the prevalence of metabolic disorders seen in obese and overweight men and comparing them with standard weight group (Controls) and placing the results in tables we get the following data:

% of prevalence	Group I Normal weight	Group II Overweight	Group III Obese
Total Cholesterol-High	23.1	25	59.3
Total Cholesterol-Borderline	19.6	38	26.5
LDL-C- High	6.6	21.4	62.5
LDL-C- Borderline	14.7	31	21.8
HDL-C-low	1.25	15.4	29.68
TG High	6.3	31	51.5
Hyperurecaemia	7.5	26.2	37.5

Table3: % of prevalence of metabolic disorders according to the BMI

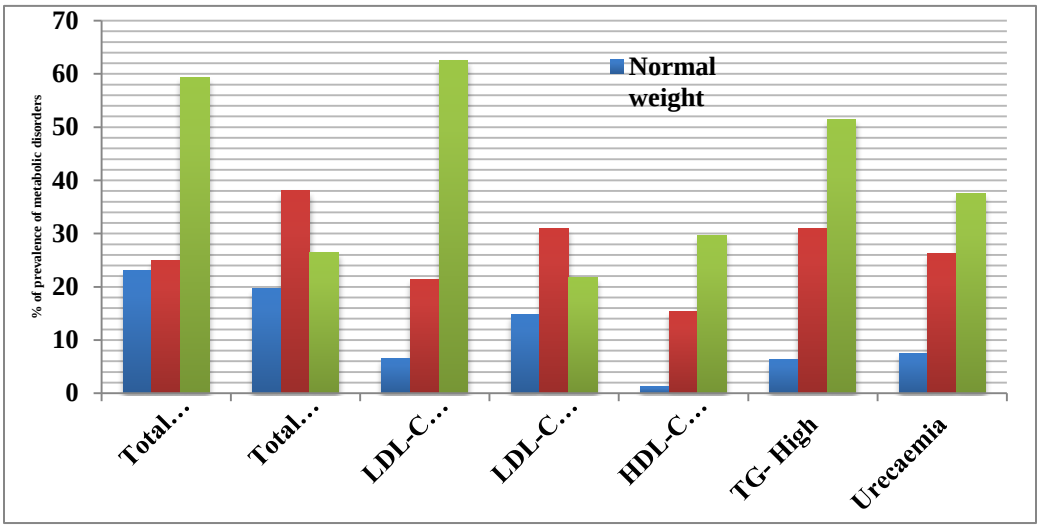


Chart 7: % of prevalence of metabolic disorders according to the BMI

1. This figure shows that the prevalence of metabolic disorders is higher in the overweight and obese group as compared with the control normal weight group.

Studying the correlation between the BMI and each of the studied variables

Correlation coefficient of Pearson was used and the results were as follows

a) Correlation between the BMI and TC

The relation between BMI and TC was linear and positive (r=0.69)

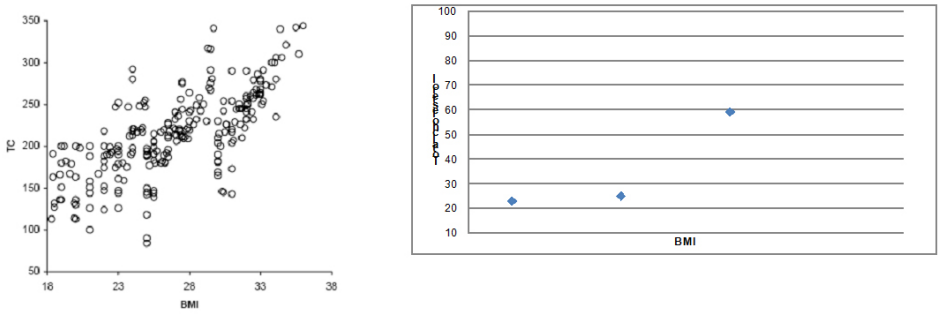
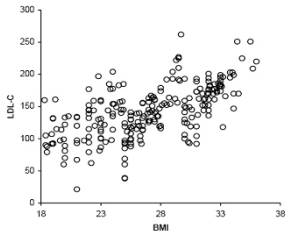


Figure1: Correlation between BMI and total cholesterol

b) Correlation between the BMI and LDL-C

The relation between BMI and LDL-C was linear and positive (r=0.59)



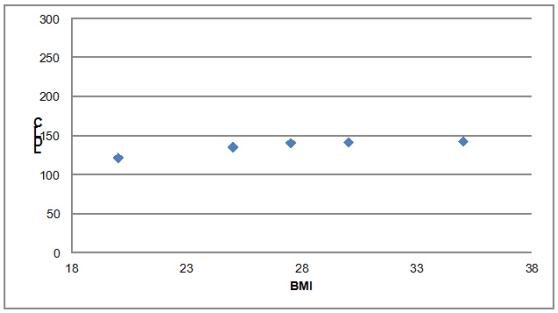
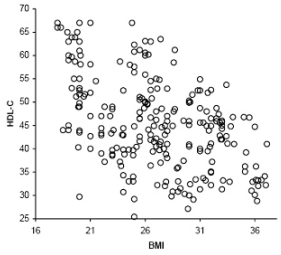


Figure2: Correlation between BMI and LDL-C values

c) Correlation between the BMI and HDL-C

The relation between BMI and HDL-C was linear and negative, but not strong (r=-0.549)



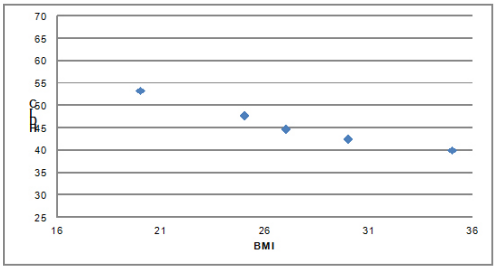
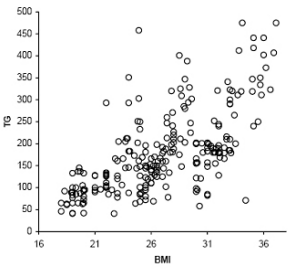


Figure3: Correlation between BMI and HDL-C values

d) <u>Correlation between the BMI and TG</u>

The relation between BMI and TG was linear and positive (r=0.66)



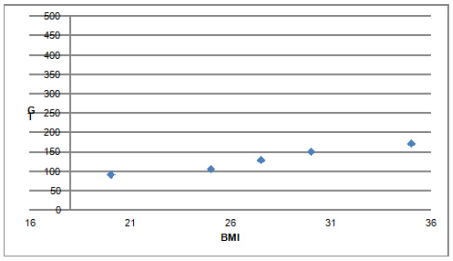


Figure4: Correlation between BMI and TG value

e) Correlation between the BMI and Uric acid

The relation between BMI and Uric acid was linear and weak (r=0.34)

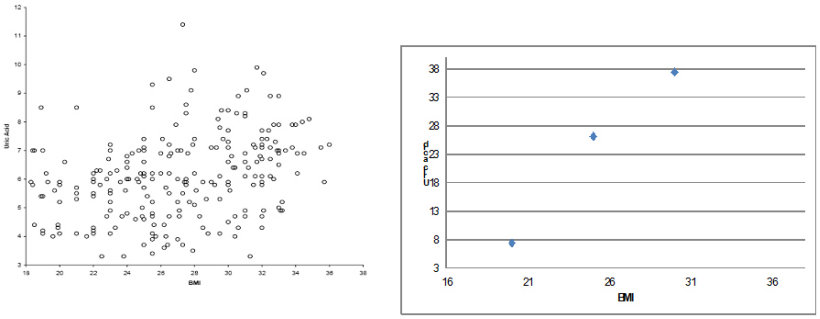


Figure5: Correlation between BMI and uric acid value.

Discussion:

1. Accompanying the increased weight with:
    - higher values for serum levels of total cholesterol, TG, LDL-C lower level values a worshipper of HDL-C.
    - Higher values for serum levels of uric acid level, but the results were not statistically significant.
    - The prevalence of higher serum levels of total cholesterol, TG, LDL-C and uric acid is higher when overweight and obese are compared to controls; and obese is higher compared to overweight. And the frequency of the low level HDL-C was higher when overweight and obese compared with controls, and higher when compared with obese overweight.
2. The relationship between positive function of increasing weight and level of total cholesterol, TG, LDL-C and reverse with the level HDL-C.
3. The relationship between increased weight and level of serum uric acid was positive and weak.

B. Comparative local studies

We did not find any local search is similar to research this and all we found was a search soon for his maysaa al Hamwi 2002 examined where fat and lipoprotein disorders in different types of obesity and its relation to cardiovascular injury frequency. Dr. Hamwi found the existence of a direct correlation between the levels of both TG and LDL-C and BMI; and the existence of an inverse relationship between HDL-C and BMI levels. Note that the study included both genders and family and non-family obesity.

C. Comparative international studies

1. Munster heart study: published by PROCAM (Groupe de reflexion international pour la prevention des maladies coronarienne) in an article entitled. Maladies coronarienne: reduire lerisque.

   The study included 12,231 men classified in 5 groups of BMI (kg/m2) are: 1. BMI ≤ 20. 2- BMI (20.1 – 25). 3- BMI (25.1 – 27.5) 4- BMI (27.6 – 30). 5- BMI > 30. The findings of this study is huge, as follows:

BMI (kg/m^2)	Mean LDL-C (mg/dl)	Mean HDL-C (mg/dl)	Mean TG (mg/dl)
≤ 20	122	53.3	92
20.1-25	136	47.8	106
25.1-27.5	141	44.7	129
27.6-30	142	42.5	151
> 30	143	40	172

   This study showed, in turn, the role and influence of weight measurements of grease and lipoproteins in the blood. This message indicates (because of the large sample studied allowed broader classification for men by BMI) that this impact continues even in ideal weight objects (De forme) and slender objects (Maigre) as evidenced by the results of this study.

2. A study by the National Health and Nutrition Examination Survey and Panel III (NHANES III); 1988-1994 17: body mass index BMI and the prevalence of risk factors in cardiovascular disease.

   Researchers examined the prevalence of high blood cholesterol, high LDL-C, low HDL-C, high triglycerides TG, and its relationship with BMI. The men were classified in four groups as follows: 1. BMI < 25. 2- BMI (25 – 26). 3- BMI(27 – 29). 4- BMI ≤ 30. And the results were as follows:

   - Increased body weight was associated with higher levels of total cholesterol.
   - Increased body weight of BMI ≤ 21 to BMI ≥ 30 was associated with higher serum levels of the TG. (The difference between these levels ranged from 62 to 118 mg/dl).
   - Statistical studies have found that changes in BMI is associated with changes in the level of serum HDL-C, noting that1 unit change in the BMI is associated with

change in level of serum HDL-C with an average of 1.1 mg/dl.

- Studies have also found that the 10 units increase in the BMI is associated with a high rate (between 10 to 20 mg/dl) in the level LDL-C.

3. Research conducted at the University of Texas, United States 5, titled "Excess body weight. An under recognized contributor to high blood cholesterol levels in white American men " to study the influence caused by overweight fat level in the serum lipids. Test results were distributed among the different types of BMI. The study showed that overweight is associated with Deleterious health damaging changes in levels of serum lipoproteins, since the high BMI at all ages is associated with a higher level of the TG, total cholesterol, TG and non-HDL-C; and a lower level of the serum HDL-C

D. Recommendations

-The need to maintain an ideal Body Weight to improve the level of triglycerides and blood lipoproteins in order to be at a lower risk for arterial disease and coronary heart and other diseases that have proved their impact on health and life.

-Encourage people, especially children in the critical stages of their development, to participate more in sports and away from sedentary life style and to avoid weight gain and obesity.

-Impose strict measures on all products with high caloric intake as did United Kingdom UK by imposing higher taxes on these articles.

- Adoption of marginal figures Cutoff Points for serum levels of total cholesterol and LDL-C and HDL-C and other studies by the NECP and the national institutes of health (NIH).

- Raising awareness of citizens about the dangers of obesity through media, seminars and lectures.

-The need for further studies to complement this study deals with the comparison of serum level of leptin in obese and non-obese.

-Complementary studies looking at the impact of reducing body weight on the levels fats and serum lipoproteins.

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A MODEL SUGGESTION FOR BUDGETING ACTIVITY COST REDUCTION UNDER ACTIVITY BASED KAIZEN BUDGETING APPROACH

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Abstract

Nowadays, competitive global business life surrounds various companies around the world. Production technology develops in a very fast manner. Also, companies are in need of advanced budgeting and costing techniques in order to make more profit and stand strong in this fast changing scene. Companies use Activity Based Budgeting (ABB), Activity Based Costing (ABC), and Activity Based Management (ABM) systems to gain successful results. These systems concentrate on overhead costs in order to assign real production cost. In this study, we consider activity based systems and introduce a new model to apply Kaizen Budgeting through ABB and ABC approach in a business organization. Also, we aim to illustrate a case study for an activity center in order to explain our kaizen budgeting model. Our ABB and ABC model has been used in many organizations in Turkey and its success has been proved for years ago. However, our new model will be the first approach for ABB and ABC model via kaizen budgeting. We aim to reduce the organization's variable cost by kaizen budgeting in an efficient manner. Furthermore, we classified costs into four categories such as resource costs on the basis of the volume of activities, resource costs on the basis of activity level, resource costs independent from the volume of activities, and direct resource cost. This approach enables us to reduce the variable costs of activities according to their characteristics.

Keywords: Activity Based Costing, Activity Based Budgeting, Cost Assignment, Kaizen Budgeting.

Introduction

Companies are in need of faster, more qualified, more efficient, and sustainable technologies in order to compete around the world. However, advanced technologies by themselves are not enough to succeed in a competitive world. Companies have been trying to reduce their costs in order to gain more profit by applying different costing and budgeting techniques. Companies have to make a decision to operate their business in a fast atmosphere. Also, the related and relevant information should be prompt, true, and accessible.

Overhead costs are very important in identifying real production cost such as rental, depreciation, maintenance, research and development, and sales expenses. "Kaizen Budgeting" is a cost reduction method that enables companies to reduce their variable costs and gain more efficient results.

Therefore, we built a new model under ABC method using Kaizen Budgeting to reduce all of the activities in terms of the cost and capacity. We developed our model under ABC Kaizen Budgeting method to be able to reduce the cost of the activities. Hence, this is aimed not only to reach the full commercial cost of products at different activity levels, but also to reduce the full commercial cost of the product's variable costs.

1. Activity Based Costing (ABC)

ABC method was first introduced by George Staubus in his book titled "Activity Costing and Input-Output Accounting" (Staubus, 1971). However, Robin Cooper and Robert S. Kaplan developed a new approach of the Balanced Scorecard and brought a notice to these concepts.

Activity Based Costing system was developed to estimate the cost of resource to produce products or services. Resources are assigned to activities, and activities are assigned to cost objects based on consumption estimates (CIMA, 2001).

1.1. Overhead Costs- ABC Approach

Activity Based Costing (ABC) assigns manufacturing overhead costs differently than the traditional costing method. Activities demanded by each product are classified; and then, costs of these activities are assigned to products based on their level of use (Kaplan & Johnson, 1991). ABC system provides a clear understanding of the exact cost consumed by a product by determining the demand of activities for that product. In addition, it is also achieved by assigning the cost of activities determined on the product which actually uses those activities. Besides providing accuracy in terms of overhead cost allocation, ABC also provides more accurate data regarding the distortion of resources as it provides value based data for management.

1.2. Activity Based Budgeting (ABB) and Activity Based Management (ABM)

Activity Based Budgeting (ABB) is a budgeting method to gather information about activities to be performed, and the cost of these activities over a specific period. Hence, it reflects the strategic goals and the current performance of a company. In ABB system, historical data produced by ABC method is used for forecasting future cost to estimate the required level of activities to access budgeted production volume.

As ABC and ABM are strongly related to each other, Institute of Management Accountants has listed their actions as follows (Institute of Management Accountants, 1998):

- ABC focuses in understanding costs and their drivers, while ABM seeks to change them.
- ABC can provide information on process, product, and market performance; hence, ABM finds ways to improve them.
- ABC is cost centered, while ABM lies in the heart of the management process.
- ABC is the result of a static analysis of the organization, while ABM is embedded in the dynamics of change.
- ABC is predominantly historical and focuses on controlling existing costs; ABM is forward looking, seeking ways to avoid unnecessary costs and putting existing resources to maximum use.
- ABC reports on internal operational and tactical results; ABM is strategic, focused on understanding the key elements of value from the customer's perspective.
- ABC is a source of explanatory data, while ABM provides actionable information.

1.3. Direct Resource Costs

If one resource is used only for a certain product, the cost of this resource should be assigned directly to the product that it is related to. For example, if a product manager only works with one product or there is a machine which is used for the production of one specific product, the costs of this type of resources should be considered as direct resource costs.

2. Definition of Kaizen Costing

The word "Kaizen" was brought to business literature by the Japanese. Basically, "Kaizen" refers to a management philosophy. Masaaki IMAI, who was described as the person of this management philosophy's founder, developed Kaizen in Japan.

Definition of the word "Kaizen" can be described as:

Kai = Change

Zen = Good
Kaizen = Continuous Improvement (BOZDEMİR, E., 2011).

Kaizen aims to carry out a continuous improvement in a business process with small steps. Since the results are effected by the processes, Kaizen helps to improve the processes in order to improve the results. Thus, competitive advantage is achieved through Kaizen strategy. If a company aims to be a permanent actor in the business field, it is obliged to respond to the customers' requests. Kaizen strategy brings improvements in time, cost, and quality. In addition, these improvements bring benefits to the customers. Therefore, all Kaizen activities are assumed to increase customer's satisfaction (IMAI, M., 1999).

Kaizen Costing can be described as continuous improvements applied in the production phase of a product in order to establish cost reduction. Kaizen Costing reduces the production costs by seeking alternative ways to increase the efficiency of the manufacturing process used for the products. In most of the companies that manufacture short-lived products, production processes have longer lives than the products. Therefore, greater savings can be achieved by focusing on the processes during the production phase of a product rather than on the product itself (COOPER, R., 1999).

When cost reduction objectives are defined clearly, Kaizen Costing works effectively like Target Costing. Unlike Target Costing, Kaizen Costing focuses on the production processes of the product, rather than the design of the product. Thus, the main purpose of Kaizen Costing is to eliminate all kinds of non-active elements of the production process (COOPER, R., 1995).

2.1. Objectives and Characteristics of Kaizen Costing

The main objective of Kaizen costing is to monitor the cost reductions on each phase of production. Thus, this is aimed at reducing the gap between the targeted (budgeted) profit and the estimated profit. This approach is different from Standard Costing both conceptually and methodologically. Conceptual and methodological features of this approach are as follows:

a) Conceptual Features

- The purpose of the cost reduction system is to reduce the actual costs down to standard costs.
- Application controls are used to achieve the goals of cost reduction.
- Current production conditions are changed continuously in order to reduce the costs

b) Methodological Features

- New cost reduction objectives are determined each month. These objectives are designed to minimize the gap between the targeted profit and estimated profit.
- To achieve the targeted cost reduction, continuous Kaizen activities were applied.
- Differences between targeted costs and actual costs were analysed.
- Researches are applied and corrective actions were taken when target cost reductions could not be achieved (MONDEN, Y., 1995).

2.2. Benefits of Kaizen Costing

In order to avoid high cost problems, poorly designed and poorly managed processes should be taken under control. In this context, when improvements are achieved, the following changes take place:

- Cost of operations reduces;
- Goods and services achieve higher quality; and
- Lower costs give the company the opportunity to reduce the product prices and increase the competitive power of the company (GURDAL, K. , 2007).

3. Kaizen Budgeting

Kaizen budgeting is part of Kaizen activity based management system and total quality control. This system is similar to a kind of contribution analysis based on the direct costs. In this system, the distribution of indirect costs is not a concern (TANAKA, Takao, 1994).

Kaizen budgeting is a budgeting approach that is based on continuous improvement in the budgeted figures during the budget period (HORNGERN, Charles T, 1997).

Kaizen budgeting activities such as plant rationalization plans include reductions in variable production cost estimations. Hence, this can be seen as the basis of Kaizen Costing activities. These plans determine the reduction targets in variable production costs where personnel plans set goals for reductions in direct and indirect labor costs (HORNGERN, Charles T, 1997).

4. A Model Suggestion

Activity Based Costing (ABC) has been the most popular costing method. It provides the most accurate way for the allocation of overheads. However, when overheads are treated the same way, there might be some inconsistence in the management of resources even though the costs assigned to products or services are exactly the right one (Pazarceviren & Şahin, 2013).

Consequently, we have developed a sub-approach for Activity Based Costing that classifies the overheads under five different categories:

1. Resource costs on the basis of the volume of activities.
2. Kaizen budgeting on the basis of activity level.
3. Kaizen budgeting through resource costs, independent from the volume of activities.
4. Direct resource cost.
5. Kaizen cost reduction for budgeting.

We have been using ABC method for most of the companies that we consult with an ERP (Enterprise Resource Planning) program designed by Professor Selim Yuksel Pazarceviren[2]. Also, we have seen the success of the method in practice. ABKB (Activity Based Kaizen Budgeting) is our new method which allows us to reduce the cost of the product or service based on the income and the managing of the company's costs efficiently.

4.1. Resource Costs on the Basis of the Volume of Activities (Per Capacity Unit)

Some resources are consumed based on the volume of activities. Most of the variable costs are considered in this category. In the case of overheads, maintenance activity is the most common example of resource that changes based on the volume of activities. This is because maintenance needs depends on the machine hours. In addition, we aim to reduce the variable cost of maintenance activity. Resource usage that changes on the basis of activity volume is consumed per capacity unit, which is the basis for the production volume of each product.

4.2. Kaizen Budgeting Through Resource Costs on the Basis of Activity Level

There are some resources that can only be used till a certain capacity level. For example, if one production expert is assigned per 50 machines and the number of the machines exceed 50, one expert himself alone will not be able to comply with the need of the department. These resources usually consist of the salary of the personnel on the activity centers as well as the depreciation of the machines in these centers. Consequently, we aim to reduce blue collar costs resulting from overtime working in an efficient manner.

[2] Professor at Istanbul Commerce University and Cost Management Consultant

4.3. Kaizen Budgeting Through Resource Costs Independent from the Volume of Activities

When one or more resources are consumed for more than one product, the costs of these resources are assigned to a cost pool first. Then, they are allocated to products based on usage volume. Thus, these resources are consumed by the activity centers, and it is not directly related with the products. Whether or not an activity center meets a certain level of activity, the cost of these resources will be placed in the total cost. Consequently, we aim to reduce variable part of the costs via the kaizen cost reduction ratio.

4.4. Direct Resource Costs

If one resource is used only for a certain product, the cost of this resource should be assigned directly to the related product. For example, if a product manager only works on one product or there is a machine which is used for the production of one specific product, the costs of these resources should be considered as a direct resource costs.

4.5. Kaizen Cost Reduction Budgeting

When assigning kaizen cost reduction ratio, we should have standard cost data in order to assume it fairly. Kaizen cost reduction ratio assumption should be related to previous year's data. Thus, we find kaizen allocation rate which is estimated for Item A's total volume. Then, Item A's total volume is divided by the total estimated production volume. Consequently, we find kaizen cost allocation rate as kaizen allocation rate multiplied by the estimated kaizen total cost target.

5. Case Study

We aimed to illustrate the use of our approach in a company case to show the entire process of activity based kaizen cost budgeting. We simplified the illustration as much as possible for both academicians and business professional to apply the model in their studies or working processes. Subsequently, we defined the following steps in our model to illustrate the entire process:

1. Budgeting production volume.
2. Budgeting required capacity of activities.
3. Budgeting activity level.
4. Budgeting capacity unit based costs.
5. Budgeting capacity level based costs.
6. Kaizen cost budgeting target through resource costs independent from the capacity and direct resource cost.
7. Kaizen cost budgeting through budgeted capacity level.
8. Kaizen budgeting through resource costs independent from the capacity.

9. Budgeting of aftermarket warranty and service costs.
10. Budgeting of kaizen cost reduction target through kaizen target cost reduction ratio.
11. Budgeting of total kaizen cost reduction target.

6. Illustration

TDS Company is a manufacturing industry for the production of luxury bags. The activities that TDS Company performs are as follows:

1. TDS Company produced 3 items: item A, item B, and item C. These are different items that require different volume of activity (see Table 1 and Table 2).
2. TDS Company has 50 working benches in the Machining Activity Center. In this process, the leather parts get shaped. Accordingly, it is predetermined that there are 50 machining hours (MH) in a working hour. (see Table 2)
3. TDS Company performs 1 maintenance hour for 400 bench hours of machining. Maintenance activity is performed as a supportive activity, and will consist of resources on the basis of capacity unit[3].
4. TDS Company kaizen cost reduction ratio is determined to be 0.05 percent for kaizen budgeting transaction. (See Table 5.1)

Step 1: TDS company budgets the volume of production based on historical data and demand forecasts for its variable costs in order to reduce variable cost according to kaizen budgeting principle. However, the company budgets production level on a yearly basis (We assume that monthly production will be at the same level each month, so that we would divide the numbers of products budgeted yearly by 12 in order to reach monthly capacity).

Table 1: Number of Product Budgeted for 2015

Product	Number of Product Budgeted (Yearly)	Number of Product Budgeted (Monthly)
Item A	12.000	1.000
Item B	24.000	2.000
Item C	36.000	3.000

Step 2: According to historical data, TDS Company budgets machining hours (MH) that is required to produce each product. There are 50 benches in Machining Activity Center; thus, each of the products consumes different period of time. Period of time required for each product is shown in Table 2.

[3]2 : The model in the illustration does not include any direct material and direct labor as the illustration was intended to be simplified.

Table 2: Capacity Budget for Machining Activity Center					
Product	**Number of Product Budgeted (Yearly)**	**Number of Product Budgeted (Monthly)**	**Machining Capacity (Required machining hours per item)**	**Machining Capacity Budgeted (MH/Year)**	**Machining Capacity Budgeted (MH/Month)**
Item A	12.000	1.000	10	120.000	10.000
Item B	24.000	2.000	15	360.000	30.000
Item C	36.000	3.000	20	720.000	60.000
Normal Capacity of Activities Budgeted				1.200.000	100.000
Budgeted Working Hours (There are a total of 50 benches in Machining Activity Center. Accordingly, there are 50 machining hours in one working hour).				24.000	2.000

Step 3: As mentioned before, there are levels for activity centers. Activity level is dependent on the activity usage of each product. However, there might be some unused capacity. Some of the costs change based on the activity level. TDS Company calculates its activity level based on the production budget as seen in Table 3.

Table 3: Activity Center - Activity Level Budget						
Activity Level	**Number of Shifts per Day**	**Shift Types**	**Working Hours per Day (WH / Day)**	**Budgeted Work Days per Year (WD / Year)**	**Budgeted Working Hours per Year (WH / Year)**	**Budgeted Working Hours per Month (WH / Month)**
Level 1	1	Normal Working Shift	8	248	1.984	165,33
Level 2	1	Normal Working Shift	8	248	1.984	165,33
Level 2		Working Overtime			170	14,17
Level 2		Total			2.154	179,50
Level 3	2	Normal Working Shift	16	248	3.968	330,67
Level 4	2	Normal Working Shift	16	248	3.968	330,67
Level 4		Working Overtime			200	16,67
Level 4		Total			4.168	347,33
Level 5	3	Normal Working Shift	24	248	5.952	496,00

Step 4: TDS Company use lube oil for the machines based on the period of time that the machines run. Also, there is maintenance cost for each machine. The company aims to reduce lube oil and maintenance cost in accordance with the predetermined kaizen cost reduction rate. Budget of the costs based on the capacity use and their kaizen cost reduction target is shown in Table 4.1 below.

Table 4.1: Machining Activity Center - Cost Budget Based on Capacity Unit						
Budgeted Capacity (HR/ Month)						100.000
Resource Costs Based on Capacity Units						
Resources	**Resource Usage Per Capacity Unit**	**Total Budgeted Resource Usage**	**Resource Price per Capacity Unit**	**Total Budgeted Resource Cost (USD / Month)**	**Kaizen Cost Reduction Allocation Rate**	**Kaizen Cost Reduction According to Allocation Rate**
Lube Oil	0,10 liter	10000 (0,10 liter x 100.000 MH)	1	$11.000	0,0990991	$550
Cost of Resources Used in the Activity Center				$11.000	0,9009009	$5.000
Activity Level Supporting Activities (Maintenance)	0,2 HR	20000 (0,2 HR x 100.000 MH)	5	$100.000		
Budgeted Activity Cost				$111.000		$5.550
Total Cost of Kaizen Target					**$5.550**	

Step 5: As mentioned before, there are some costs which are not dependent on the exact capacity used, but on the level of activities. TDS company budgets its costs based on the capacity level. In addition, kaizen cost target aims to reduce the amount of overtime payment to blue collar employees in an efficient manner. Thus, related figures are shown in Table 4.2.

Table 4.2: Machining Activity Center - Cost Budget based on Capacity Level					
Budgeted Capacity Level			**Level 3**		
Resources	**Budgeted Resource Usage based on the Budgeted Capacity Level**	**Budgeted Standard Unit Price of the Resource Unit**	**Direct Resource Cost (USD/ Month)**	**Kaizen Cost Reduction Allocation Rate**	**Kaizen Cost Reduction According to Allocation Rate**
Foreman	2	$1.800	$3.600	0,75	$180
Apprentice					
Headworker	1	$1.200	$1.200	0,25	$60
Depreciation of Molding Machine	10	$200	$2.000		**$240**
Depreciation of Polishing Machine	2	$500	$1.000	**Total Cost of Kaizen Target**	
Depreciation of Sewing Machine	3	$400	$1.200		
Depreciation of Sealing Machine	5	$300	$1.500	**$240**	
Budgeted Activity Cost			$10.500		

Step 6: There are some cost which are completely independent from the activity level. These costs are incurred whether or not the company meets some certain activity level budget. The company does not have any objectives to reduce white collar employees' cost. However, it aims to reduce other indirect costs. TDS Company budgets the resource costs independent from the capacity as shown in Table 4.3.

Table 4.3: Machining Activity Center - Resource Costs Independent from the Capacity					
Resources	**Budgeted Resource Usage**	**Budgeted Unit Price of the Resource (USD)**	**Total Machining Activity-Direct Resource Cost (USD/ Month)**	**Kaizen Cost Reduction Allocation Rate**	**Kaizen Cost Reduction According to Allocation Rate**
Production Manager	1	$8.000	$8.000		
Production Responsible	1	$2.500	$2.500		
Cost of Resources Used in the Activity Center			$3.000	0,75	$150
Resources Used at the Company Level (Security, Air Condition, Lighting. Cleaning, Facility Depreciation etc.)			$1.000	0,25	$50
Budgeted Activity Resource Cost			$4.000		$200
Total Cost of Kaizen Target				**$200**	

Step 7: Some costs apply directly to the products rather than the activity centers. Depreciation expenses for the machines are the most common direct resource costs. Thus, TDS Company budgets direct resource cost as shown in Table 4.4.

Table 4.4: Machining Activity Center - Direct Resource Costs

Resources	Product/ Project	Direct Fixed Resource Cost (USD/Month)
Depreciation for the Conveyor Band (used only for Item A)	Item A	$200
Depreciation for the Conveyor Band (used only for Item B)	Item B	$150
Depreciation for the Conveyor Band (used only for Item C)	Item C	$275
Budgeted Direct Resource Cost		$625

Based on the production and activity budget, the total cost and the fixed cost that TDS Company has to bear is shown in Table 4.5.

Table 4.5 : Machining Activity Center- Budget Total

Resource Usage Types	Resource Costs Based on Capacity Units Total Budgeted Resource Cost (USD/ Month)	Resources Costs Based on Capacity Levels Direct Resource Cost (USD/ Month)	Resource Costs Independent from the Capacity Total Budgeted Activity Cost	Direct Fixed Resource Cost (USD/ Month)
Resources				
Lube Oil	$11.000			
Production Manager			$8.000	
Foreman		$3.600		
Headworker			$1.200	
Production Responsible		$2.500		
Depreciation of Molding Machine		$2.000		
Depreciation of Polishing Machine		$1.000		
Depreciation of Sewing Machine		$1.200		
Depreciation of Sealing Machine		$1.500		
Depreciation for the Conveyor Band (used only for Item A)				$200
Depreciation for the Conveyor Band (used only for Item B)				$150

Depreciation for the Conveyor Band (used only for Item C)				$275
Resources Used at the Company Level (Security, Air Condition, Lighting. Cleaning, Facility Depreciation etc.)			$1.000	
Activity Level Supporting Activities (Maintenance)	$100.000			
Budgeted Activity Cost	**$111.000**	**$11.800**	**$10.200**	**$625**

Table 4.6: Aftermarket Warranty and Service Costs

	Item A	Item B	Item C	Total
Changing	$1.200	$2.400	$3.600	$7.200
Spare Part	$600	$1.200	$1.800	$3.600
Repair Labor	$360	$720	$1.080	$2.160
Total	**$2.160**	**$4.320**	**$6.480**	**$12.960**

Table 4.7: Cost Allocation to Products

	Item A	Item B	Item C
Number of Product (Monthly)	1.000	2.000	3.000
Required capacity per product	10	15	20
Total Capacity (Monthly)	10.000	30.000	60.000
Resource Costs Based on Capacity Units Total Budgeted Resource Cost (USD/Month)	$11.100	$33.300	$66.600
Resources Costs Based on Capacity Levels Direct Resource Cost (USD/Month)	$1.180	$3.540	$7.080
Resource Costs Independent from the Capacity Total Budgeted Activity Cost	$1.020	$3.060	$6.120
Direct Fixed Resource Cost (USD/Month)	$63	$188	$375
Aftermarket Warranty and Service Costs	$2.160	$4.320	$6.480
Total Cost	**$15.523**	**$44.408**	**$86.655**

Step 7: TDS Company needs standard cost in order to assume kaizen cost reduction ratio for the following years' estimated production cost. Kaizen cost reduction ratio assumption should be related with previous years' data. In addition, company's budget of direct resource cost is shown in Table 4.4:

Table 5.1: Kaizen Cost Reduction Budgeting Table

Product	Production Cost for 2014	Total Production Volume for 2014	Estimated Production Volume for 2015	Kaizen Cost Reduction Ratio	Kaizen Cost Reduction Allocation Rate	Kaizen Cost Reduction According to Allocation Rate
Item A	$3.000,00	11.000	12.000	0,05	0,16666667	$281,19
Item B	$8.500,00	23.000	24.000	0,05	0,33333333	$562,37
Item C	$18.000,00	30.000	36.000	0,05	0,5	$843,56
Total	**$29.500,00**	**64.000**	**72.000**			**$1.687,11**
Actual Unit Cost for 2014		**$0,4609**				

Table 5.2:Total Kaizen Cost Reduction Budgeting Table

Product	Production Cost for 2014	Total Production Volume for 2014	Production Unit Cost for 2014	Estimated Production Cost for 2015
Item A	$3.000,00	11.000	0,273	$3.272,73
Item B	$8.500,00	23.000	0,37	$8.869,57
Item C	$18.000,00	30.000	0,6	$21.600,00
			Total Cost	**$33.742,29**

Kaizen Total Cost Reduction Budgeting Target for 2015	$1.687,11

7. Conclusion

In conclusion, company's activities are directly related to resources. In order to reach full commercial cost beyond the production cost, managing overheads is a highly important operation for companies. Therefore, since overheads results from activities, activities are the other important part of full commercial cost. In the past, companies have focused only on production cost. Full commercial cost enables companies to see the big picture regarding all activities. Thus, the companies gain the advantage of being one step forward in the market.

Activity Based Costing (ABC) method enables companies to manage their costs with better style. It gives opportunities to companies to define their resources for the activities with more details. Also, it gives companies a better, more accurate, and a more flexible data to reach the activity results.

Kaizen budgeting aims to bring about a more effective and faster solution to manufacturing companies. We aim to reach beyond the Activity Based Costing (ABC) and Activity Based Budgeting (ABB) through reducing companies' variable cost to gain more profit and make the companies' production processes to become more efficient.

Our approach with five major categories of activity costs provides information on different levels. Capacity unit based costs, kaizen budgeting through capacity level based costs, kaizen budgeting through activity costs independent from the capacity, direct resource costs, and kaizen cost reduction budgeting are the major categories in our approach along with direct labor and direct materials. This classification provides better management in reducing the variable part of the activity costs. Consequently, we use ABC and ABB approach in many companies in Turkey with an appropriate ERP system. Thus, using this method has been proven successful. However, we have been planning to use kaizen budgeting technique regarding our current model.

Through ABC and ABB techniques, we reached not only the manufacturing cost, but also the full commercial costs of products as well as the costs of activities in a more realistic way. In addition, we aim to reach kaizen budgeting target through reducing variable part of the full commercial cost. Through the use of our method, managers have the opportunity to have a more efficient cost management system via reducing variable costs. Thus, it enables companies to compete in an efficient manner.

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A MODEL SUGGESTION FOR CASH CONVERSION OF INVENTORY AND BASEMENT OF MODEL FINANCIAL RATIOS ANALYSIS

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Abstract

Companies are trying to compete with each other with different management techniques such as cost management, sales management etc. Financial analysis is a very important tool for companies in measuring efficiency, measuring the degree of success, and in measuring the determination of companies' target and cost volume. Although companies focus on cost management, they do not consider financial ratio analysis on the same platform. Traditionally, companies usually consider material costs. However, the aim of this study is to give vision beyond the material costs according to the financial statement ratio analysis. We aimed at looking at material costs as a finished cost with their performance result. Thus, it will give a more competitive power to companies. Also, we considered to see through analytical liquidity analysis simulation tables, material costs cash collection and their effects on financial ratios. In addition, we analyzed the current assets cash flow and cash balance and their effects. On the other hand, we aim to simulate with different current assets, scenarios effects on companies' financial structure and cash balances through this model. Consequently, we aim to make risk analysis (risk simulation) for different current assets scenarios. Thus, this is done in order to simulate effects on companies' financial structure and cash balance.

Keywords: Financial ratio analysis, cash flow, risk analysis, cash balance, analytical liquidity analysis.

Introduction

Financial analysis technique is very important for companies to see their performance result. However, it is a very important tool to plan a companies' future. Conventional financial analysis ensures a company's

financial results through efficient calculation techniques. We aim to show that in a company's production, there is a relationship between the production department and the finance department of the company. In addition, our model shows companies' cash flow situation before the start of the production process. Then, it shows what will happen next when the company starts production. We built a new model titled "Cash Conversion of Inventory and Basement of Model Financial Ratios Analysis" to show production cost with efficient financial ratio analysis and proactive cash flow management to company. We developed our model known as "cash conversion of inventory" to be able to show cash flow situation beyond the conventional financial management techniques. Consequently, according to this model, we aim to make special link in the middle of the production and finance department with new and effective interfaces.

1. Financial Statements

1.1 Income Statement

Income statement presents information on the financial results of a company's business activities over a period of time. The income statement communicates how much revenue the company generated during a period and what costs it incurred in connection with generating that revenue. Net income (revenue minus all costs) on the income statement is often referred to as the "bottom line" because of its proximity to the bottom of the income statement. Income statements are reported on a consolidated basis. Thus, this means that they include the revenues and expenses of affiliated companies under the control of the parent (reporting) company. Sometimes, income statement is referred to as a statement of operations or profit and loss (P & L) statement (Robinson & Thomas, 2008).

1.2 Balance Sheet

The balance sheet (also known as the statement of financial position or statement of financial condition) presents a company's current financial position by disclosing the resources that the company controls (assets) and what it owes (liabilities) at a specific point in time. Owners' equity represents the excess of assets over liabilities. This amount is attributable to the owners or shareholders of the business. Thus, it is the residual interest in the assets of an entity after deducting its liabilities. The three parts of the balance sheet (assets, liabilities, and owner's equity) are formulated in an accounting relationship known as the accounting equation. However, this equation is expressed as: Assets = Liabilities + Owners' equity (that is the

total amount for assets must balance with the combined total amounts for liabilities and owners' equity) (Robinson & Thomas, 2008).

1.3 Cash Flow Statement

Although the income statement and balance sheet provides a measure of a company's success in terms of performance and financial position, cash flow is also vital for a company's long-term success. Disclosing the sources and uses of cash helps creditors, investors, and other statement users to evaluate the company's liquidity, solvency, and financial flexibility. In addition, financial flexibility is the ability to react and adapt to financial adversities and opportunities (Robinson & Thomas, 2008).

2. Financial Analysis

In general, analysts seek to examine the performance and financial position of companies as well as forecast future performance and financial position. Analysts are also concerned about factors that affect the risks of the company's future performance and financial position. Analysts usually work in a variety of positions. Some are equity analysts whose main objective is to evaluate potential equity (share) investments. Therefore, this is used to determine whether a prospective investment is attractive and what an appropriate purchase price might be. Others are credit analysts who evaluate the creditworthiness of a company to decide whether (and with what terms) a loan should be made or what credit rating should be assigned. Analysts may also be involved in a variety of other tasks, such as evaluating the performance of a subsidiary company, evaluating a private equity investment, or finding stocks that are overvalued for purposes of taking a short position (Robinson & Thomas, 2008).

3. Scope and Purpose of Financial Analysis

The role of financial reporting by companies is to provide information about their performance, financial position, and changes in their financial position. Thus, this is useful to a wide range of users in making economic decisions. The role of financial statement analysis is to take financial reports prepared by companies, combined with other information, in evaluating the past, current, and prospective performance and financial position of a company. This is done for the purpose of making investment, credit, and other economic decisions. In evaluating financial reports, analysts typically have an economic decision in mind. Thus, their decisions include:

- Determining the creditworthiness of a company that has made a loan request.
- Extending credit to a customer.
- Examining compliance with debt covenants or other contractual arrangements.
- Assigning a debt rating to a company or bond issue.
- Valuing a security for making an investment recommendation to others.
- Forecasting future net income and cash flow.

These are certain themes in financial analysis. In general, analysts seek to examine the performance and financial position of companies. In addition, it also forecast the future performance and financial position of the company. Analysts are also concerned about factors that affect the risks of the company's future performance and financial position (Robinson & Thomas, 2008).

4. Financial Analysis Techniques

Financial statements are analyzed by financial analysis techniques and obtained results are reviewed. The techniques used in financial analysis are (Arat, Finansal Analiz Aracı Olarak Oranlar, 2005):

- Horizontal Analysis
- Vertical Analysis
- Trend Analysis
- Ratios

4.1Horizontal Analysis

Horizontal analysis is the calculation of changes on financial statements which are prepared for financial analysis in two sequential periods (Yazıcı, 1976). In other words, horizontal analysis technique provides changes in accounts of assets, liabilities, and income statements over two consecutive periods in the fastest way (Arat & Durmuş, Mali Tablolar Tahlili, 1997). In horizontal analysis technique, the income and balance sheets of two sequential periods are compared with each other. Also, variance is calculated by the subtraction of the last period from the previous period. Difference between two period with (+) and (-) sign is put on the variance column. In addition, increasing and decreasing values are put on additional column in order to see variances on accounts in a better way.

Therefore, the following example shows the horizontal analysis of balance sheets in two sequential periods.

ASSETS	**2013**	**2014**	**Variance**	**Increase**	**Decrease**
CASH AND CASH EQUIVALENTS	*41.000*	*26.000*	*-15.000*		*-15.000*
BUYERS	*76.262*	*120.309*	*44.047*	*44.047*	
NOTES RECEIVABLE	*415*	*347*	*-68*		*-68*
FINISHED GOODS	*234.694*	*222.420*	*-12.274*		*-12.274*
RAW MATERIALS AND SUPPLIES	*120.000*	*100.000*	*-20.000*		*-20.000*
CURRENT ASSETS	***472.371***	***469.076***	***-3.295***		***-3.295***
FIXED ASSETS	***97.889***	***146.909***	***49.020***	***49.020***	
TOTAL OF ASSETS	570.260	615.985	45.725	45.725	
LIABILITIES					
BANK LOANS	308.129	361.857	53.728	53.728	
ACCOUNTS PAYABLE	4.534	4.860	326	326	
OTHER PAYABLES	5.785	10.955	5.170	5.170	
SHORT TERM EXTERNAL RESOURCES	***318.448***	***377.672***	***59.224***	***59.224***	
TOTAL OF LONG TERM EXTERNAL RESOURCES	***5.287***	***19.189***	***13.902***	***13.902***	
EQUITY	***136.234***	***134.428***	***-1.806***		***-1.806***
TOTAL LIABILITIES	459.969	531.289	71.320	71.320	

4.2 Vertical Analysis

Vertical analysis technique is an analysis of financial statements by assuming the value of an item as 100, and calculating other items value as a percentage of this item (Yazıcı, 1976). In vertical analysis of balance sheet, the total of assets and total of liabilities are assumed as 100. Percentages of other lines are calculated based on the total assets and total liabilities. Sales value is assumed as 100 in income statement. In addition, the percentages of other lines are calculated based on sales value.

Therefore, the following example shows the vertical analysis of balance sheets in two sequential periods.

ASSETS	**2013**		**2014**	
CASH AND CASH EQUIVALENTS	*41.000*	*7,2*	*26.000*	*4,2*
BUYERS	*76.262*	*13,4*	*120.309*	*19,5*
NOTES RECEIVABLE	*415*	*0,1*	*347*	*0,1*
FINISHED GOODS	*234.694*	*41,2*	*222.420*	*36,1*
RAW MATERIALS AND SUPPLIES	*120.000*	*21,0*	*100.000*	*16,2*
CURRENT ASSETS	***472.371***	***82,8***	***469.076***	***76,2***
FIXED ASSETS	***97.889***	***17,2***	***146.909***	***23,8***
TOTAL OF ASSETS	570.260	100,0	615.985	100,0
LIABILITIES				
BANK LOANS	308.129	67,0	361.857	68,1
ACCOUNTS PAYABLE	4.534	1,0	4.860	0,9
OTHER PAYABLES	5.785	1,3	10.955	2,1

SHORT TERM EXTERNAL RESOURCES	***318.448***	***69,2***	***377.672***	***71,1***
TOTAL OF LONG TERM EXTERNAL RESOURCES	***5.287***	***1,1***	***19.189***	***3,6***
EQUITY	**136.234**	**29,6**	**134.428**	**25,3**
TOTAL LIABILITIES	**459.969**	**100,0**	**531.289**	**100,0**

In this example, the percentage of "CASH AND CASH EQUIVALENTS" line is calculated by the following formula:

$$x = \frac{41.000x100}{570.00}$$

x=7.2.

Thus, this means that 7.2% of the total assets are cash and cash equivalents line.

4.3 Trend Analysis

Trend analysis technique aims to show changes on financial statements over the periods which is based on the first period (Arat, Finansal Analiz Aracı Olarak Oranlar, 2005). In this technique, the value of the first period of each line is assumed as 100. Then, other periods of each line are calculated based on the first value as percentage. The following formula shows the trend value of a line:

$$x = \frac{Value\ of\ current\ period\ x100}{\text{value of base period}}$$

Increases and decreases in accounting components can be easily observed when we view the trend analysis in an easy way. The results which are above 100 show this increase. Furthermore, results which are below 100 show the decrease (Aktan & Bodur, 2006).

Therefore, the following example shows the trend analysis of balance sheets in two sequential periods.

ASSETS	**2012**	**Trend I**	**2013**	**Trend II**	**2014**	**Trend III**
CASH AND CASH EQUIVALENTS	*40.000*	*100,0*	*41.000*	*102,5*	*26.000*	*65,0*
BUYERS	*72.273*	*100,0*	*76.262*	*105,5*	*120.309*	*166,5*
NOTES RECEIVABLE	*120*	*100,0*	*415*	*345,8*	*347*	*289,2*
FINISHED GOODS	*247.893*	*100,0*	*234.694*	*94,7*	*222.420*	*89,7*
RAW MATERIALS AND SUPPLIES	*110.000*	*100,0*	*120.000*	*109,1*	*100.000*	*90,9*
CURRENT ASSETS	***470.286***	***100,0***	***472.371***	***100,4***	***469.076***	***99,7***
FIXED ASSETS	***89.735***	***100,0***	***97.889***	***109,1***	***146.909***	***163,7***
TOTAL OF ASSETS	**560.021**	**100,0**	**570.260**	**101,8**	**615.985**	**110,0**
LIABILITIES						
BANK LOANS	298.325	100,0	308.129	103,3	361.857	121,3
ACCOUNTS PAYABLE	8.412	100,0	4.534	53,9	4.860	57,8
OTHER PAYABLES	65.982	100,0	5.785	8,8	10.955	16,6
SHORT TERM EXTERNAL	***372.719***	***100,0***	***318.448***	***85,4***	***377.672***	***101,3***

RESOURCES						
TOTAL OF LONG TERM EXTERNAL RESOURCES	***4.591***	***100,0***	***5.287***	***115,2***	***19.189***	***418,0***
EQUITY	**140.123**	**100,0**	**136.234**	**97,2**	**134.428**	**95,9**
TOTAL LIABILITIES	**517.433**	**100,0**	**459.969**	**88,9**	**531.289**	**102,7**

5. Ratios

The word "ratio" can be defined as a reasonable relationship between two quantities. In other words, rate describes the links (connections) between the actives or passives in balance sheet and income statement items by a percentage or a fraction (Arat, 2005, s. 89). Ratio analysis is different from the other techniques in that it is applicable to all financial statements and it reveals the relationships between items which are hidden in the financial statements. In this way, it provides a better understanding of the financial statements. When credit institutions and finance managers want to obtain an overview of key statistics of a business, they use the ratio analysis. By following these ratios over time, they obtain information about the performance of the business (Aktan & Bodur, 2006).

However, commonly used ratios are divided into four main groups (Akaytay, Çatı, & Yücel, 2015):

- **Liquidity Ratios:** The aim of the ratio in this group is to measure the power of the short-term loan payments and to determine whether the company has enough capital. For this reason, it is even more important for lenders. While calculating this ratio, we build various relationships between the sum of items of assets or components and short-term foreign sources.
- **Financial Structure Ratios:** This is the ratio that indicates to what extend the business is financed by debt, the degree of the financial risk, and the safety margins of the people providing credit to a business.
- **Profitability Ratios:** These ratios indicate to what extend that funds brought to the company by shareholders or provided by external sources allocated to the investment are used efficiently and profitably. Through these ratios, it is possible to reach the ultimate information about business regarding what extend it is managed effectively. However, this is possible by measuring profitability from different dimensions.
- **Turnover (Activity) Ratios**: Turnover ratios indicate whether or not the assets of businesses are managed effectively. Furthermore, it also states if the asset investments are sufficient or not. If there is a high turnover of assets of businesses, it can be stated that the assets are

being used efficiently. Hence, because of this, profitability is positively affected.

6. Liquidity Ratios

Liquidity ratios are used to examine the short-term debt repayment capability of the business. Ratios are calculated by dividing the current assets to short-term debt on the balance sheet. The reason is that sources used for the repayment of the business' short-term debt are the current assets. If these rates are extremely very high, this shows that the business could not reach profitability targets by holding liquid assets. If these rates are low, this shows that the business had difficulties in the repayments of the debts coming days (Berk, 2002). In loaning to a business, firstly we should look at the liquidity ratios. Therefore, bankers and credit analysts examine the various liquidity ratios (Brealey, Richard and Markus, 2001). A full liquidity analysis requires the use of cash budgets. Consequently, by relating the amount of cash and other current assets to current obligations, ratio analysis provides a quick and easy-to-use measure of liquidity (Brigham & Ehrhardt, 1999, s. 73).

More especially, we need to give attention to the following points in the analysis of company's liquidity ratios (Berk, 2002, s. 35). Thus, these points include:

- Trend in which the current assets is compared to the volume of the business.
- Trend in which the liquid assets is compared to previous periods.
- The collection ability, times, appearance reasons, and sales compliance of the registered receivables
- Appearance reason of debts on specialty.
- Nature of stocks.
- Appropriateness of the term structure of short-term debt.
- Appropriateness of the net working capital compared to business volume.
- Consideration of the other factors that affect the company's ability to pay its short-term debt.

Consequently, the analysis of the company's solvency often uses three main rates. These are: current ratio, acid-test ratio or liquidity ratio, and cash ratio (Berk, 2002).

Therefore, the example of the following balance sheet will be used in the explanation of current ratio, acid-test, and cash ratios.

ASSETS	**2014**
CASH AND CASH EQUIVALENTS	*26.000*
BUYERS	*120.309*
NOTES RECEIVABLE	*347*
INVENTORIES	*322.420*
CURRENT ASSETS	***469.076***
FIXED ASSETS	***146.909***
TOTAL OF ASSETS	**615.985**

LIABILITIES	
BANK LOANS	361.857
ACCOUNTS PAYABLE	4.860
OTHER PAYABLES	10.955
TOTAL CURRENT LIABILITIES	***377.672***
TOTAL OF LONG TERM EXTERNAL RESOURCES	***19.189***
EQUITY	**134.428**
TOTAL LIABILITIES	**531.289**

6.1 Current Ratio

Current ratio refers to the ability of the firm to meet short-term obligations. Current assets normally include cash, marketable securities, accounts receivable, and inventories. Current liabilities consists of accounts payable, short-term notes payable, current maturities of long term debt, accrued taxes, and other accrued expenses. The current ratio is calculated by dividing current assets by current liabilities (Brigham & Ehrhardt, 1999, s. 73). Thus, this can be expressed as:

$$Current\ ratio = \frac{Current\ assets}{Current\ liabilities}$$

Current ratio indicates how many dollars of current assets the company have corresponding to the company's short-term foreign sources of 1 dollar. The purpose of calculating the current ratio is to measure the ability to pay short-term debts of the company and to determine whether there is enough of the business source or not. It is a better measure that shows the company's debt repayment capacity compared to net working capital amount (Arat, 2005). When the current ratio is above the standard, it shows that there are current assets which are more than enough. Although this is viewed positively by the lenders and creditors, it is not good in terms of the adverse impact on the return on equity. This can mean that there is the presence of idle operation and it is not well evaluated (Arat, 2005). This situation can be thought negatively by shareholders. Current account ratio is calculated as follows according to the sample of balance sheet:

$$Current\ ratio\ = \frac{469.076}{377.672}$$

Current Ratio = 1.24

In the balance sheet sample, 1.24 dollars of current assets corresponds to the company's short-term foreign sources of 1 dollar.

6.2 Acid Test or Quick Ratio

The quick ratio or acid test is calculated by deducting inventories from current assets, and then dividing the remainder by current liabilities (Brigham & Ehrhardt, 1999, s. 73):

$$Acid\ Test, or\ Quick\ Ratio\ = \frac{Current\ assets - Inventories}{Current\ liabilities}$$

This ratio completes the current rate ratio and makes it more meaningful because it ignores inventories which are the least liquid item in a balance sheet (Acar, 2003).

Acid-test ratio calculation is as follows according to a balance sheet sample:

$$Acid\ Test, or\ Quick\ Ratio\ = \frac{469.076 - 322.420}{377.672}$$

Acid-test ratio = 0.39

6.3 Cash Ratio

Cash ratio means the ability of the firm to meet short-term obligations with only cash and cash equivalents. Cash ratio is calculated by adding cash and cash equivalents, and dividing it by the total current liabilities. This can be described as shown below:

$$Cash\ ratio\ = \frac{Cash + \text{ Cash Equivalents}}{Current\ Liabilities}$$

This rate is more accurate than the other rates. It demonstrates the ability of the company to pay its short-term debt in case of interruption in sales, uncollected receivables, and if they encounter difficulties during the redemption of stocks.

Cash ratio calculation is as follows according to a balance sheet sample:

$$Cash\ ratio\ = \frac{26.000}{377.672}$$

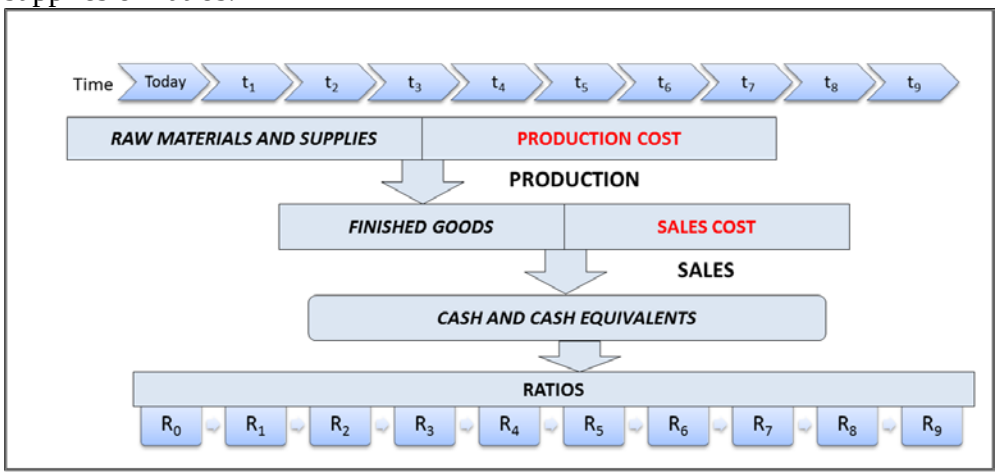
Cash Ratio = 0.07

In a related example, if the company's sales are completely stopped and the company cannot collect the receivables, they are able to pay only 7% of the short-term debt.

7. A Model Proposition for Cash Conversion of Inventory and Raw Materials

While the evaluation of businesses is being carried out using the rates of raw materials and supplies, inventories are evaluating their current value. In fact, raw materials and supplies can be converted to inventories by enduring production costs. During this conversion, the value of the inventory is greater than the value of raw materials. Inventories can be converted to cash and receivables by enduring sales cost. The obtained value as a result of the sale of the inventory cost by enduring sales costs is lower than the value of inventories. In addition, it is more than the value of the raw materials used to produce these inventories. These conversions change the financial ratio of companies.

The following proposed model shows the effect of raw materials and supplies on ratios.



In this model, raw materials are converted to finished goods, but it consumes cash and cash equivalents for production. In this case, the value of finished goods is greater than the difference in the value of raw material and production cost. It can be shown in the following formula: Value Finished Goods > Value of Raw Materials – Production Cost. For example, $ 15,000 worth of products can be produced with materials worth of $ 10,000 and $ 1,000 cost. Finished goods are converted to cash and cash equivalents, but it consumes cash and cash equivalents for sales cost. In this case, cash changes on balance sheets can be shown in the following formula: Cash Changes = Value Sold Goods – Sales Cost. In both cases, liquidity ratios may change. In this model, effect of raw materials and finished goods on ratios and cash flows are considered in a right way.

The following example is used to illustrate the above.

ABC Company is in the manufacturing industry with production of machine. In the management of ABC Company, the identified activities they perform are as follows:

1. ABC Company produced 10 ratios as R_0, R_1, R_2, R_3, R_4, R_5, R_6, R_7, R_8, and R_9. These are different ratios requiring different amount and volume of production activity.
2. ABC Company has 9 due dates to organize cash flow management as T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, and T_9. Thus, these represent the due date for payment in planning a wide range of cash flow.
3. ABC Company has 3 financial analysis ratio types which are current ratio, acid test ratio, and cash ratio. Thus, these represent due date for payment in planning a wide range of cash flow. They are shown according to each item types under the due date financial situation basement of production activity.

BALANCE SHEET CHANGES										
ASSETS	t_0	t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9
CASH AND CASH EQUIVALENTS	*50.000*	*102.550*	*155.100*	*207.650*	*260.200*	*312.750*	*365.300*	*417.850*	*470.400*	*523.170*
BUYERS	*120.000*	*120.000*	*120.000*	*120.000*	*120.000*	*120.000*	*120.000*	*120.000*	*120.000*	*120.000*
NOTES RECEIVABLE	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*	*1.000*
FINISHED GOODS	*250.000*	*223.000*	*196.000*	*169.000*	*142.000*	*115.000*	*88.000*	*61.000*	*34.000*	*6.780*
RAW MATERIALS AND SUPPLIES	*200.000*	*180.000*	*160.000*	*140.000*	*120.000*	*100.000*	*80.000*	*60.000*	*40.000*	*20.000*
CURRENT ASSETS	***621.000***	***626.550***	***632.100***	***637.650***	***643.200***	***648.750***	***654.300***	***659.850***	***665.400***	***670.950***
FIXED ASSETS	***150.000***	***146.909***	***146.909***	***146.909***	***146.910***	***146.911***	***146.912***	***146.913***	***146.914***	***146.915***
TOTAL OF ASSETS	771.000	773.459	779.009	784.559	790.110	795.661	801.212	806.763	812.314	817.865
LIABILITIES										
BANK LOANS	361.857	361.857	361.857	361.857	361.857	361.857	361.857	361.857	361.857	361.857
ACCOUNTS PAYABLE	4.860	4.860	4.860	4.860	4.860	4.860	4.860	4.860	4.860	4.860
OTHER PAYABLES	10.955	10.955	10.955	10.955	10.955	10.955	10.955	10.955	10.955	10.955
SHORT TERM EXTERNAL RESOURCES	***377.672***	***377.672***	***377.672***	***377.672***	***377.672***	***377.672***	***377.672***	***377.672***	***377.672***	***377.672***
TOTAL OF LONG TERM EXTERNAL RESOURCES	***19.189***	***19.189***	***19.189***	***19.189***	***19.189***	***19.189***	***19.189***	***19.189***	***19.189***	***19.189***
EQUITY	**134.428**	**134.428**	**134.428**	**134.428**	**134.428**	**134.428**	**134.428**	**134.428**	**134.428**	**134.428**
TOTAL LIABILITIES	**531.289**	**531.289**	**531.289**	**531.289**	**531.289**	**531.289**	**531.289**	**531.289**	**531.289**	**531.289**

PRODUCTION & SALES									
Production									
Consumed Raw Material and Supplies	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
Production Cost	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400	1.400
Produced Finished Goods	28.000	28.000	28.000	28.000	28.000	28.000	28.000	28.000	28.000
Sales									
Sales Cost	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050	1.050
Saled Finished Goods	55.000	55.000	55.000	55.000	55.000	55.000	55.000	55.000	55.220

RATIO CHANGES										
	R_0	R_1	R_2	R_3	R_4	R_5	R_6	R_7	R_8	R_9
Current Ratio	1,64	1,66	1,67	1,69	1,70	1,72	1,73	1,75	1,76	1,78
Acid Test	0,45	0,59	0,73	0,87	1,01	1,15	1,29	1,43	1,57	1,71
Cash Ratio	0,13	0,27	0,41	0,55	0,69	0,83	0,97	1,11	1,25	1,39

8. Conclusion

Information technology provides very effective and well detailed information quickly to companies. However, management is responsible to choose the right tool for their operation. Companies need to check their financial situation timely and fairly. In addition, financial planning is a very

important part of the management system. Management departments need to be sure when they budget their activities. Furthermore, we give an assurance to companies so as to plan their management activities in their financial management difficulties. Our model ensures the effects on cash inflow and financial ratios of the material stock. In addition, our model ensures the effects of analysis on cash return and cash balance of the current assets on a monthly basis. On the other hand, through this model, we can simulate effects of activities on companies' financial structures and the cash balance of the different current assets scenarios.

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