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Index

#	Paper Title	Pages
01	Association of seminal zinc and copper level with infertility in Sudanese male in Shendi town - Northern Sudan	01-14
02	Evaluation of Antimicrobial Activity of Aqueous and Methanolic Extracts of *Peganum harmala* against Reference and multidrug resistance Clinical Isolates organisms	15-31
03	The Optimal Control Model Use for Remove Mold from Homes	32-42
04	Sobolev Embeddings and Capacity on Metreic Spaces	43-57
05	إستخدام خرائط الوسط الحسابي والإنحراف المعياري والمدى في مراقبة جودة الإنتاج (بالتطبيق على بيانات شركة فابي للصناعات الغذائية للعام 2021م . شندي . ولاية نهرالنيل . السودان)	58-74
06	Immunohistochemical Detection of P53 and Ag NOR Score among Sudanese Patients with Prostate Cancer in Military Hospital 2019-2020	75-84
07	AN EVALUATION OF CONSISTENCY MODELS IN NOSQL DATABASES	85-98
08	Hairy cell leukemia with atypical presentation and hematemesis; a case report	99-107
09	*Hematinix Status IN Breast Cancer Patients in Sudan*	108-113
10	Nursing teaching staff' knowledge and attitude regarding peer assisted learning at governmental faculties of nursing, Khartoum state 2022	114-130
11	Awareness and Attitude of Female About Harassment in Dar Almaali Secondary School River Nile state Sudan	131-140
12	Efficiency and Utilization of Long-Lasting Insecticide Nets (LLINs) in Selected Villages of ALRahad Locality, Gedarif State, Sudan2014	141-154

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Original research

Association of seminal zinc and copper level with infertility in Sudanese male in Shendi town - Northern Sudan

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Abstract

Background: Male fertility is the essence for human race continuity**.** The presence of abnormal levels of zinc (Zn) and copper (Cu) concentrations in human semen may affect sperm production, maturation, motility and fertilizing ability. **Objective:** To evaluate the levels of zinc and copper in seminal plasma and to correlate their concentrations with various semen parameters among fertile and infertile Sudanese male subjects in Shendi town- River Nile State - Northern Sudan. **Methods:** The study was conducted from September 2021 to January 2022.The concentrations of Zn and Cu were measured in fifty (50) semen samples ، thirty five (35)of them had abnormal semen analysis (oligozoospermic, azoospermic and asthenozoospermic) as case study and fifteen (15) were normal semen analysis as control. **Results:** Results showed that the mean value of seminal plasma Zn concentration was significantly decreased in the case group compared to control group. The mean value of seminal plasma Zn concentrations was significantly decreased in the groups azospermic with P. value of (0.007)and oligozoospermic with P. value of (0.011) and no effect of asthenozopermic on seminal Zn with P. value of (0.713). While the mean value of seminal plasma Cu concentration were significantly increase in the case group compared to control group, with no effect as regard to azoospermic with P. value of (0.652), asthenozopermic with P. value of (0.329) and oligozoospermic with P. value of (0.122) .There is no correlation between body mass index and level of zinc with P. value of (0.458) and copper with P. value of (0.209).

Keywords: Infertility, Semen ,Zinc (Zn), Copper (Cu), oligozoospermia, asthenozopermia. Azoospermia, Sudanese.

Introduction

Men in about fifty percent of cases are either the single cause or contribute to couple's infertility , which affects about (8%) to (12%) of the world's population Seminal plasma is very important for sperm metabolism, function, survival, and transport in the female genital tract.[1] Cations such as Na, K, Ca, and Mg establish osmotic balance,. Increasing evidence of a direct relationship of zinc which represent prostatic secretary function was found with seminal parameters.[1]

The decrease in the seminal plasma zinc concentration may result from inadequate intake which is commonest cause, reduced absorption, increased losses, or increased demand. [2]

Copper is an important element for numerous metalloenzymes and metalloproteins, involved in energy metabolism. It,s higher level is toxic to human spermatozoa . The use of Cu in intrauterine devices prevents conception .[3]

According to the World Health Organization (WHO) guidelines semen analysis include volume, pH, vitality, sperm concentration, motility and morphology .Sperm concentration was determined by a Neubauer counting chamber, The samples were divided into 4 groups of; normospermic, azospermic (no sperm in semen), oligozoospermic (sperm concentration fewer than 20×106/ml) and asthenozoospermic (fewer than 50% spermatozoa with forward progression) groups. [4]

Zn is referred to as a trace element, as its plasma concentration is only (12–16 μM), In the serum Zn is predominantly bound to albumin (60 %, low-affinity), α2-macroglobulin (30 %, high-affinity) and transferrin (10 %;)[5].

Zn has important role as inhibitor of oxidative damage[6].Evidence suggests that seminal Zn has an important role in the physiologic functions of the sperm and that its reduced levels result in low seminal quality and subsequent chances of fertilization[7].

Zn therapy improves sperm quality with increases in sperm density, progressive motility and improved conception and pregnancy outcome. Zn plays an important role in membrane-stabilizing and antioxidant activity and maintains sperm viability by inhibiting DNases [7].

Copper is an essential trace element for humans and exist mostly in second oxidation form [8]. Copper plays an important role in our metabolism, can act as both anti oxidant and pro-oxidant [9]. Copper deficiency is more commonly an acquired condition, attributable to nutritional deficiency, and may be seen in malnourished low-birth-weight infants, newborns, and small infants, also after gastrointestinal surgery, intractable diarrhea, and prolonged parenteral or enteral nutrition[10,11,12] .Copper depletion affects male reproduction in different species , the copper chelation was involved in suppression of spermatogenesis. On the other hand, it can be toxic at elevated concentrations [4].

Objectives

The general objective of this study is to evaluate semen zinc and copper level among abnormal semen Sudanese male, while the specific objectives are to associate semen zinc and copper with azoospermia, oligospermia, asthenozoospermia, in infertile Sudanese males.

Material and methods

It is case control study, conducted from September 2021 to January 2022 , in Shendi town. It included fifty (50) males , thirty five (35) of them who had regular sexual intercourse for at least one year without conception, and their age is between(25- 55) years old, with abnormal semen analysis parameters and fifteen

(15) of them males are with normal semen analysis parameters. The study included all willing patients attending fertility clinic for routine infertility medical check- up Exclusion from the study is based on clinical assessment, those with a history of sexually transmitted diseases, mumps-related orchitis ,diabetes mellitus ,testicular injury , small testicles (<10mL), and varicocele . Also excluded those with past history of excessive alcohol intake, abnormalities of reproductive endocrine system and fever including typhoid fever in the past three (3) months duration.

Collection of samples and preparation

Patient's information was collected by a structured questionnaire.

Semen specimens were collected in polystyrene semen containers through masturbation after three (3) days of abstinence. The samples were centrifuged 3000 at (15-20 m). The supernatant was frozen at -20 for further analysis.

For examination of sperms motility, one drop of well mixed, liquefied semen was placed on a clean dry slide and covered with a cover slip. Using x40 objective, with the condenser iris closed sufficiently to give a good contrast, several fields were examined formotile spermatozoa. Then the approximate percentage of actively motile spermatozoa was reported. The. Sperm Cell Count Using a graduated tube, the semen was diluted 1 in 20as follows: The tube was filled to the 1ml mark with the well-mixed liquefied semen, then sodium bicarbonate- formalin diluting fluid was added to the 20 ml mark and then mixed very well. Using a Pasteur pipette, an improved neubauer countingchamber was charged with the diluted semen and allowed to stand for 3-5 minutes for the spermatozoa to settle. Using x10 objective lens, with the condenser iris closed sufficiently to give a good contrast,.to. Morphology The morphological examination of the semen was doneas follows: A thin smear of the liquefied well mixed semen was made on a slide while the samples were still wet; the smear was fixed with 95%v/v ethanol for 5-10

minutes and then allowed to air dry. The smear was washed with sodium bicarbonate-formalinsolution toremove any mucus which may be present and then rinsed with several changes of water. The smear was covered with dilute carbolfuchsin (1 in 20) and allowed to stain for 3 minutes, and the stain was then washed off. This was counterstained with dilute Loeffler's methylene blue for 2 minutes and then washed off with water, drained and allowed to air dry. Using the oil and x 40 objective and the condenser iris closed gently to give a good contrast, the slide was examined for normal and abnormal spermatozoa. Seminal plasma were diluted 1:10 with 0.5% v/v HNO_3 to determine the concentrations of zinc and copper using flame atomic absorption spectrophotometer (Buck Scientific, model 210 VGP).

Statistical Analysis

The data was analyzed using Statistical Package of Social Science (SPSS) version (22) for windows. Frequencies, Means, SD, Independent t-test and Pearson's correlation have been used to compare and correlate between parameters and study variables.

Ethical Approval

The study was approved by the Board of Faculty of Graduate Studies in Shendi University. Verbal informed consent was obtained from all participant after explanation of the study aims .

Results

Table (1): Zinc concentration in seminal plasma in case and control groups.

Group	N	Mean concentration (mg/l)	Std. deviation	P. value
Case	35	12.62	4.44	0.000
Control	15	20.66	2.52	

Table (2) : Copper concentration in seminal plasma in case and control groups.

Group	N	Mean concentration (mg/l)	Std. deviation	P. value
Case	35	0.23	0.11	0.000
Control	15	0.150	0.03	

Table (3): Zinc and copper concentration in seminal plasma in oligospermia:

Group		N	Mean concentration (mg/l)	Std . deviation	P. value
Zn	Oligospermia	23	15.56	5.13	0.011
	Other abnormalities	12	18.65	1.27	
Cu	Oligospermia	23	0.25	0.12	0.122
	Other abnormalities	12	0.19	0.09	

Table (4): Zinc and copper concentration in seminal__plasma in asthenospermia:

Group		N	Mean concentration (mg/l)	Std. deviation	P. value
Zn	Asthenospermia	15	16.29	5.00	0.713
	Other abnormalities	20	16.86	4.10	
Cu	Asthenospermia	15	0.25	137.5	0.329
	Other abnormalities	20	0.21	0.09	

Table (5): Zinc and copper concentration in seminal plasma in azoospermia

Group		N	Mean concentration (mg/l)	Std. deviation	P. value
Zn	Azoospermia	7	12.70	4.97	0.007
	Other abnormalities	28	17.60	3.80	
Cu	Azoospermia	7	0.21	0.12	0.652
	Other abnormalities	28	0.24	0.11	

Table (6): Correlation between zinc concentration (mg/l) in seminal plasma and body mass index (BMI) .

	N	Mean	Std. deviation	P. value	Person correlation – R
BMI	35	28.91	5.25	0.458	- 0.130
Zn	35	17.83	4.36		

Table (7): Correlation between copper concentration (mg/l) in seminal plasma and body mass index (BMI) .

	N	Mean	Std. deviation	P. value	Person correlation – R
BMI	35	28.91	5.25	0.209	- 0. 218
Cu	35	0.23	0.11		

Discussion

In this study, there was a significant low level of seminal plasma zinc in case group who had abnormal semen analysis ,with *P. value* (0.000) and mean of (16.6229) , compared to control with normal semen analysis; mean (20.6600). Similar findings have been reported by Hassan Ali, et al in (2007) [1] and other similar results have been reported by Yosra M. Altaher and AbdElkarim A. Abdrabo in (2014) [3] and also by Nawal .K. Hussain ,et al in (2011) [14] .On the other aspect ,Fuse. H, et al in (1999) [15] found no significant difference in the mean value of seminal plasma Zn between infertile individuals compared to fertile individuals .

In this study, there was significant decrease of zinc concentration in seminal plasma in oligospermic, with p. value of (0.0110) and mean of (15.5643), Azoospermic, with p .value (0.007) and mean of (12.7029) compare with other abnormal semen analysis and insignificant in asthenospermic,with p. value (0.713) and mean of (16.2960) . In odds with the findings obtained by Basil Oied ,et al. in (2008) [13] which point to insignificant level of Zn as regard to Azoospermia.

This study found that copper (Cu) concentration was significantly increased in seminal plasma in case group ,who had abnormal semen analysis ,with p. value of (0.000) and mean of (0.2363) compared to control group who had normal semen analysis, with mean of (0.1501) . The copper concentration was insignificantly increased between the sub groups of oligospermic, azospermic and asthenospermic with p. value (0.122) and mean (0.2583) ,p. value(0.652) and mean(0.2171). and p. value(0.329)mean(0.2587) respectively. The results of the current study were comparable with the findings of Yosra M. Altaher and AbdElkarim A. Abdrabo in (2014) and other result by Basil Oied ,et al. (2008)[13] and Nawal .K. Hussain ,et al (2011)[14] ,which showed significantly decrease copper concentration in asthenospermic and insignificant in oligospermia. Other study published by Hamad et al. in (2014) [16] reported significantly higher concentration of copper in infertile males. The findings of this study also support those obtained by Mathias Abiodun Emokpae and Muyiwa Adeleye Moronkeji in (2020)) in Benin City, Nigeria as regard to the antagonistic interactions between copper and zinc concentration in seminal plasma as contributing factor in man fertility[17].

The association of higher copper concentration with infertility in men in this study provides supportive information regarding the effect of copper ion (Cu2+) released from intrauterine devices (IUD) in preventing pregnancy[18] .

In this study no correlation between body mass index and level of seminal plasma concentrations of zinc and copper.

Conclusion

Based on the findings of this study and other reported results, there was a significant low level of seminal plasma zinc and increased concentration of copper in the infertile men. Therefore zinc and copper concentration in semen plasma contribute significantly to male fertility [19,20].

Recommendations

On the basis of the results of this study and other recent ones findings, it is recommend that the concentration of zinc and copper in seminal plasma to be considered in laboratory investigation of infertility and zinc nutritional supplement to be offered to those who need it, as Zn deficiency may be an important risk factor for lowered semen quality [21,22,23] .

Conflict of interests' declaration

All authors have no conflict of interests to be declared

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References

1. Hasan Ali, Masood Ahmed, Mukhtiar Baig, Moazzam Ali. Relationship of zinc concentrations in blood and seminal plasma with various semen parameters in infertile subjects. Pakistan Journal of Medical Sciences. 2007 Jan 1;23(1):111-114

2. Salim KT, Ali AO, Babiker RA, Gafoor MA, Hussien MO, Alameen M, Hamad MN, Abdrabo AA. Assessment of zinc and copper among patients with abnormal semen analysis. Saudi J Biomed Res, Dec., 2019; 4(12): 416-419. doi: 10.36348/sjbr.2019.v04i12.002.
3. Yosra M. Altaher and AbdElkarim A. Abdrabo . Levels of zinc and copper in seminal plasma of Sudanese infertile males. BJMMR, 2015.5(4): 533-538,; Article no.BJMMR.2015.058
4. Eidi M, Eidi A, Pouyan O, Shah mohammadi P, Fazaeli R, Bahar M. Seminal plasma levels of copper and its relationship with seminal parameters. International Journal of Reproductive Bio Medicine. 2010 Jul 10;8(2):60-0.
5. Kerns K, Zigo M, Sutovsky P. Zinc: A necessary ion for mammalian sperm fertilization competency. International Journal of Molecular Sciences. 2018 Dec;19(12):4097.
6. Kidd MT, Ferket PR, Qureshi MA. Zinc metabolism with special reference to its role in immunity. World's Poultry Science Journal. 1996 Nov;52(3):309-24.
7. Fallah A, Mohammad-Hasani A, Colagar AH. Zinc is an essential element for male fertility: a review of Zn roles in men's health, germination, sperm quality, and fertilization. Journal of Reproduction & Infertility. 2018 Apr;19(2):69.
8. Angelovi M, Casanovas S, Nedkova V and koleva-kolarovaR. Copper in the Human organism. Trakia Journal of Sciences (2011).9 (1): 88-98

9. Osredkar J. and Sustar N. Copper and Zinc; Biological role and significance of copper/zinc imbalance. Clinical Toxicology .S3:001(2011)
10. Lutsenko S, Barnes N.L., Bartee, M.Y and Dmitriev, O.U. Function and regulation of human copper-transporting ATPases. Physioical Rev (2007) 87:. Physiological Reviews.Vol. 87, No. 3 : 799–1082
11. Uauy R, Olivares M and Gonzalez M. Essentiality of copper in Human. The American Journal of clinical nutrition(1998).67 (suppl):952–961
12. Williams D.M. Copper deficiency in humans. Semin Hematol(1983) (20):118–28.
13. Basil Oied Mohammed Saleh , Nawal Khiry Hussain , Ali Yakub Majid , Ban Thabet and Khazraj Abbas Fadhil., Status of zinc and copper concentration seminal plasma of male infertility and their colerration with various sperm parameters . The Iragi Postgaduate Medical Journal (2008);7:1 . 76-80
14. Nawal .K. Hussain , Shahlaa S. Rzoqi , Ali W. Numan and Dina T. Ali.A comparative study of fructose, zinc and copper levels i nseminal plasma in fertile and infertile men.Iraqi J Med Sci, 2011; Vo l.9 (1) -48-54.
15. H. Fuse , T Kazama, S Ohta, and Y .Fujiuchi . Relationship between zinc concentrations in seminal plasma and various sperm parameters. Int Urol Nephrol. 1999;31(3):401-8. doi: 10.1023/a:1007190506587
16. Hamad AWR, Al-Daghistani HI, Shquirat WD, Dayem MA, Al-Swaifi M. Sodium, potassium, calcium and copper levels in seminal

plasma are associated with sperm quality in fertile and infertile men. Biochem Pharmacol .2014; (3): 141. doi:10.4172/2167-0501.1000141

17. Mathias Abiodun Emokpae and Muyiwa Adeleye Moronkeji. Association of copper-to zinc ratio with sperm concentration among males investigated for infertility. J Infertil Reprod Biol, 2020, Volume 8, Issue 3, Pages: 49-52. https://doi.org/10.47277/JIRB/8(3)/49 .
18. L Roblero , A Guadarrama, T Lopez, F Zegers-Hochschild. Effect of copper ion on the motility, viability, acrosome reaction and fertilizing capacity of human spermatozoa in vitro . Reprod Fertil Dev . 1996;8(5):871-4. doi: 10.1071/rd9960871.
19. Radhika Purushottam Kothari and Ajay Rajeshwar Chaudhari, Zinc levels in seminal fluid in infertile males and its relation with serum free testosterone. Journal of Clinical and Diagnostic Research. 2016 May, Vol-10(5): CC05-CC08. doi: 10.7860/JCDR/2016/14393.7723.
20. Jiang Zhao , Xingyou Dong , Xiaoyan Hu , Zhou Long , Liang Wang , Qian Liu , Bishao Sun , Qingqing Wang , Qingjian Wu , Longkun Li. Zinc levels in seminal plasma and their correlation with male infertility: A systematic review and meta-analysis . Sci Rep . 2016 Mar 2;6:22386. doi: 10.1038/srep22386.
21. Ludmila Osadchuk , Maxim Kleshchev, Anna Danilenko, Alexander Osadchuk.Impact of seminal and serum zinc on semen quality and hormonal status: A population-based cohort study of Russian young men .Journal of Trace Elements in Medicine and Biology 68 (2021) 126855.

22. P. Fatima, M. M. Hossain, P. Fatima, M. M. Hossain, D. Rahman, C. R. Mugni, H. Hossain, H. N. Hossain, G. Sumon. Impact of seminal plasma zinc and serum zinc level on semen parameter of fertile and infertile males.J Bangladesh Coll Phys Surg 2017; 35(1): 15-19 . doi:10.3329/JBCPS.V35I1.32566

23. Andrea Milostić-Srb, Aleksandar Včev, Marijan Tandara, Svjetlana Marić, Vesna Kuić-Vadlja, Nika Srband Dubravka Holik. Importance of zinc concentration in seminal fluid of men diagnosed with infertility. Acta Clin Croat 2020; 59:154-160.
doi: 10.20471/acc.2020.59.01.19.

Evaluation of Antimicrobial Activity of Aqueous and Methanolic Extracts of *Peganum harmala* against Reference and multidrug resistance Clinical Isolates organisms

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ABSTRACT

Background: Down the ages, extracts of plants have evoked interest as sources of natural products as alternative remedies for treating many infectious diseases. Due to the emergence of resistance to antimicrobial drugs. This issue has prompted the need for effective and efficient of herbal treatment. **Objectives:** To assess the antimicrobial activity of *Peganum harmala* against certain type of pathogenic microorganism. **Materials and Methods:** This is an experimental in*vitro* study was conducted on ten organisms. The coarsely seeds powdered 200g of *Peganum harmala*was exhaustively extracted with 80% Methanol and water. Antibacterial activity of the extracts were tested using the cup-plate agar diffusion method (25). The broth microdilution method was used to determine the Minimum inhibition concentration (MIC) and Minimum bactericidal concentration (MBC). **Results:** The extracts of *Peganum harmala* have broad antimicrobial activity against most of the organisms, with high methanolic extract activity compared with water extracts, it was showed thatall tested microorganisms were sensitive to the Methanolic extract at the concentration of 100 mg/ml(Zone of inhibition >18 mm), with high antimicrobial activity against *S. aureus* ATCC 6538, *E.coli* ATCC 8739 and *Proteus mirabilis* under all concentrations, The highest inhibition zone reached 32 mm to ward *E. coli* ATCC 8739 at concentration 100 mg/ml and smallest inhibition zone zero mm toward *Pseudomonas aeruginosa* ATCC 9027 at concentration 12.5 mg/ml. The Minimum inhibition concentration (MIC) revealed high value was 1.25 in methanolic extract against (*Ps. aeruginosa*ATCC 9027, *C. albicans* ATCC 10231,*Proteus mirabilis).*

keywords: Peganum harmala, MDR, ESBL, MBC, MIC.

INTRODUCTION :

Bacterial contaminations are around the world, this present circumstance is more basic in the underdeveloped nations where much of the time absence of satisfactory disinfection and essential medical care programs makes it troublesome and costly to battle sicknesses of bacterial beginning, along these lines, a few underdeveloped nations are starting to understand that logical assessment of conventional medication might enhance current clinical benefits. The higher plants are chosen based on writing information and data provided by customary healers, the technique for extraction of the plant and testing is fundamental assuming that tantamount outcomes are to be gotten. Various higher plants have been utilized for nations as solutions for human infections. This has urged the researchers to evaluate higher plantfor different natural exercises including antibacterial and antifungal effects(1)

As a matter of fact, it can accurately be contended that the improvement of current drugs depends on the old information on restorative plants and customary clinical practice,thus around 40% of drugs are gotten from regular sources (plants, creatures, microbes and growths) in addition a few normal items got from therapeutic plant prompted the advancement of different drug analogs or derivatives(2). In Africa and the non-industrial nations, conventional prescriptions from plants kept on framing the premise of provincial clinical consideration this is because of the way that these regular meds are effectively accessible and cheap(3). Be that as it may, the utilization of such meds in their unrefined structures without laying out deductively their viability and security could in brief time or long run, be adverse to very strength of humankind in this way, there is a pressing need to complete efficient logical assessment of these meds to check their guaranteed natural action and to disconnect and distinguish the bioactive agents(4). One of these normal medications

Peganum harmala Wild Syrian regret otherwise called Harmal, "Espand" in Iran,"Harmel" in North Africa and "African regret," "Mexican mourn" or "Turkish lament" in the US which is a restoratively significant glabrous plant and enduring spice of family Zygophyllaceae(5) . Different pieces of this plant including, its seeds, bark, and root have been utilized as people medication. Late long stretches of exploration have exhibited different pharmacological and remedial impacts of *Peganumharmala* and its dynamic alkaloids, particularly harmine and harmaline. Insightful examinations on the substance arrangement of the plant show that the main constituents of this plant are beta‑carboline alkaloids, for example, harmalol, harmaline, and harmine. Harmine is the most contemplated among these normally happening alkaloids. There are a few reports which demonstrate the incredible assortment of

pharmacological and natural exercises of *Peganumharmala*, for example, angiogenic inhibitor and to treat hypertension and cardiovascular sickness likewise has bactericidal movement, anticancer,against protozoal, antibacterial, antifungal, calming properties (6)

Traditional medicine and superstition: -

has been customarily used to treat diabetes in people medication of certain pieces of the world(7). likewise, to treat colic in man and animals (8). most often used to treat hypertension and cardiovascular infection around the world, it has been utilized as pain relieving, emmenagogue, and abortifacient agent(5). In Moroccan seeds of *Peganum harmala* were utilized as powder, decoction, maceration or mixture for fever, loose bowels, early termination and subcutaneous cancers and is broadly utilized as a solution for distressed occasions (rheumatic torment, excruciating joint and digestive pain(9). it is significant therapeutic plant in Iranian customary medication, which has different advantages, for example, hostile to contamination, against irritation, hostile to cancer and hostile to parasite(10).

Botanical description: -

grow up to 30-100 cms in level. the leaves are palmatisected into 3-5 liner curves which are 3-6 cms in length and 1.5-3.0 mm wide blossoms emerge by 1-3 on peaks of branches which bear whitish - yellow petals in variety. The organic products are globular case with 3 chamber ,0.9-1.3 cm in width and containing 35-45 rakish blackish seeds,the plant has unpleasant taste so generally not brushed by animals(11).

Pharmacological uses: -

Is notable and compelling restorative plant in Turkey, Iran and China, particularly in Xinjiang and Mongolia (12) The seed and the entire plant gangs therapeutic properties (Uighur Medication Standard of the Service of General Wellbeing) and different reports propose that the plant can be utilized to treat illness like stiffness ,hypertension , diabetes , asthma and jaundice additionally groups stimulating and hypothermic properties and are utilized as a clinical cure, incense, fixing with necrotic ,narcotic , love potion , energizer and emetic properties and it is one of the most often utilized restorative plants to treat hypertension and cardiovascular sickness worldwide(13). It has additionally been displayed in different pharmacological examinations that P. harmala separate or its vitally dynamic alkaloids, harmine, harmaline, Harman and harmalol, have different cardiovascular impacts, for example, bradycardia, diminishing fundamental blood vessel circulatory strain and absolute

fringe vascular opposition, expanding beat pressure, top aortic stream and heart contractile force(5). antitumor and pain-relieving impacts, antimicrobial properties, and solid inhibitors of monoamine oxidase (14). It was uncovered in a review that harmine is a strong angiogenic inhibitor This substance can fundamentally diminish the multiplication of vascular endothelial cells and lessen articulation of various pro‑ angiogenic factors, for example, vascular endothelial development factor(15).

Toxicity: -

While this plant has customarily been utilized in Bedouin medication as an emmenagogue and as abortifacient specialist and to treat hypertension and cardiovascular sickness around the world, The excess ingestion of *Peganum harmala* can cause human poisonous impacts and condition, and a few instances of harmfulness have been as of now detailed. It causes cerebral pain, dazedness, queasiness seizure, fantasy, loss of motion, happiness, stomach related issues, bronchodilator, hypothermia and bradycardia, Numerous pharmacological investigations. Recommend a cell reinforcement and free revolutionary rummaging impact of *Peganum harmala* (16).

PHYTOCHEMISTRY: -

Several alkaloids have been isolated from Peganum harmala, including - carbolines such as harmine, harmaline (identical to harmidine), harmalol, and harman, and quinazoline derivatives such as vasicine and vasicinone (20).The total alkaloid content ranges from 2 to 5%.Alkaloids are most abundant in seeds and roots, with low levels in stems and leaves and none in flowers.The roots contain 2.0 and 1.4% (w/w) harmine and harmol, respectively (18).Harmaline (harmidine) (harmidine).C13H15ON2 was first isolated from the plant's seeds and roots, and it is the plant's main alkaloid (1).Is nearly twice as toxic as harmine, causing tremors and clonic convulsions in moderate doses but no increase in spinal reflex excitability (21)Harmine (banisterine) (banisterine).C13H12ON2 is found in *Peganum.harmonium* and and in some species of *Banisteia*, viz., *B.caapi, Spruce., B. lutea* and *B. metallicolor*,the alkaloidis optically inactive is pharmacologically resembles harmaline in its action, but is less toxic (22)Harmalol.C12H12ON2 - Which occurs in *Peganumharmala* crystallizes from water as the trihydrate.Harman.C12H10N2. This alkaloid is inactive.Vasicinone the potential quinazoline alkaloids and were first discovered in flowers and stems , It is an active bronchodilator ,The authors reported that these alkaloids were mainly investigated in seeds by using different methods (%yield, retention factor values, melting point , Ultraviolet and

infrared spectra)for their identification and isolation(17**)**. Confirmed harmaline, harmine, harmol and tetrahydroharmine and quantified as the mainalkaloids in *Peganumharmala* extracts(18).

Materials and methods

Ethical approval:

This study was approved by ethical committee of the Sudan International University (SIU), Facultymedical Laboratory Sciences.

Collection of plant and identification:

Deride mature seeds of*Peganum harmala*were collected from different herbal medicine shops of Khartoum state Sudan in February 2020. seeds were identified and authenticated in Medicinal and Aromatic plants Research Institute (MAPRI). seeds were then ground to obtain fine powderThe powdered material was weighed properly 200g and stored in tight polythene bags for further usage.

Preparation of Crude Extracts:

For the methanolic extract thecoarsely powdered material (100 g) was exhaustively extracted by macerated in 500ml Methanol(80%)for 3daysat room temperature, Occasional shaking themethanolic extract was filtered and evaporated under reduced pressure using Rota-vapor apparatus, then air-dried, repacked in the Soxhlet and exhaustively extracted,each residue was weighed and the yield percentage was determined,the methanol residue (3.5g) was dissolved in methanol 8.75 ml (con. 400mg/ml), and kept in refrigerator until used.

For aqueous extract 100 g of the plant sample was infused in 500 ml hot water for 4 hours then filtered with Whatman filter paper. Extracts kept in Deep freezer for 48 hours, then introduced in freeze dryer till completely dried. The residue was weighed and the yield percentage was determined. The aqueous residue (4g) was dissolved in sterile distilled water 10 ml (con. 400mg/ml), and kept in refrigerator until used.

Percent recovery of the crude extracts of plants was calculated by weighing the dried extracts of pants. Following formula was used for calculating percent extract recovery.

% Extract recovery = (a / b) × 100

Where; a = Total weight of dried extract obtained after drying, and b = Total weight of ground plant material taken for each extraction.

Microorganisms used:

A total of tenorganisms were selected for this study. Five reference standard microorganisms from American Type Culture Collection (ATCC) One Gram positive bacteria *Staphylococcus aureus*(ATCC 3889),three Gram negative bacteria *Eschericia coli*(ATCC 3887), *salmonella entrica* (ATCC 14028) and *Pseudomonas aeruginosa*(ATCC 9027), as well as one fungi *Candida albicans* (ATCC 10231).

And five Multidrug resistanceclinical isolated organisms*Proteus mirabilis*and *Pseudomonas aeruginosa*, *Escherichia coli*and *Klebsiella pneumoniae* (ESBL makers), and Methicillin resistance *staphylococcus aureus* (MRSA), These species were originally isolated from clinical specimens and identified by standard biochemical reactions based on morphological and biochemical characters according to the methods described in **(19)**.

Different characteristics were Gram stain, pigmentation, motility and utilization of different carbon and nitrogen sources and antibiotic sensitivity tests.

Identification of MRSA and ESBL isolates:

Methicillin-resistant *Staphylococcus aureus* (MRSA) was detected using the disc diffusion method with Cefoxitin and oxacillin disc, as recommended by the Clinical and Laboratory Standards Institute (CLSI).

The identification of *Escherichia coli* and *Klebsiella pneumoniae*Extended Spectrum Beta Lactamse (ESBL) makers isolates were achieved by disc diffusion method for screening and confirmatory tests using Cefotaxime (30g), Ceftazidime (30g), and Ceftriaxon (30g)alone and in combination with clavulanic acid on inoculated Mueller-Hinton agar plates and incubated at 37°C for 24 hours. the inhibition zones of the drugs for bacteria were ≤27mm for Cefotaxime(30µg), ≤22mm for Ceftazidime(30µg), ≤25mm for Ceftriaxon(30µg) respectively.

The double disc synergy test was used to screen multi drug resistant*Pseudomonas aeruginosa*and *Proteus mirabilis.* a disc of amoxiclav (20 g amoxycillin and 10 g clavulanic acid) and a 30-g disc of each 3Gc (gas chromatography) test antibiotic were placed 15 mm apart on a lawn culture of the isolate to determine synergy. the zone of inhibitionwas increased towards the Amoxyclav disc.

Inoculums preparation for antibacterial assay:

The testedorganisms cultured at 37 °C for 18-24 hours in the Muller-Hinton Broth (MHB, HIMEDIA) and used as inoculums.

The standardization of the inoculums suspension turbidity adjusted to the

McFarland 0.5 turbidity standard (1.5×10^8 cfu/ml)(20).

Antibacterial assay procedure:

Antibacterial activity of the extracts were tested using the cup-plate agar diffusion method (25) was adopted to assess the antibacterial activity of the prepared extracts.

The test inoculum (0.5 McFarland's turbidity) was spread onto Muller- At first, a total of 0.1 ml of bacterial suspension was poured on each plate containing Muller-Hinton Agar (MHA, HIMEDIA). The lawn culture was prepared by sterile cotton swab and allowed to remain in contact for 1 min. Then the wells were punched by a sterile well puncture. Four concentrations of methanolic and water extracts (100,50, 25, and 12.5mg/ml) from seeds parts of P. harmala were prepared, and added to each well using micropipette, then incubated at 37°C for 24 hours. The presence of zones of inhibition was regarded as the presence of antimicrobial action. The diameter of zone of inhibition was measured in mm. antimicrobial activity was expressed in terms of average diameter of the zones of inhibition measured, and methanolic crude extract was dissolved in Dimethyl sulfoxide (DMSO) (1:3 w/v, final concentration 250mg/ml).

This experiment was carried out in triplicate. As positive controls, discs containing novobiocin 30 µg, colistin 10 µg, streptomycin 10 µg and methicillin 5 µg were used. All of these synthetic antibiotic discs were prepared from Difco. Discs impregnated with 80 % and methanol was also included to test if they had an inhibitory effect on the test bacteria.

Minimum inhibition concentration & minimum bactericidal concentration:

The broth microdilution method was used to determine Minimum inhibition concentration (MIC) and Minimum bactericidal (MBC) according to Clinical and Laboratory Standards Institute (CLSI). Sterile 96-well microplates were used for the assay. The stock extract (80 mg/mL) was dissolved in sterile distilled water. All tests were performed in Mueller-Hinton broth. Briefly, serial doubling dilutions of the extracts were prepared in a 96-well microtiter plate ranging from 40 mg/ml to 0.3125mg/ml.

Sterile 96-well microplates 0.1 mL (Mueller-Hinton broth, HIMEDIA). Test extract (0.1 mL) was added to the first well of each row and serial double-fold dilutions (40, 20, 10, 5, 0.25,

0.125, 0.625, and 0.3125 mg/ml) were made down to the desired minimum concentration. The wells (two rows for each microorganism) were inoculated with 0.1 mL suspension of each test bacteria (0.5 McFarland) and incubated at 35 ± 2 °C for 16-20 hours. The growth of each microorganism in the different dilutions of extracts was determined by measuring the optical density at 630 nm with ELIZA. The wells filled with Mueller-Hinton broth and the suspension of each test bacteria were included as a positive control in each assay. The wells filled with Mueller-Hinton broth and extract were used as a negative control. All assays were carried out in triplicate.

Results:

This research was conducted on the methanolic and water extracts of seeds parts ofmedically important plants *Peganumharmala.*

The researchwas done toevaluate the antimicrobial activity of *Peganumharmala* against reference standard microorganisms from American Type Culture Collection (ATCC), and multidrug resistance clinical isolates organisms using cup-plate agar diffusion method and broth microdilution method using 96-well microplates.

The reference standard microorganisms from American Type Culture Collection (ATCC) One Gram positive bacteria *Staphylococcus aureus*(ATCC 3889),three Gram negative bacteria *Eschericia coli*(ATCC 3887), *salmonella entrica* (ATCC 14028) and *Pseudomonas aeruginosa*(ATCC 9027), as well as one fungi *Candida albicans* (ATCC 10231).

The antimicrobial activity of seeds methanolic and water extracts of *pengum harmala*was screened for its antimicrobial activity against clinical isolated multi drug resistance microorganisms, one Gram positive bacteria Methicillin resistant *Staphylococcus aureus*(MRSA), and three Gram negative bacteria *Escherichia coli* , *Pseudomonas aeruginosa*, ,*klebsiella pneumoniae*and *proteus mirables*.

Extracts resulting in more 18mm growth inhibition zone are considered to possess high antimicrobial activity, those the resulting (14-18mm)are of intermediate activity and those resulting in zone below 14mm are inactive.

Yields percentage of methanolic and water extracts of *Peganumharmala* Plants:

Tables (1) showed the yield percentage of (99.8%) methanolic and water seeds extracts of *Peganumharmala*.

Scientific Name of Plant	Solvent	Weight of sample(g)	Yield (%)

Peganumharmala	Methanol	100 grams	3.7
	Water	100 grams	4.5

The antimicrobial activity of aqueous and Methanolic extracts of *Peganumharmala* against tested organisms :

According to the result obtained that are shown in Table 2, 3, and Figures1, and 2,The seed extracts of *Peganumharmala* have a broad antimicrobial activity against most of organisms under this study with moderately increasing in the methanolic extract activity compared with water extracts, and high antimicrobial effect against the reference standard microorganisms compared withthe clinical isolated multi drug resistance microorganisms.

The antimicrobial activity of the methanolic and water extracts of *Peganum harmala* directly proportional to their increasing in the concentration. The highest inhibition zone reached 32 mm to ward E. coli ATCC 8739at concentration 100 mg/ml and smallest inhibition zone zero mm toward *Pseudomonas aeruginosa* ATCC 9027 at concentration 12.5 mg/ml.

The obtained result indicate that the average inhibition zone of the methanolic extracts were 25.1.mm (100 mg/ml), 18.4 mm (50 mg/ml), 16.0 mm (25mg/ml) and 11.3 mm (12.5 mg/ml), while the average inhibition zone of the water extracts slightly decreased 21.8.mm (100 mg/ml), 17.8 mm (50 mg/ml), 12.4 mm (25mg/ml) and 7.4 mm (12.5 mg/ml).

The invitro antimicrobial activity shown that all tested microorganisms were sensitive to the methanolic extract at concentration of 100 mg/ml(Zone of inhibition >18 mm)with highly antimicrobial activity mainly against *Staphylococcus aureus* ATCC 6538, *E. coli* ATCC 8739,*klebsiella pneumoniae*, *Proteus mirabilis* and *Escherichia coli*, (Zone of inhibition >25mm), moderate antimicrobial activity against, *Salmonella enterica* ATCC 14028,*Candida albicans* ATCC 10231 and MRSA (Zone of inhibition >20 mm) and low antimicrobial activity mainly against *Pseudomonas aeruginosa* ATCC 9027 and MDR *Pseudomonas aeruginosa* (Zone of inhibition 18 mm) .While most of the organisms under this study indicate the sensitivity against the methanolic extract at the concentration of 50 mg/ml(Zone of inhibition >18 mm) except *Pseudomonas aeruginosa* ATCC 9027 and MDR *Pseudomonas aeruginosa* which indicate their resistance(Zone of inhibition 12 mm).

The results indicate that the methanolic extract possess high antimicrobial activity(Zone of inhibition >18 mm) against *Staphylococcus aureus* ATCC 6538, *E. coli* ATCC 8739 and *Proteus mirabilis* under all concentrations in this study (100, 50, 25, and 12.5 mg/ml), intermediate antimicrobial activity effect (Zone of inhibition >14 mm) against *Candida albicans* ATCC 10231,*Salmonellaenterica* ATCC 14028 and *E. coli*, at concentration of 50

and 25 mg/ml and no antimicrobial activity(Zone of inhibition < 14 mm) against MRSA and *Klebsiella pneumoniae*, at concentration of 25 and 12.5 mg/ml .

The water extract possess no antimicrobial activity(Zone of inhibition <14 mm) against all of the microorganisms under this study at concentration of 25 and 12.5 mg/ml except *Klebsiella pneumonia* and *Proteus mirabilis* with moderately intermediate antimicrobial activity against *Staphylococcus aureus* ATCC 6538 at concentration of 25 mg/ml.

The water extract possess high antimicrobial activity effect (Zone of inhibition >18 mm) against all of the microorganisms under this study at concentration of 100 mg/ml except *Pseudomonasaeruginosa* ATCC9027 and MDR *Pseudomonas aeruginosa* which had an intermediate antimicrobial activity(Zone of inhibition 18-14 mm).

The water extract possess high antimicrobial activity(Zone of inhibition >18 mm) against *Staphylococcus aureus*ATCC 6538 , E.coli ATCC 8739 , *S.enterica* ATCC 14028 ,*Klebsiella pneumoniae* and *Proteus mirabilis*at concentration of 50 mg/ml ,and an intermediate antimicrobial activity(Zone of inhibition 18-14 mm) against *Candida albicans* ATCC 10231 , MRSA and *Escherichiacoli* .

Pseudomonasaeruginosa ATCC 9027 and *Pseudomonas aeruginosa* were appear highly resistant to *Peganum harmala* water extract at 50 mg/ml, 25 mg/ml and 12.5 mg/ml.

Tables (2) showed Antimicrobial activity of Methanolic extracts of *Peganumharmala* against Reference and MDR Clinical Isolated microorganisms:

Organism Name	Methanolic Extracts of *Peganumharmala* Inhibition zone (mm)			
	100 mg/ml	50 mg/ml	25 mg/ml	12.5 mg/ml
S.aureus ATCC 6538	30 ± 0.31	22 ± 0.45	20 ± 0.4	18 ± 0.2
E.coli ATCC 8739	32 ± 0.40	28 ± 0.21	25 ± 0.2	20 ± 0.46
P.aeruginosa ATCC 90	18 ± 0.35	12 ± 0.42	12 ± 0.31	Zero
S.enterica ATCC 1402	24 ± 0.25	18 ± 0.15	15 ± 0.40	10 ± 0.45
C.albicans ATCC 1023	22 ± 0.30	16 ± 0.45	16 ± 0.44	12 ± 0.06
MRSA	20 ± 0.35	18 ± 0.06	12 ± 0.52	08 ± 0.20
Escherichia.coli,	26 ± 0.26	20 ± 0.45	14 ± 0.55	06 ± 00
Pseudomonas aerugino	18 ± 0.12	12 ± 0.55	10 ± 0.70	06 ± 00
Klebsiella pneumoniae	31 ± 0.10	26 ± 0.32	12 ± 0.60	09 ± 0.06
Proteus mirabilis.	30 ± 0.40	22 ± 0.25	24 ± 0.25	24 ± 0.30

Each sample was analyzed individually in triplicate. The diameter of cup/disc = 6 mm.

Key: MDIZ (mm) = Mean diameter of growth inhibition zone in mm. Interpretation of results: MDIZ (mm); >18 mm: Sensitive, 14 to 18 mm: Intermediate, <14 mm: Resistant.

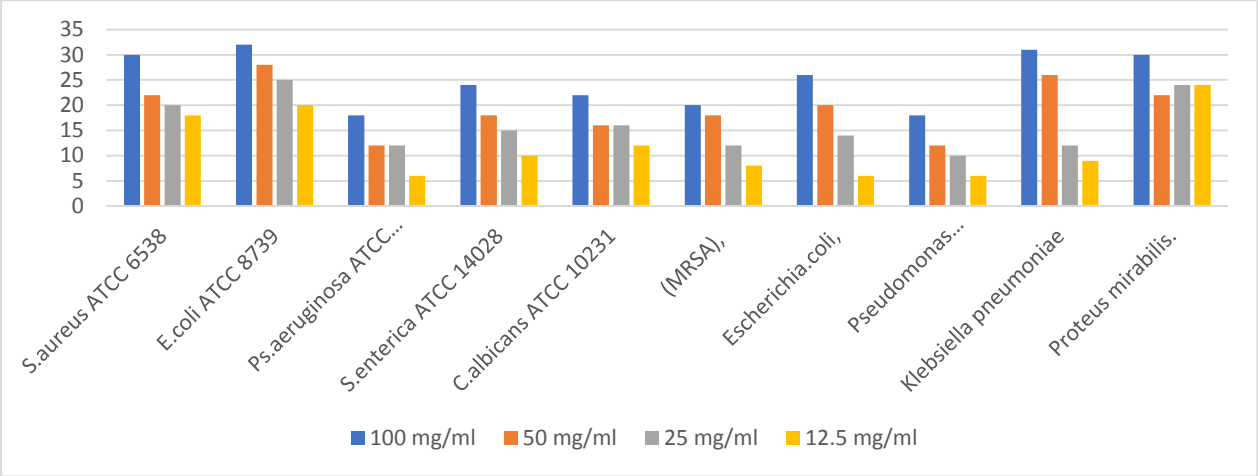

Figure **1**

Tables (3) showed Antimicrobial activity of Water extracts of *Peganumharmala* against

Reference and clinical MDR Isolated organisms:

Organism Name	Water extracts of *Peganumharmala* Inhibition zone (mm)			
	100 mg/ml	50 mg/ml	25 mg/ml	12.5 mg/ml
S.aureus ATCC 6538	28± 0.36	22 ± 0.40	16 ± 0.23	10± 0.2
E.coli ATCC 8739	25 ± 0.25	19 ± 0.5	12 ±0.13	6 ± 0
P.aeruginosa ATCC 9027	14 ± 0.49	10 ± 0.45	6 ± 0	6 ± 0
S.enterica ATCC 14028	20 ± 0.75	18 ± 0.15	12 ± 0.31	10 ± 0.45
C.albicans ATCC 10231	19 ± 0.57	16 ± 0.45	12 ± 0.07	9 ± 0.55
MRSA	18 ± 0.44	14 ± 0.06	10 ± 0.6	6 ± 0
Escherichiacoli,	20 ± 0.45	16 ± 0.29	10 ± 0.35	6 ± 0
Pseudomonas aeruginosa	15± 0.29	12 ± 0.47	6 ± 0	6 ± 0
Klebsiella pneumoniae	29± 0.75	22 ± 0.35	20 ± 0.25	6 ± 0
Proteus mirabilis.	30 ± 0.45	29 ± 0.21	20 ± 0.4	6 ± 0

Each sample was analyzed individually in triplicate. The diameter of cup/disc = 6 mm.

Key: MDIZ (mm) = Mean diameter of growth inhibition zone in mm. Interpretation of results: MDIZ (mm); >18 mm: Sensitive, 14 to 18 mm: Intermediate, <14 mm: Resistant.

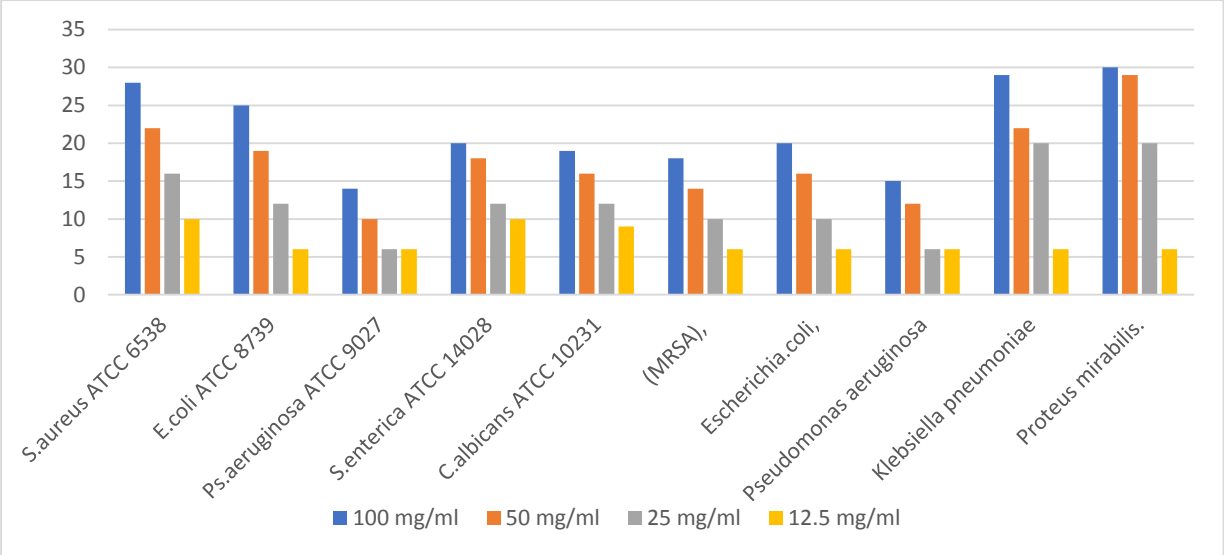

Figure**2**

Determination of theMICs and MBC for both Methanolic and Water extracts:

According to the result obtained that are shown in Table **5**, and Figure **3**, the methanolic extract has high effect at the concentration of**1.25**mg/ml against (*Ps.aeruginosa*ATCC 9027, *C.albicans*ATCC 10231,*Proteus mirabilis)* and moderate effect at the concentration of **2.5**mg/ml against (*E.coli* ATCC 8739, *S.enterica*ATCC 14028, MRSA and *Escherichia coli*, *Klebsiella pneumoniae*) and low effect against *Pseudomonas aeruginosa* at the concentration **10**mg/ml. while table **6** and figure **4** showed the high effect of water extract at the concentration of **2.5**mg/ml against (*C.albicans*ATCC 10231,*Proteus mirabilis*), and moderate effect at the concentration of **10**mg/ml (*S.aureus*ATCC 6538**,** *Ps.aeruginosa*ATCC 9027, and *S.enterica*ATCC 14028, MRSA and *Klebsiella pneumoniae*), and no effect at 40mg/ml concentration against *Pseudomonas aeruginosa*.

Table 5: The MIC and MBC values of Methanolic extracts of P. harmala against Reference and MDR clinical Isolated organisms:

Bacterial species	**MIC (mg/ml)**	**MBC (mg/ml)**
***S.aureus*ATCC 6538**	5mg/ml	10mg/ml
***E.coli* ATCC 8739**	2.5mg/ml	5mg/ml
***Ps.aeruginosa*ATCC 9027**	1.25mg/ml	5mg/ml
***S.enterica*ATCC 14028**	2.5mg/ml	5mg/ml
***C.albicans*ATCC 10231**	1.25mg/ml	2.5mg/ml
MRSA	2.5mg/ml	5mg/ml

Pseudomonas aeruginosa	10mg/ml	20mg/ml
Escherichiacoli	2.5mg/ml	5mg/ml
Klebsiella pneumoniae	2.5mg/ml	5mg/ml
Proteus mirabilis	1.25mg/ml	2.5mg/ml

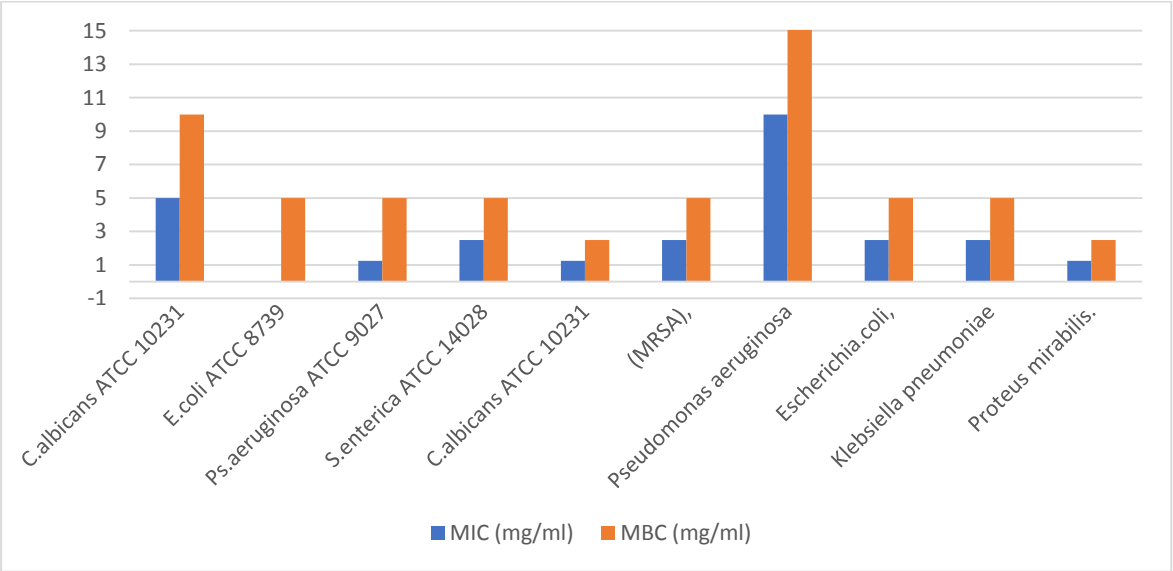

Figure **3**

Table 6: The MIC and MBC values of Water extracts of *P. harmala* against Reference and MDR Clinical Isolated organisms:

Bacterial species	**MIC (mg/ml)**	**MBC (mg/ml)**
***S.aureus*ATCC 6538**	10mg/ml	20mg/ml
***E.coli* ATCC 8739**	20mg/ml	40mg/ml
***Ps.aeruginosa*ATCC 9027**	10mg/ml	20mg/ml
***S.enterica* ATCC 14028**	10mg/ml	20mg/ml
***C.albicans*ATCC 10231**	2.5mg/ml	5mg/ml
(MRSA)	10mg/ml	20mg/ml
Pseudomonas aeruginosa	No Reaction at 40mg/ml	No Reaction at 40mg/ml
Escherichiacoli	5mg/ml	10 mg/ml
Klebsiella pneumoniae	10mg/ml	20mg/ml
Proteus mirabilis.	2.5mg/ml	5mg/ml

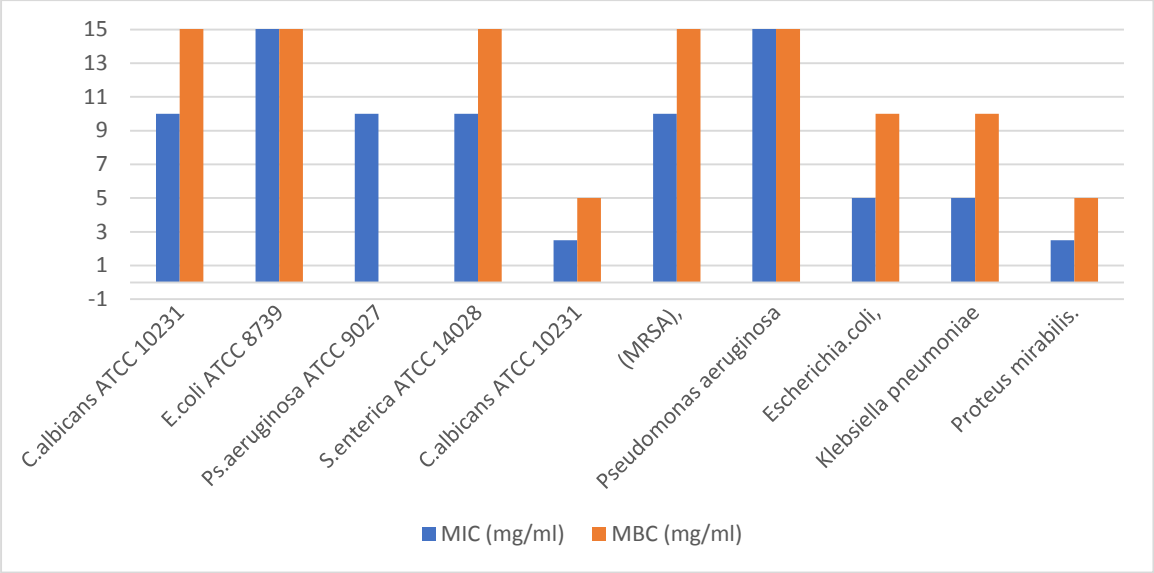

Figure **4**

Discussion:

Aromatic and medicinal plants, which are the mainstay of complementary and alternative medicine, have recently raised significant hopes for symptom relief and disease-related cures**(21).**Potential sources of natural materials that are useful in avoiding a variety of human ailments include medicinal plants. In the past, the Middle East, North Africa, and West China have utilized *P. harmala* as an emmenagogue and an abortifacient. It is a blooming plant that grows wild and is a member of the Zygophyllaceous family(22).

This experimental study was done in order to estimate antimicrobial activity of *P. harmala* and we found that The seed extracts of *P. harmala* have a broad antimicrobial activity against most of organisms under this study with moderately increasing in the methanolic extract activity compared with water extracts, and high antimicrobial effect against the reference standard microorganisms compared with the clinical isolated multi drug resistance microorganisms.

The antimicrobial activity of the methanolic and water extracts of *Peganumharmala* directly proportional to their increasing in the concentration. The obtained result indicate that the average inhibition zone of the methanolic extracts were 25.1.mm (100 mg/ml), 18.4 mm (50 mg/ml), 16.0 mm (25mg/ml) and 11.3 mm (12.5 mg/ml), while the average inhibition zone of the water extracts slightly decreased 21.8.mm (100 mg/ml), 17.8 mm (50 mg/ml), 12.4 mm (25mg/ml) and 7.4 mm (12.5 mg/ml).which is almost similar to study done in Iran 2016 to asses antimicrobial activity of *Peganum harmala*against*S.mutans* which indicate that the

average inhibition zone of the methanolic extracts were 25.1.mm (100 mg/ml), 18.4 mm (50 mg/ml), 16.0 mm (25mg/ml) and 11.3 mm (12.5 mg/ml), while the average inhibition zone of the water extracts slightly decreased 21.8.mm (100 mg/ml), 17.8 mm (50 mg/ml), 12.4 mm (25mg/ml) and 7.4 mm (12.5 mg/ml)(22). Furthermore, the results of this study showed that the *P.harmala* extracts inhibited the growth of all the microbial isolates tested. And the methanolic extract antimicrobial activity was higher Than the water extract which is similar to all litruters about *P.harmala* .furthermore extracts are equally broad spectrum in activity as their activities were independent of Gram reaction, this result is similar to (ahmed et al) (23) study in Libya 2021 which concluded that the actions of the extracts are as wide-ranging as their independence from the Gram reaction. Higher antimicrobial activity of the extracts was observed against Higher *S.enterica* flowed by pseudomonas as control strain group and the higher antimicrobial activity among multidrug resistant strain was against *protues spp*. Iranian study in 2011 showed that Among Gram positive bacteria, *S. epidermidis* and *Str. pyogenes* were the most sensitive strains to the seed and root extracts while among Gram negative bacteria, *K.pneumoniae* and *Br.melitensis* had the most sensitivity to the seed extract and *K.pneumoniae* and *E.coli* to the root extract too. *P. mirabilis* and *P. aeruginosa* were the most resistant strains to these two extracts. Antibacterial activity of the root extract against tested *Bacillus species* and *S. aureus* was better than the seed extract(24). The main differences in the susceptibility maybe due to assay methods that they used disc diffusion method.

Conclusion:

In conclusion, the extracts of*P. harmala's* have broad antibacterial activity against resistance organism.with high methanolic extract activitycompared with water extracts, the use of this plant as an antibacterial agent has promising future. its use may be more beneficial for resistant bacteria than the commonly used antibiotics. So additional antibacterial and cytotoxicity tests on animals or human beings are required.

References:

1. Hay RJ, Morris-Jones R. Bacterial infections. Rook's Textbook of Dermatology, Ninth Edition. 2016:1-100.

2. Cragg GM, Newman DJ. Natural products: a continuing source of novel drug leads. Biochimica et Biophysica Acta (BBA)-General Subjects. 2013;1830(6):3670-95.

3. Karunamoorthi K, Jegajeevanram K, Vijayalakshmi J, Mengistie E. Traditional medicinal plants: a source of phytotherapeutic modality in resource-constrained health care settings. Journal of Evidence-Based Complementary & Alternative Medicine. 2013;18(1):67-74.

4. Payyappallimana U. Role of traditional medicine in primary health care: an overview of perspectives and challenging. 2010.

5. Mahmoudian M, Salehian P, Jalilpour H. Toxicity of Peganum harmala: review and a case report. 2002.

6. Pal SK, Shukla Y. Herbal medicine: current status and the future. Asian pacific journal of cancer prevention. 2003;4(4):281-8.

7. Prashanth D, John S. Antibacterial activity of Peganum harmala. Fitoterapia. 1999;70(4):438-9.

8. Hayet E, Maha M, Mata M, Mighri Z, Laurent G, Mahjoub A. Biological activities of Peganum harmala leaves. African Journal of Biotechnology. 2010;9(48):8199-205.

9. Bellakhdar J. Pharmacopée marocaine traditionnelle: Ibis press; 1997.

10. Shahrajabian MH, Sun W, Cheng Q. Improving health benefits with considering traditional and modern health benefits of Peganum harmala. Clinical Phytoscience. 2021;7(1):1-9.

11. Marwat SK, ur Rehman F. Medicinal and pharmacological potential of harmala (Peganum harmala L.) seeds. Nuts and Seeds in Health and Disease Prevention: Elsevier; 2011. p. 585-99.

12. Hürkul MM, Köroğlu A. Investigation of Peganum harmala L.(Üzerlik) fruits sold in the market from the view of pharmaceutical botany. Biological Diversity and Conservation. 2019;12(2):65-77.

13. Tahraoui A, El-Hilaly J, Israili Z, Lyoussi B. Ethnopharmacological survey of plants used in the traditional treatment of hypertension and diabetes in south-eastern Morocco (Errachidia province). Journal of ethnopharmacology. 2007;110(1):105-17.

14. Herraiz T, González D, Ancín-Azpilicueta C, Arán VJ, Guillén H. β-Carboline alkaloids in Peganum harmala and inhibition of human monoamine oxidase (MAO). Food and Chemical Toxicology. 2010;48(3):839-45.

15. Moloudizargari M, Mikaili P, Aghajanshakeri S, Asghari MH, Shayegh J. Pharmacological and therapeutic effects of Peganum harmala and its main alkaloids. Pharmacognosy reviews. 2013;7(14):199.

16. Kamel S, Ibrahim L, Afifi A, Hamza S. Major alkaloidal con-stituents of the Egyptian plant. Peganum harmala. 1970.

17. Bukhari, N., Choi, J. H., Jeon, C. W., Park, H. W., Kim, W. H. and Khan, M. A. (2008). Phytochemical studies ofthe alkaloids from Peganum harmala. Applied Chemistr., 12(1): 101–104..

18. Wang K-B, Di Y-T, Bao Y, Yuan C-M, Chen G, Li D-H, et al. Peganumine A, a β-carboline dimer with a new octacyclic scaffold from Peganum harmala. Organic letters. 2014;16(15):4028-31.

19. Vos P, Garrity G, Jones D, Krieg NR, Ludwig W, Rainey FA, et al. Bergey's manual of systematic bacteriology: Volume 3: The Firmicutes: Springer Science & Business Media; 2011.

20. Biemer JJ. Antimicrobial susceptibility testing by the Kirby-Bauer disc diffusion method. Annals of Clinical & Laboratory Science. 1973;3(2):135-40.

21. Samuels N, Ben-Arye E. Exploring herbal medicine use during palliative cancer care: The integrative physician as a facilitator of pharmacist–patient–oncologist communication. Pharmaceuticals. 2020;13(12):455.

22. Rao AV. Herbal cure for common diseases: Diamond Pocket Books (P) Ltd.; 2004.

23. Motamedifar M, Khosropanah H, Dabiri S. Antimicrobial activity of Peganum Harmala L. on Streptococcus mutans compared to 0.2% Chlorhexidine. Journal of Dentistry. 2016;17(3):213.

24. Arif M, Wang X, Kazi MSK, Ullah Khan S, Saeed S, Khan AM, et al. Antimicrobial activities of different solvent extracts from stem and seeds of Peganum Harmala L. Plos one. 2022;17(4):e0265206.

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The Optimal Control Model Use for Remove Mold from Homes

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Abstract

In this paper we consider a mathematical model of mold $x(t)$ and Fungicide $u(t)$. The aim of this model is permanently remove mold from houses. Molds can cause mild to severe health problems in sensitive individuals when a sufficient number of airborne spores are inhaled. We used the optimal spray strategies to remove amount of mold. We work optimal control framework by applying the Pontryagin's Maximum Principle. A characterization of the optimal control via adjoint variables was established. We obtained an optimality system that we sought to solve numerically by used MATLAB program.

المستخلص

في هذا البحث نعتبر نموذجا رياضيا للعفن $x(t)$ ومبيد الفطريات $u(t)$ الهدف من هذا النموذج هو إزالة العفن بشكل دائم من المنازل .يمكن أن تسبب العفن مشاكل صحية خفيفة إلى شديدة لدى الأفراد الحساسين عند استنشاق عدد كاف من الجراثيم المحمولة جوا . استخدمنا استراتيجيات الرش المثالية لإزالة كمية العفن .نحن نعمل بإطار تحكم مثالي من خلال تطبيق مبدأ بونتريا جن الأقصى .تم وضع توصيف للتحكم الأمثل عبر المتغيرات المجاورة .لقد حصلنا على نظام أمثل سعينا إلى حله عدديا باستخدام برنامج MATLAB

Keywords: ***Optimal Control Model, Pontryagin's Maximum Principle, algorithm, MATLAB.***

1-Introduction

1.1 General Introduction

Molds are fungi, usually microscopic in size, that occur in nature in large quantities. They reproduce by releasing spores into the air that settle on surfaces and, under the right conditions, grow. Growths of mold can often be seen in the form of a discoloration, ranging from white to orange and green to brown and black. Mold can sometimes be detected by its musty odor. Mildew is a common mold. When mold spores settle on organic or contaminated surfaces and when other conditions of temperature, humidity, shade or darkness, and oxygen supply are conducive, they germinate and develop new colonies of mold. Even surfaces from which mold has previously been removed can have mold growing again if the conditions are right.

Molds thrive on organic materials like natural fibers (such as cotton and wool), paper, leather, wood, or surfaces coated with the slightest amount of organic matter such as food, grease, and soil. Molds that continue to grow can eventually eat away the organic medium that is their source of food.

Wooden structural materials and textiles can deteriorate when mold is allowed to thrive on them.

Molds grow best in warm temperatures, 77 to 86 degrees Fahrenheit, though some growth may occur anywhere between 32 and 95 degrees.

Molds require moisture. Moisture can come from water leaks, flooding, capillary movement (wicking from one area to another), high relative humidity, and condensation. The moisture may be in the host material, on its surface, or in the form of humidity in the air. Relative humidity levels above 70 percent appear to be optimal for fungal or mold spore growth. A lower relative humidity level reduces the rate of mold growth as the mold goes dormant but does not stop growth and development entirely. In fact, at low relative humidity levels, there is increased spore release into the air.

We are all exposed to many kinds of mold both inside and outside the house. However, some people seem to be more sensitive to mold and have allergies to some types of mold. These people may suffer from cold-like Symptoms. When people are experiencing these symptoms, it is difficult to know if they are the result of exposure to molds or have other causes. When breathed,

some mold spores are small enough to go deeply into the lungs and cause serious illness. It is not healthy to live in a home with high levels of mold.

Many times, mold can be detected by a musty odor. Although mold spores are too small to be seen, colonies of mold growth are sometimes visible on damp walls and musty-smelling textiles. Mildew is one type of mold that can often be seen. In most cases, it is not practical to test for mold growth in a house. There are no standards for "acceptable" levels of mold in a dwelling, and when testing is done, it is usually to compare levels of mold spores inside the house with levels outside the house. It is generally better to look for mold in those places where conditions promote mold growth.

Generally, mold may be found any place where moisture or relative humidity levels are high. Wet or damp **basements** may have mold growing on the walls, floors, carpeting, or on materials stored in the basement.

Moisture from the earth can migrate through concrete walls causing them to remain damp. Water standing in sump holes, condensate from an air conditioner or dehumidifier, leaky pipes, or water seeping into the basement are all sources of moisture that can support mold growth. Basement carpeting often has mold growing on or under it if the carpeting is installed on a concrete floor that remains cool and damp. Materials stored in a damp basement may have mold growing on them. In particular, firewood stored in the basement puts moisture into the air and is an excellent medium for mold growth. The mold spores can then spread throughout the house. **Crawlspaces** built over uncovered earth can have mold problems when the moisture in the ground causes dampness in the space. Crawlspaces that are sloped incorrectly and have water pooling in them are particularly likely to have problems.

Mold can often be found growing in the **bathroom**. If an exhaust fan is not used during bathing, large amounts of moisture can remain in the shower or tub area. Soap scum on bath and shower walls, even on ceramic tile or fiberglass, is a nutrient source for mold growth. In the **laundry room**, unvented clothes drying produces high levels of relative humidity that support mold growth. Damp towels and clothes in laundry hampers, washers, or dryers can develop mildew growth. Using a **humidifier** sometimes raises the relative humidity high enough that mold will grow. Particularly in the winter, high relative humidity in areas where there is little air movement

results in condensation on cold walls and subsequent mold growth. Dark patches of mold can sometimes be seen inside the upper corner of a closet on an outside wall or behind furniture placed against outside walls. Window condensation can result in mold growth where the moisture runs onto the sill or wood trim. Mold growth can be found on **kitchen** walls if household cooking involves large amounts of boiling water and no exhaust fan is used. The cooking spatters and grease film on walls are the source of nutrients for the mold, combined with the high humidity levels in those areas. Floor-level pans that collect the condensate from automatic defrosting refrigerators often have mold growing in them. **New construction materials**, such as new wooden wall studs and floor joists, drywall compound, and masonry materials emit moisture into the home while the construction components dry. **Unvented combustion heaters**, such as kerosene heaters, emit large amounts of humidity into the air with the exhaust gases [1, 2, 3,4].

Fungicide is a chemical substance that destroys or inhibits the growth of fungi.

1.2 The mathematical model

In our basic optimal control problem for ordinary differential equations, we use $u(t)$ for the control and $x(t)$ for the state. The state variable satisfies a differential equation which depends on the control variable:

$$x'(t) = g(t, x(t), u(t))$$

As the control function is changed, the solution to the differential equation will change. Thus, we can view the control-to-state relationship as a map $u(t) \rightarrow x = x(u)$ (of course, x is really a function of the independent variable t, we write x (u) simply to remind us of the dependence on u). Our basic optimal control problem consists of finding a piecewise continuous control $u(t)$ and the associated state variable $x(t)$ to maximize the given objective functional, i.e

$$\max_u \int_{t_0}^{t_1} f\big(t, x(t), u(t)\big)dt$$

$$\text{Subject to } x'(t) = g(t, x(t), u(t))$$

$$x(t_0) = x_0 \, and \, x(t_1) free.$$

Such a maximizing control is called an optimal control. By $x(t_1)$ free, it ismeant that the value of $x(t_1)$ is unrestricted. For our purposes, f and g will always be continuously differentiable

functions in all three arguments. Thus, as the control(s) will always be piecewise continuous, the associated states will always be piecewise differentiable [5].

1.3 Pontryagin's maximum principle

$$H(t,x,u,\lambda) = f(t,x,u) + \lambda g(t,x,u)$$

= integrand + adjoint * RHS of DE*:*

We are maximizing *H* with respect to *u* at u^*, [6, 7] and the above conditions can be written in terms of the Hamiltonian:

$$\frac{\partial H}{\partial u} = 0 \; at \; u^* \Rrightarrow f_u + \lambda g_u \qquad (\textit{Optimality condition}),$$

$$\lambda' = -\frac{\partial H}{\partial x} \Rrightarrow \lambda' = -(f_x + \lambda g_x) \qquad (\textit{adjoint equation}),$$

$$\lambda(t_1) = 0 \qquad (\textit{transversality condition}).$$

We are given the dynamics of the state equation:

$$x' = g(t,x,u) = \frac{\partial H}{\partial \lambda}, x(t_0) = x_0.$$

Theorem

Consider

$$J(u) = \int_{t_0}^{t_1} f\big(t, x(t), u(t)\big)dt$$

$$\text{Subject to } x'(t) = g\big(t, x(t), u(t)\big), \quad x(t_0) = x_0$$

Suppose that $f(t,x,u)$ *and* $g(t,x,u)$ are both continuously differentiable functions in their three arguments and concave in *x* and *u*. suppose u^* is a control, with associated state x^*, and λ a piecewise differentiable function, such that u^*, x^*, [5, 6] and λ together satisfy on $t_0 \le t \le t_1$:

$$f_u + \lambda g_u = 0,$$
$$\lambda' = -(f_x + \lambda g_x),$$
$$\lambda(t_1) = o,$$
$$\lambda(t) \ge 0.$$

Then for all controls u, we have

$$J(u^*) \ge J(u).$$

Proof

Let u be any control, and x its associated state. Note, as $f(t,x,u)$ is concave in both the x and u variable, we have by the tangent line property

$$f(t,x^*,u^*) - f(t,x,u) \geq (x^* - x)f_x(t,x^*,u^*) + (u^* - u)f_u(t,x^*,u^*)$$

This gives

$$J(u^*) - J(u) = \int_{t_0}^{t_1} f(t,x^*,u^*) - f(t,x,u)$$

$$\geq \int_{t_0}^{t_1} (x^*(t) - x(t))f_x(t,x^*,u^*) + (u^*(t) - u(t))f_u(t,x^*,u^*)dt \ldots\ldots\ldots (1)$$

Substituting

$f_x(t,x^*,u^*) = -\lambda'(t) - \lambda(t)g_x(t,x^*,u^*)$ and

$$f_u(t,x^*,u^*) = -\lambda(t)g_u(t,x^*,u^*)$$

as given by the hypothesis, the last term in (1) becomes

$$\int_{t_0}^{t_1} \big(x^*(t) - x(t)\big)\big(-\lambda'(t) - \lambda(t)g_x(t,x^*,u^*)\big)dt + \big(u^*(t) - u(t)\big)\big(-\lambda(t)g_u(t,x^*,u^*)\big)dt.$$

Using integration by parts, and recalling , $\lambda(t_1) = 0$ and $x(t_0) = x^*(t_0)$, we see

$$\int_{t_0}^{t_1} -\lambda'(t)\big(x^*(t) - x(t)\big)dt = \int_{t_0}^{t_1} \lambda(t)(x^*(t) - x(t))'\,dt$$

$$= \int_{t_0}^{t_1} \lambda(t)(g\big(t,x^*(t),u^*(t)\big) - g\big(t,x(t),u(t)\big)dt.$$

Making this substitution,

$$J(u^*) - J(u) \geq \int_{t_0}^{t_1} \lambda(t)[g(t,x^*,u^*) - g(t,x,u) - (x^* - x)g_x(t,x^*,u^*)$$

$$+ (u^* - u)g_u(t,x^*,u^*)]dt$$

Taking into account $\lambda(t) \geq 0$ and that g is concave in both x and u, this gives the desired result

$$J(u^*) - J(u) \geq 0.$$

2-Results and discussion

2.1 The optimal control problem

Let x (t) be a population concentration at time t, and suppose we wish to reduce the population over a fixed time period. We will assume x has a growth rate r and carrying capacity M. The application of a substance is known to decrease the rate of change of x, by decreasing the

rate in proportion to the amount of *u* and *x*. Let *u* (*t*) be the amount of this substance added at time *t*. For example, the population could be an infestation of an insect, or a harmful microbe in the body. Here we view *x*(*t*) as the concentration of a Mold and *u*(*t*) an Fungicide known to kill it. The differential equation representing the mold is given by

$$x'(t) = r\big(M - x(t)\big) - u(t)x(t), x(0) = x_0,$$

Where $x_0 > 0$ is the given initial population size. Note the term *u*(*t*)*x*(*t*) pulls down the rate of growth of the Mold. The effects of both the Mold and Fungicide are negative for individuals around them, so we wish to minimize both. Further, while a small amount of either is acceptable, we wish to penalize for amounts too large. Hence, our problem is as follows

$$\min_u \int_0^T Ax(t)^2 + u(t)^2 dt$$

$$\text{Subject to } x'(t) = r\big(M - x(t)\big) - u(t)x(t), x(0) = x_0.$$

The coefficient *A* is the weight parameter, balancing the relative importance of the two terms in the objective functional [5].

2.2 Numerical solution

Before writing the code we develop the optimality of this problem by first noting the Hamiltonian is

$$H = Ax^2 + u^2 + \lambda r(M - x) - \lambda xu$$

Using the optimality condition

$$0 = \frac{\partial H}{\partial u} = 2u - \lambda x \; at \; u^* \Rightarrow u^* = \frac{\lambda x}{2}$$

The adjoint equation is

$$\lambda'(t) = -\frac{\partial H}{\partial x} = -2Ax + \lambda r + \lambda u$$

$$= -2Ax + \lambda r + 0.5\lambda^2 x$$

$$= \lambda r + (0.5\lambda^2 - 2A)x$$

$$x'(t) = Mr - x(r + u) \quad , \qquad x(0) = x_0$$

$$\lambda'^{(t)} = \lambda r + (0.5\lambda^2 - 2A)x \quad , \qquad \lambda(T) = 0$$

Using these two differential equations and the representation of u^*, we generate the numerical code as described above, written in MATLAB [8].

Using the Runge- kutta sweep method [5] solving $x^{\rightarrow}$ forward in time

```
For i = 1:N
k1 = M*r - x(i)*(r + u(i));
k2 = M*r-(x(i) + h2*k1)*(r + 0.5*(u(i) + u(i+1)));
k3 = M*r-(x(i) + h2*k2)*(r + 0.5*(u(i) + u(i+1)));
k4 = M*r - (x(i) + h*k3)*(r + u(i+1));
x(i+1) = x(i) + (h/6)*(k1 + 2*k2 + 2*k3 + k4);
```

Using the Runge- kutta sweep method solving $u^{\rightarrow}$ backward in time

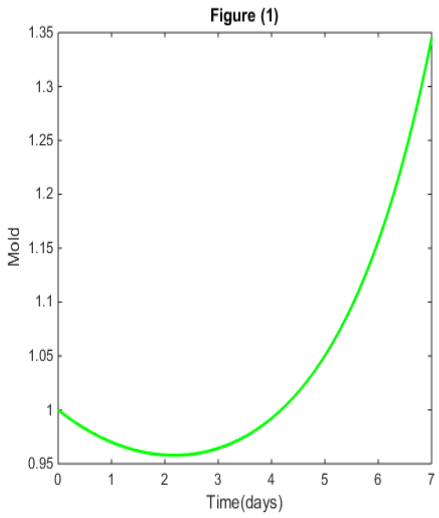
```
for i = 1:N
j = N + 2 - i;
k1 = lambda (j)*r + [0.5*(lambda (j)) ^2-2A] * x(j);
k2= (lambda (j)-h2*k1)*r + [0.5*(lambda (j) - h2*k1)^2-2A]*0.5*(x(j)+x(j-1)) ;
k3=(lambda(j)-h2*k2)*r + [0.5*(lambda(j)- h2*k2)^2-2A] * 0.5*(x(j)+x(j-1)) ;
k4 = (lambda (j)-h*k3)*r +[ 0.5*(lambda (j) - h*k3)^2-2A] * x(j-1) ;
lambda (j-1) = lambda(j) - ...
                    (h/6)*(k1 + 2*k2 + 2*k3 + k4);
```

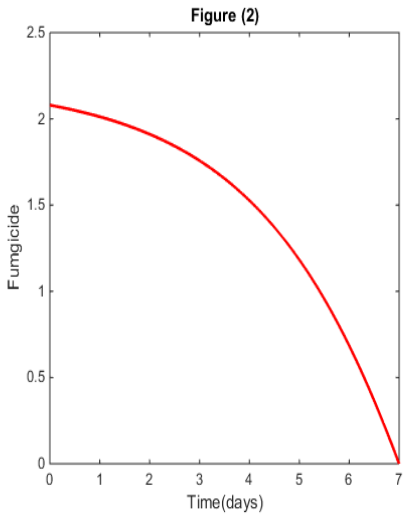
2.3 Numerical results

Here we consider a general mold and fungicide model and all the parameter values are chosen hypothetically.

Enter the values

r =0.2, M =10, A = 1, x_0 =1.

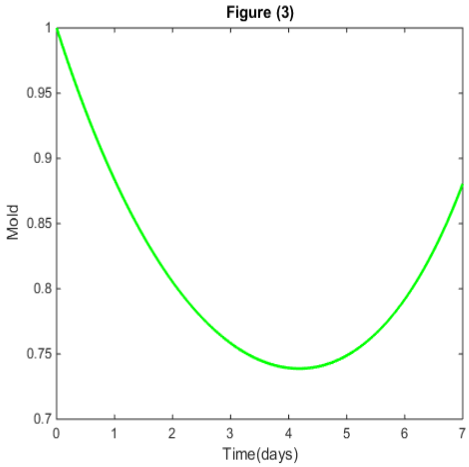


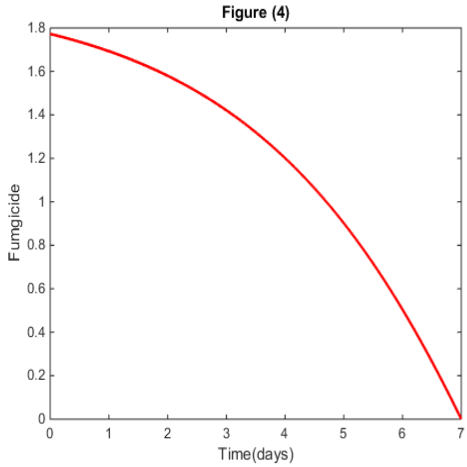


From figure (1) and figure (2) we find mold state in first and second day decrease but from third day to last day increases

Enter the values

$$r = 0.2, \quad M = 5, \quad A = 5, \quad x_0 = 1.$$

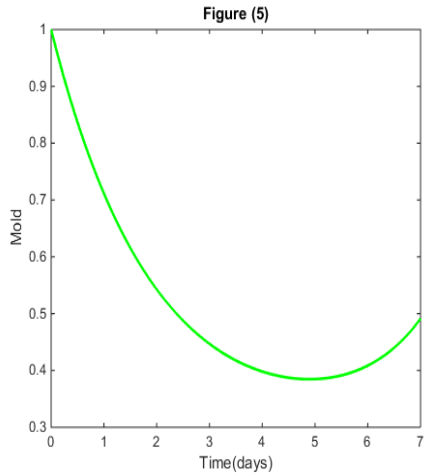


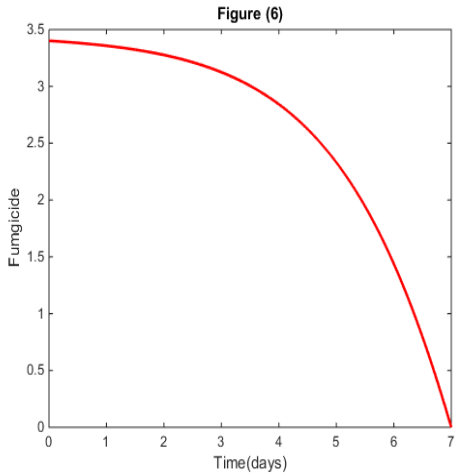


From figure (3) and figure (4) we find mold state in decrease from first day to fourth day but from third day to last day increasing mold growth

Enter the values

$$r = 0.2, \quad M = 5, \quad A = 50, \quad x_0 = 1.$$





From figure (5) and figure (6) we find mold state in decreased from first day to fifth day but from sixth day to last day increasing mold growth. We repeat this case until we get rid of the mold completely.

3-Conclusions

In this paper, the mold is sprayed every week with the fungicide until we get rid of it completely and until the houses are purified of this mold. We clean and dry the buildings as quickly as possible, as it are preferable to clean every 24 to 48 hours and use fans to help in the drying process.

References

[1] Marilyn bode and Deana Munson, controlling mold growth in the home, Kansas state university, September 1995.

[2] Oatman, laure, and charles A. Lane. Mold and mildew in the home. St. paul, Minnesota: Minnesota Extension service, university of Minnesota, 1988.

[3] Clean – up procedures for mold in houses. Ottawa, Ontario: Canada mortgage and Housing Corporation, 1993.

[4] http://www.osha.gov/SLTC/molds/index.html

[5] Suzanne lenhart, johnT.workman, Optimal control applied to Biological Models, 2007.

[6] W. H. Fleming R. W. Rishel . Determinshic and stochastic optimal control.springer-verlag,NewYork,1975.

[7] F. H. clark. Optimal control and Nonsmooth Analysis. STAM, Philadelphia, 1990.

[8] Matlab. *Matlab Release 13*. The Mathworks, Inc., Natich, MA, 2003.

[9] L. S. Pontryagin, V. G. Boltyanskii, R. V. Gamkrelize, and E. F. Mishchenko. *The Mathematical Theory of Optimal Processes*. Wiley, New York, 1962.

[10] F. H. clark. Optimal control and Nonsmooth Analysis. STAM, Philadelphia, 1990.

[11] Bickers, U., E.C. Oerke and H.D. Dehne. 1999. Influence of formulation and application on the biological availability and efficacy of systemic fungicides. p. 131-136. In: H. Lyr, P.E. Russell, HW. Hehne and H.D. Sisler, eds. Modern fungicides and antifungal compounds. Intercept Ltd., Andover, U.K.

[12] Sigler,W.v., Z. Reicher,C. Throssell, M. Bischoff and RJ. Turco. 2003. Absorption and degradation of selected fungicides in the turfgrass canopy. Water, Air, and Soil Pollution 142:311-326.

[13] Morton I. Kamien and Nancy L. Schwartz. Dynamic Optimization: The Calculus of Variations and Optimal Control in Economics and Management. North-Holland, New York, 1991.

[14] Wayne M. Getz. Optimal control and principles in population management. Proceedings of Symposia in Applied Mathematics, 30:63,82, 1984.

[15] H. J. Sussman and V. Jurdjevic. Controllability of nonlinear systems. Journal of Differential Equations, 12, 1972.

[16] John Butcher. A multistep generalization of Runge-Kutta methods with four or five stages. Journal of the ACM, 14:84{99, 1967.

[17] S. Butler, D. Kirschner, and S. Lenhart. Optimal control of chemotherapy affecting the infectivity of HIV. Advances in Mathematical Population Dynamics - Molecules, Cells and Man, 6:557{69, 1997.

[18] H. T. Banks, H-D. Kwon, J. Toivanen, and H. T. Tran. A state dependent Riccati equation-based estimator approach for HIV feedback control. Optimal Control Applications and Methods, 27, 2006.

[19] Peter Dorato, Chaoki Abdallah, and Vito Cerone. Linear Quadratic Control: An Introduction. Prentice Hall, Englewood Cliffs, New Jersey, 2000.

[20] Frank L. Lewis. Optimal Control. Wiley-Interscience, New York, 1986.

[21] Arthur E. Bryson, Jr. and Yu-chi Ho. Applied Optimal Control. Ginn and Company, Waltham, Massachusetts, 1969.

[22] J. Canada, J. L. Gamez, and J. A. Montero. A study of an optimal control problem for diffusive nonlinear elliptic equations of logistic type. SIAM J. of Control Optim., 36:1171{89, 1998.

[23] W. H. Fleming R. W. Rishel . Determinshic and stochastic optimal control.springer-verlag,NewYork,1975.

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Sobolev Embeddings and Capacity on Metreic Spaces

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Abstract:

The main aim of this study is to know the Sobolev embeddings into spaces of Campanato and Hölder type with scaling invariant Sobolev-Lorentz capacity on metric spaces and in the Euclidean setting. We develop a capacity theory based on the definition of Sobolev functions on metric spaces with a Borel regular outer measure, with respect to the Lorentz norm .The basic properties of capacity including monotonicity countable (finite) are studied. The researcher used the historical mathematical and analytical method to access related informations to Sobolev embeddings and capacity on metreic spaces**.** The most important result of the study they are embedded inside the paper and refer to theorems of Sobolev embeddings and capacity on metreic and $\mathbb{R}^n$ spaces .

المستخلص :

الهدف الأساسي لهذه الدراسة هو التعرف علي طمر سوبوليف في فضاءات كامباناتو ونوع هولدر مع سعة سوبوليف- لورنتز اللامتغيرة الترقيم علي الفضاءات المترية وفي الوضع الإقليدى .وتم تطوير نظرية السعة بناءاً علي تعريف دوال سوبوليف في الفضاءات المترية بواسطة مقياس بوريل الخارجي المنتظم مع مراعاة معيار لورنتز . وأيضا تمت دراسة الخصائص الأساسية للسعة بما في ذلك الرتابة القابلة للعد (المنتهية) . إستخدم الباحث المنهج الرياضي و التحليلي التاريخي للوصول فيما يتعلق بمعلومات طمر سوبوليف والسعة في الفضاءات المترية . ومن أهم النتائج التي توصلت اليها الدراسة هي متضمنة داخل الورقة وتشير الي نظريات سوبوليف والسعة في الفضاءات المترية والنونية .

Keywords: Campanato spaces , Morrey spaces , Hölder spaces ,Sobolev embeddings, Capacity, Metric spaces.

1.Introduction:

Necessary and sufficient conditions on a rearrangement-invariant Banach function space $X(Q)$ on a cube Q in $\mathbb{R}^n, n \geq 2$, are given for the corresponding Sobolev space $W^1X(Q)$ to be continuously embedded into (generalized) Campanato, Morrey, or Hölder spaces. As an application **,**we prove that each Sobolev function has a quasicontinuous representative. For doubling measures **,**we provide sharp estimates for the capacity of balls. Capacity and Hausdorff measures are related under an additional regularity assumption on the measure, are studied. We develop a capacity theory based on the definition of Sobolev

functions on $\square^n$ with respect to the Lorentz norm. Basic properties of capacity, including monotonicity, finite subadditivity .

2. Campanato with Morrey, and Hölder Type.

We establish Sobolev embedding, in the spirit of Morrey's theorem, into the spaces $C^{0,\varphi}(Q)$, $L^C_\varphi(Q)$, and $L^M_\alpha(Q)$ In fact, the aim is to determine optimal summability conditions on the gradient of a weakly differentiable function on *Q* for such a function to belong to each of these space.

Lemma (2.1). Let $X(Q)$ be an r.i. space on the cube $Q \subset \mathbb{R}^n$.

(i) If $u \in W_0^1 X(Q)$, then u^* is locally absolutely continuous and

$$nC_n^{1/n} \| s^{1/n'} \left(-\frac{du^*}{ds} \right) \|_{\tilde{X}(0,1)} \leq \| \nabla u \|_{X(Q)} \tag{1}$$

Here $C_n = \pi^{n/2} / \Gamma(1+n/2)$, the measure of the unit ball in Rn. Equality holds in (3) if u is radially decreasing.

(ii) If $u \in W^1 X(Q)$, then u° is locally absolutely continuous and there exists a constant K_n depending only on n , such that

$$K_n \| \min\{s, 1-s\}^{1/n'} \left(-\frac{du^\circ}{ds} \right) \|_{\tilde{X}(0,1)} \leq \| \nabla u \|_{X(Q)} \tag{2}$$

Let f be a real-valued measurable function on *Q*. The non increasing rearrangement f^* of f is given by

$$f^*(t) = \sup\{ s > 0 : |\{ x \in Q : |f(x)| > s \}| > t \}, 0 < t < 1$$

and the signed non increasing rearrangement f° of f is given by

$$f^\circ(t) = \sup\{ s \in \square : |\{ x \in Q : f(x) > s \}| > t \}, 0 < t < 1 \tag{3}$$

A Banach space $X(Q)$ of functions defined on *Q*, equipped with the norm $\|\cdot\|_{X(Q)}$ is said to be rearrangement-invariant if the following five axioms hold:

(i) $0 \leq g \leq f$ a.e implies $\| g \|_{X(Q)} \leq \| f \|_{X(Q)}$.

(ii) $0 \leq f_n \leq f$ a.e implies $\| f_n \|_{X(Q)} \leq \| f \|_{X(Q)}$.

(iii) $\|1\|_{X(Q)} < \infty$.

(iv) A constant *C* exists such that $\int_Q f \leq \| f \|_{X(Q)}$ for every $f \in X(Q)$

(v) $\| g \|_{X(Q)} = \| f \|_{X(Q)}$ whenever $f^* = g^*$.

Given an r.i. space $X(Q)$,the set

$$X'(Q) = \left\{ f \text{ measurable on } Q \int_Q |fg| < \infty \text{ for every } g \in X(Q) \right\}$$

equipped with the norm

$$\| f \|_{X'(Q)} = \sup_{\|g\|_{X(Q)} \leq 1} \int_Q |fg| \tag{4}$$

is called the associate space of $X(Q)$. It turns out that $X(Q)$ is again an r.i. space and $X''(Q) = X(Q)$. Furthermore, the Hölder type inequality

$$\int_Q |fg| \le \|f\|_{X(Q)} \|g\|_{X'(Q)}$$

holds for every f and g. For every r.i. space $X(Q)$, there exists a unique r.i. space $\bar{X}(0,1)$ on $(0,1)$, satisfying $\|f\|_{X(Q)} = \|f^*\|_{\bar{X}(Q)}$. such a space, endowed with the norm

$$\|f\|_{\bar{X}(Q)} = \sup_{\|g\|_{X(Q)} \le 1} \int_0^1 f^*(t) g^*(t) dt$$

is called the representation space of $X(Q)$. A property which will be used in our proofs is that the dilation operator E_t, defined for $0 < t \le 1$ by $E_t \varphi(s) = \varphi(st), s \in (0,1)$ at a measurable function φ on (0,1), is bounded on every r.i. space on (0,1) . For a comprehensive treatment of r.i. spaces we refer the reader to [3]. The first-order Sobolev space $W^1X(Q)$ built upon an r.i. space $X(Q)$ is defined as $W^1X(Q) = \{u : u$ is a real-valued weakly differentiable function on $Q\}$ and

$$|\nabla u| \in X(Q)\}.$$

Lemma (2.2). Let G be a measurable subset of $\mathbb{R}^n, n \ge 1$, having finite measure, and let $f \in L^1(G)$. Then

$$\min_{c \in \mathbb{R}} \int_G |f(x) - c| dx = \int_G |f(x) - f^\circ\left(\frac{|G|}{2}\right)| dx \qquad (5)$$

where f° is defined as in (3), with Q replaced by G .

Proof. We prove (5) under the assumption that f is nonnegative. The general case can be dealt with analogously, on splitting f into its positive and negative parts. The fact that the minimum in (5) is attained is an easy consequence of the dominated convergence theorem for the Lebesgue integral.

Now, since

$$f(x) = \int_0^\infty \chi_{\{f > t\}}(x) dt \quad \text{for} \quad x \in G$$

then, for every $c \in \mathbb{R}$,

$$\begin{aligned}
\int_G |f(x) - c| dx &= \int_{\{f > c\}} \left(\int_0^\infty \chi_{\{f > t\}}(x) dt - c \right) dx \\
&+ \int_{\{f \le c\}} \left(c - \int_0^\infty \chi_{\{f > t\}}(x) dt \right) dx \\
&= \int_0^\infty \int_G \chi_{\{f > t\}}(x) \, dx \, dt - c\,|f > c| \\
&+ c(|G| - |\{f > c\}|) - \int_0^\infty \int_G \chi_{\{f \le c\}}(x) \, dx \, dt \\
&= \int_c^\infty |\{f > t\}| dt - \int_0^c |\{f > t\}| dt + c\,|G|
\end{aligned}$$

Thus, $\int_G |f(x)-c|dx$ is a locally absolutely continuous function of c in $\mathbb{R}$ whose derivative equals to $|G|-2|\{f > c\}|$ for a.e. $c \in \mathbb{R}$. Hence, (5) follows , in general, $f^*(|G|/2)$ need not be the unique minimizer in (5).

Lemma (2.3). Let $X(Q)$ be an r.i. space. Then

$$\frac{1}{s}\| r^{1/n}\chi_{(0,s)}(r)\|_{\tilde{X}(0,1)} \le s^{-1/n'}\|\chi_{(0,1)}, s \in \left(0,\frac{1}{2}\right) \tag{6}$$

Proof. Given $s \in (0,1/2)$, we have

$$\begin{aligned}\frac{1}{s}\| r^{1/n}\chi_{(0,s)}(r)\|_{\tilde{X}(0,1)} &\le s^{-1/n'}\|\chi_{(0,1)}(r)\|_{\tilde{X}(0,1)}, s \in \left(0,\frac{1}{2}\right)\\ &\le 2^{-1/n'}\|(s+r)^{-1/n'}\chi_{(0,s)}(r)\|_{\tilde{X}(0,1)}\\ &\le 2^{-1/n'}\|(s+r)^{-1/n'}\chi_{(0,1-s)}(r)\|_{\tilde{X}(0,1)}\\ &\le 2^{-1/n'}\|r^{-1/n'}\chi_{(s,1)}(r)\|_{\tilde{X}(0,1)}\end{aligned}$$

Example(2.4). Assume that α ∈ (-∞, 1], α≠0, and $\varphi(t)=t^{\alpha}$. Then $\theta(t)\approx t^{(1-\alpha)/n}$ when $M_{\theta}(Q)=L_{n/(1-\alpha),\infty}(Q)$ a classical Marcinkiewicz space.

$$W^1 L_{n/(1-\alpha),\infty}(Q) \to L^C_{\varphi}(Q)$$

and $L_{n/(1-\alpha),\infty}(Q)$ is optimal, that is, the largest such r.i. space. Moreover, if $\alpha \in (0,1)$, then

$$W^1 Z_{t^{\alpha}}(Q) \to C^{0,\varphi}(Q)$$

where $Z_{t^{\alpha}}(Q)$ is optimal. Since $\psi \approx \varphi$.

If $\alpha \in (-\infty,0)$, then

$$W^1 Y_{t^{\alpha}}(Q) \to L^M_{\varphi}(Q)$$

with $Y_{t^{\alpha}}(Q)$ optimal, and, since $\omega \approx \varphi$ and $L^C_{\varphi}(Q)=L^M_{\varphi}(Q)$, we get

$$Y_{t^{\alpha}}(Q)=L_{n/(1-\alpha),\infty}(Q).$$

3. Sobolev Capacity on Metric Spaces.

We develop a capacity theory based on the definition of Sobolev functions on metric spaces due to Hajtasz [290]. His definition makes use of the fact that a smooth real-valued function *u* on $\mathbb{R}^n$satisfies

$$|u(x)-u(y)| \le C|x-y|(\mu|\nabla u|(x)+\mu|\nabla u|(y)) \tag{7}$$

for every $x, y \in \mathbb{R}^n$, where μf is the Hardy-Littlewood maximal operator of a locally integrable function *f* defined by

$$\mu f(x)=\sup_{r>0}\frac{1}{|B(x,r)|}\int_{B(x,r)}|f(y)|dy$$

Sobolev space (3.1).Let (X, d) be a metric space and let μ be a non-negative Borel regular out measure on X . In the following, we keep the triple (X, d, μ) fixed, and for short, we denote it by X . Let $1<p<\infty$. The $L^p(X)$ is the Banach space of all μ-a.e. defined μ-measurable functions $u: X \to [-\infty,\infty]$ for which the norm

$$\| u \|_{L^p(X)} = \left(\int_X |u|^p \, d\mu \right)^{1/p}$$

is finite. Suppose that $u : X \to [-\infty, \infty]$ is μ-measurable. We denote by $D(u)$ the set of all μ-measurable functions $g : X \to [0, \infty]$ such that

$$|u(x) - u(y)| \leq d(x, y)(g(x) + g(y)) \quad (8)$$

for every $x, y \in X \setminus F, x \neq y$, with $\mu(F) = 0$. Note that the right hand side of (8) is always defined for $x \neq y$. At the points $x, y \in X$, $x \neq y$, where the left hand side of (8) is undefined we may assume that the right hand side is $+\infty$. Following the original definition due to Hajtasz, the Dirichlet space $L^{1,p}(X)$ consists of all μ-measurable functions u with $D(u) \cap L^p(X) \neq \varphi$; the space $L^{1,p}(X)$ is endowed with the semi norm

$$\| u \|_{L^{1,p}(X)} = \inf \left\{ \| g \|_{L^p(X)} : g \in D(u) \cap L^p(X) \right\} \quad (9)$$

The Sobolev space $W^{1,p}(X)$ is the space of all functions $u \in L^p(X)$ for which $D(u) \cap L^p(X) \neq \varphi$. It is clear that (9) defines a seminorm in $W^{1,p}(X)$ .An application of the uniform convexity of $L^p(X)$ implies that there is a unique minimizer of (9); this means that the infimum is attained by a unique function in $D(u) \cap L^p(X)$ .We equip the Sobolev space $W^{1,p}(X)$ with the norm

$$\| u \|_{W^{1,p}(X)} = \left(\| u \|^p_{L^p(X)} + \| u \|^p_{L^{1,p}(X)} \right)^{1/p} \quad (10)$$

Then $W^{1,p}(X)$ is a linear space.

Theorem (3.2). The Sobolev *p*-capacity is an outer measure.

Proof. Clearly $C_p(\varphi) = 0$ and the definition of the capacity implies monoonicity.To prove countable subadditivity, suppose that $E_i, i = 1, 2, 3, \ldots$. are subsets of X . Let $\varepsilon > 0$. We may assume that $\sum_{i=1}^{\infty} C_p(E_i) < \infty$**.** Next we choose $u_i \in A(E_i)$ and $g_{u_i} \in D(u_i) \cap L^p(X)$ so that $\| u_i \|^p_{L^p(X)} + \| g_{u_i} \|^p_{L^p(X)} \leq C_p(E_i) + \varepsilon 2^{-i}$ for $i = 1, 2, 3, \ldots$**.** We show that $v = \sup_i u_i$ is admissible for $\bigcup_{i=1}^{\infty} E_i$ and . First we observe that $v, g \in L^p(X)$ **.**Then we define $v_k = \max_{1 \leq i \leq k} u_i$. the function $g_{v_k} = \max_{1 \leq i \leq k} g_{u_i}$ belongs to $D(v_k) \cap L^p(X)$ **.**Since $g = \sup_i g_{u_i} \in D(v) \cap L^p(X)$ $v_k \to v$ **,** μ-a.e. and $g_{v_k} \to g$ **,** μ-a.e. Clearly $v \geq 1$ in a neighborhood of $\bigcup_{i=1}^{\infty} E_i$. This implies that

$$C_p\left(\bigcup_{i=1}^{\infty} E_i \right) \leq \| v \|^p_{W^{1,p}(X)} \sum_{i=1}^{\infty} (\| u_i \|^p_{L^p(X)} + \| g_{u_i} \|^p_{L^p(X)}) \leq \sum_{i=1}^{\infty} C_p(E_i) + \varepsilon$$

The claim follows by letting $\varepsilon \to 0$.

Theorem (3.3). If $Q_1 \subset Q_2 \subset \ldots$ are open subsets of X and $O = \bigcup_{i=1}^{\infty} O_i$,then

$$C_p(O) = \lim_{i \to \infty} C_p(O_i)$$

Proof. Monotonicity implies $\lim_{i\to\infty} C_p(O_i) \le C_p(O)$. To prove the opposite inequality, we may assume that $\lim_{i\to\infty} C_p(O_i) < \infty$. Let $\varepsilon > 0$ and $u_i \in A(O_i)$, $i = 1,2,3,\ldots$, and $g_{u_i} \in D(u_i) \cap L^p(X)$ be such that

$$\| u_i \|^p_{L^p(X)} + \| g_{u_i} \|^p_{L^p(X)} \le C_p(O_i) + \varepsilon$$

Now (u_i) is a bounded sequence in $L^p(X)$ and hence it has a weakly convergent subsequence, which we denote again (u_i).The sequence (g_{u_i}) is also bounded in $L^p(X)$ and hence, by passing to a subsequence, we may assume that $u_i \to u$ weakly in $L^p(X)$ and $g_{u_i} \to g$ weakly in $L^p(X)$ Using the Banach-Saks theorem we see that the sequence $v_j = j^{-1}\sum_{i=1}^{j} u_i$ converges to u in $L^p(X)$ and $g_{v_j} = j^{-1}\sum_{i=1}^{j} g_{v_j}$ converges to g in $L^p(X)$.Now there is a subsequence of (v_i) so that $v_j \to u$, μ-a.e. and $g_{v_k} \to g$, μ-a.e. The function u belongs to $W^{1,p}(X)$. On the other hand $v_j \to 1$ μ-a.e. in O and hence $u \ge 1$, $\boldsymbol{\mu}$-a.e. there. This means that $u \in A(O)$ By the weak lower semi continuity of norms

$$C_p(O) \le \| u \|^p_{L^p(X)} + \| g \|^p_{L^p(X)} \le \liminf_{i\to\infty}(\| u_i \|^p_{L^p(X)} + \| g_{u_i} \|^p_{L^p(X)}) \lim_{i\to\infty} C_p(O_i) + \varepsilon$$

from which the claim follows by letting $\boldsymbol{\varepsilon} \to 0$.

Theorem(3.4). For each Cauchy sequence of functions in $W^{1,p}(X) \cap C(X)$ there is a subsequence which converges point wise *p*-*q*.e. in X . Moreover, the convergence is uniform outside a set of arbitrary small *p*-capacity.

Proof. There is a sub sequence of (u_i), which we still denote by (u_i),such that .

$$\sum_{i=1}^{\infty} 2^{ip} \| u_i - u_{u+1} \|^p_{W^{1,p}(X)} < \infty$$

For $i = 1,2,3,\ldots$, denote $E_i = \{x \in X : |u_i(x) - u_{i+1}(x) > 2^{-j}\}$ and $F_j = \bigcup_{i=j}^{\infty} E_i$. By continuity $2^i (u_i - u_{i+1})$ is admissible for E_i, which implies

$$C_P(E_i) \le \sum_{i=j}^{\infty} 2^{ip} \| u_i - u_{u+1} \|^p_{W^{1,p}(X)}$$

and by subadditivity we obtain

$$C_p(F_j) \le \sum_{i=j}^{\infty} C_p(E_i) \le \sum_{i=j}^{\infty} 2^{ip} \| u_i - u_{u+1} \|^p_{W^{1,p}(X)}$$

Hence

$$C_p\left(\bigcap_{j=1}^{\infty} F_j\right) \le \lim_{j\to\infty} C_p(F_j) = 0$$

and (u_i) converges in . Mor $X \setminus \bigcap_{j=1}^{\infty} F_j$ eover,

$$|u_j - u_k| \le \sum_{i=j}^{k-1} |u_i - u_{i+1}| \le \sum_{i=j}^{k-1} 2^{-i} \le 2^{1-j}$$

in X / F_j for every $k > j$, which means that (u_i) convergence is uniform in X / F_j. The theorem follows. A function $u : X \to [-\infty,\infty]$ is p-quasi continuous in X if for every $\varepsilon > 0$ there is a set E such that $C_p(E) < \varepsilon$ and the restriction of u to $X \setminus E$ is continuous. By outer regularity , we may assume that E is open.By [8], $W^{1,p}(X)$ is a Banach space and by [8], $C(X) \cap W^{1,p}(X)$ is a dense subspace of $W^{1,p}(X)$ and hence completeness implies that $W^{1,p}(X)$ can be characterized as the completion of $C(X) \cap W^{1,p}(X)$ in the norm defined by (8). This means that $u \in W^{1,p}(X)$ if and only if there exist sequences of functions $u_i \in L^p(X) \cap C(X)$ and $g_i \in D(u_i - u)$ such that $u_i \to u$ and $g_i \to 0$ in $L^p(X)$ We deduce from the previous theorem that the limit function is p-quasi continuous and hence each Sobolev function,has a p-quasi continuous representative.

4.Capacity and measure:

We are mainly interested in the sets of vanishing capacity, since they are in some sense exceptional sets in the theory Sobolev spaces. Our first result is rather immediate.

Lemma (4.1). Let $\mu(E) \le C_p(E)$ for every $E \subset X$.

Proof. If $u \in A(E)$, then there is an open $O \supset E$ such that $u \ge 1$ in O and hence

$$\mu(E) \le \mu(O) \le \|u\|^p_{L^p(X)} \le \|u\|^p_{w^{1,p}(X)} .$$

We obtain the claim by taking the infimum over all $u \in A(E)$.

In particular, sets of capacity zero are also of measure zero. From now on we assume in this section that the measure is nontrivial, Borel regular and that there is $c_d \ge 1$ such that

$$\mu B(x, 2r) \le c_d \mu B(x, r) \tag{11}$$

for all $x \in X$ and $r > 0$. A measure satisfying the condition (11) is said to be doubling and the constant cd is called the doubling constant. If μ is doubling, then every open set has a nonzero measure. If $0 < r < R < \infty$ and $x \in X$, then iterating the doubling condition we get

$$\mu B(x, R) \le c \left(\frac{R}{r}\right)^s \mu(B(x, r)) \tag{12}$$

Where

$$s = \frac{\log c_d}{\log 2} \tag{13}$$

and c depends only on the doubling constant c_d . Observe that in the Euclidean case with the Lebesgue measure s equals to the dimension of the space. Hence (13) defines a dimension related to the doubling measure μ .

Theorem (4.2). Let $x_0 \in X$ and $0 < r \le 1$. If μ is doubling , then

$$C_p(B(x_0, r)) \le c r^{-p} \mu B(x_0, r) \tag{14}$$

where c depends only on the doubling constant and p.

proof. Let $0<r<R$ and define

$$u(x)=\begin{cases}\dfrac{R-d(x,x_0)}{R-r}, & x\in B(x_0,R)\setminus B(x_0,r)\\ 1, & x\in B(x_0,r)\\ 0, & x\in X\setminus B(x_0,R)\end{cases}$$

and

$$g(x)=\begin{cases}\dfrac{1}{R-r}, & x\in B(x_0,R)\\ 0, & x\in X\setminus B(x_0,R)\end{cases}$$

We show that $g\in D(u)$.Let first $x,y\in A=B(x_0,R)\setminus B(x_0,r)$. Then

$$|u(x(-u(y)|=\frac{|d(x,x_0)-d(y,x_0)|}{R-r}\le\frac{d(x,y)}{R-r}$$

Hence (8) follows in this case. Next let $x\in A$ and $y\in B(x_0, r)$. Now

$$|u(x(-u(y)|=1-u(x)\le\frac{d(x,x_0)-r}{R-r}$$

Since $d(x,x_0)\ge r>d(y,x_0)$ we have

$$d(x,x_0)-r\le d(x,x_0)-d(y,x_0)\le d(x,y)$$

and (8) follows. The case $y\in A$ and $x\in B(x_0, r)$ is completely analogous. If $x,y\in B(x_0,r)$ or $x, y\in X/B(x_0, R)$, then clearly (8) holds. For the remaining cases, let $y\in B(x_0, r)$ and $x\in X/B(x_0, R)$. Now

$$|u(x(-u(y)|=1=u(x)\le\frac{R-r}{R-r}\le\frac{d(x,y)}{R-r}$$

which implies (8). Finally, if $x\in A$ and $y\in X\setminus B(x_0, R)$, then

$$|u(x(-u(y)|=u(x)\le\frac{R-d(x,x_0)}{R-r}$$

and since $d(x,x_0)<R<d(y,x_0)$, we obtain

$$R-d(x,x_0)\le d(y,x_0)-d(x,x_0)\le d(x,y)$$

and (8) again holds. Thus $g\in D(u)$,u belongs to $A(B(x_0,r))$ and

$$C_p(B(x_0,r))\le\int_{B(x_0,R)}u^p d\mu+\int_{B(x_0,R)}g^p d\mu\le(1+(R-r)^{-p})\mu(B(x_0,R))$$

$$\le(1+(R-r)^{-p})\left(\frac{R}{r}\right)^s\mu(B(x_0,R))$$

This leads to (14) if we choose $R=2r$.To this end, we need a simple equality which holds for any Borel measure μ.

5.Hausdorff measures: We recall the definition of Hausdorff measures. $E\subset X$ and suppose that $h:[0,\infty)\to[0,\infty)$ is a non-decreasing function so that

$$\lim_{r\to 0}h(r)=h(0)=0$$

For $0<\delta\le\infty$ and $E\subset X$ we define

$$\mathrm{H}_{\delta}^{h}(E)=\inf\left\{\sum_{i=1}^{\infty}h(r_i):E\subset\bigcup_{i=1}^{\infty}B(x_i,r_i),r_i\le\delta\right\}$$

Now

$$\mathrm{H}^{h}(E)=\lim_{\delta\to0}\mathrm{H}_{\delta}^{h}(E)=\sup_{\delta>0}\mathrm{H}_{\delta}^{h}(E)$$

produces the standard (spherical) *h*-Hausdorff measure of *E*. If $h(t) = t^{s}$ for $0 \le s < \infty$, then we obtain the ***s***-dimensional (spherical) Hausdorff measure which we denote by $\mathcal{H}^{s}$. The Hausdorff dimension of a set $E \subset X$ is

$$\dim E=\inf\left\{s:\mathrm{H}_{\delta}^{h}(E)=0\right\}=\sup\left\{s:\mathrm{H}^{s}(E)=\infty\right\}$$

For the properties of Hausdorff measures we refer to [13].

We say that a measure μ is regular with dimension $s>0$, if there is $c\ge1$ such that

$$c^{-1}r^{s}\le\mu(B(x,r))\le cr^{s} \tag{15}$$

for each $x \in X$ and $0 < r \le \operatorname{diam}(X)$. If μ is regular with dimension *s***.** Moreover, *X* has Hausdorff dimension *s* and there is a constant $c > 0$ such that $c^{-1}\mathrm{H}^{s}(E)\le\mu(E)\le c\mathrm{H}^{s}(E)$ for every $E \subset X$.

Theorem (5.1). Let $\mathrm{h}:[0,\infty)\to[0,\infty)$,

$$h(t)=\begin{cases}t^{s-p} & for\ s>p\\ \left(\log\dfrac{1}{t}\right)^{1-s} & for\ s=p\end{cases}$$

If μ is regular with dimension ***s***, then for every $E\subset X$, $C_p(E)\le c\mathrm{H}^{h}(E)$ .The constant ***c*** depends only on *p* and the constant in (28)**.**

Proof. Let $B(x_i,r_i),i=1,2,3,....$ be any covering of *E* such that the radii satisfy $r_i\le\dfrac{1}{2}$.

Now (14) and (15) yield

$$C_p(B(x_i,r_i))\le\begin{cases}\left(\log\dfrac{1}{r_i}\right)^{1-s} & ,\ for\ s=p\\ cr_i^{s-p} & ,\ for\ s<p\end{cases}$$

and subadditivity implies

$$C_p(E)\le c\sum_{i=1}^{\infty}h(r_i)$$

The claim follows by taking the infimum over all coverings by balls and letting the radii tend to zero.

6. Invariant Sobolev-Lorentz Capacity on $\mathbb{R}^n$

We recall that for $1\le p<\infty$ and $0\le\lambda\le n$, the Morrey space $L^{P,\lambda}(\mathbb{R}^n)$is defined to be the linear space of measurable functions $u\in L^{I}_{loc}(\mathbb{R}^n)$ such that

$$\|u\|_{L^{p,\lambda}(\mathbb{R}^n)} = \sup_{x\in\mathbb{R}^n}\sup_{r>0}\left(r^{-\lambda}\int_{B(x,y)}|u(y)|^p dy\right)^{1/p} < \infty$$

Definition (6.1). Let $1<p<\infty$ and $1\le q\le\infty$, $X = L^{p,q}(\Omega,\mathbb{R}^n)$. A function f in X is said to have absolutely continuous normin X if and only if $\|f_{\chi E_k}\|_X \to 0$ for every sequence E_k satisfying $E_k \to \phi$ a.e.

Theorem(6.2). Let $\Omega\subset\mathbb{R}^n$. Suppose $1<p<\infty$ and $1\le q\le\infty$. If $f\in L^{p,q}(\Omega)$ and $g\in L^{p,q}(\Omega)$, then

$$\int_\Omega |f(x)g(x)|\,dx \le \|f\|_{L^{p,q}(\Omega)}\|g\|_{L^{p',q'}(\Omega)}$$

Proof. We have to analyze two situations, depending on whether $q\in(1,\infty)$ or not. Suppose first that $1<p<\infty$. Then $1<q<\infty$ and by Hölder's inequality, we have

$$\int_0^\infty f^*(s)g^*(s)\,ds = \int_0^\infty f^*(s)s^{1/p-1/q}g^*(s)s^{1/p'-1/q'}\,ds \le \|f\|_{L^{p,q}(\Omega)}\|g\|_{L^{p',q'}(\Omega)}$$

By using this and [300], we get the desired conclusion for $1<q<\infty$.

We assume now without loss of generality that $q=1$. The case $q=\infty$ is similar. If $q=1$ then $q'=\infty$ and we have

$$\begin{aligned}\int_0^\infty f^*(s)g^*(s)\,ds &= \int_0^\infty f^*(s)s^{1/p-1}g^*(s)s^{1/p'}\,ds\\ &\le \sup_{s>0} g^*(s)s^{1/p'}\int_0^\infty f^*(s)s^{1/p-1}\,ds\\ &\le \|g\|_{L^{p',\infty}(\Omega)}\|f\|_{L^{p,1}(\Omega)}\end{aligned}$$

By using this and [1] we get the desired conclusion for $q=1$ as well. This finishes the proof.

As an application of Theorem (6.1) we have the following result

Proposition (6.3). Suppose $1<p<\infty$ and $1\le q\le\infty$. Then

(i) $\|Tf\|_{L^{p,q}(\mathbb{R}^n)} \le \|f\|_{L^{p,q}(\mathbb{R}^n)}$ for every $f\in C_0.(\mathbb{R}^n)$

(ii) If $1\le q\le p$, then $\|Tf\|_{L^{p,q}(\mathbb{R}^n)} \le \|f\|_{L^{p,q}(\mathbb{R}^n)}$ for every $f\in C_0(\mathbb{R}^n)$.

Proof. We fix $p\in(1,\infty)$ and $q\in[1,\infty]$ .Let $f\in C_0(\mathbb{R}^n)$. It is easy the discussion afterwards) that $Tf\in C_0(\mathbb{R}^n)$.

Let $g\in L^{p',q'}(\mathbb{R}^n)$ .Without loss of generality we can assume that g is supported in $\operatorname{supp} Tf$ .Then it follows from Theorem (6.2) that $g\in L^1(\mathbb{R}^n)$. Moreover, we have

$$\begin{aligned}\int_{\mathbb{R}^n}(Tf)(x)g(x)\,dx &\le \int_{\mathbb{R}^n}|(Tf)(x)g(x)|\,dx\\ &\le \int_{\mathbb{R}^n}\left(\int_{SO(n)}\left(|f(Hx)|\,d\mu(H)\right)\right)|g(x)|\,dx \qquad (16)\end{aligned}$$

$$\leq \int_{SO(n)} \left(\int_{\mathbb{R}^n} |f(Hx)g(x)|\,dx \right) d\mu(H)$$

where we used Fubini's theorem for the equality in the sequence. It is easy to see that

$|f \circ H|^* = |f|^*$ for every $H \in SO(n)$. Since μ is a probability measure, we obtain, via (16):

$$\int_{\mathbb{R}^n} |(Tf)(x)\,g(x)|\,dx \leq \int_0^\infty f^*(s)g^*(s)\,ds \tag{17}$$

From (17) it follows:

$$\int_0^\infty (Tf)^*(s)g^*(s)\,ds \leq \int_0^\infty f^*(s)g^* \tag{18}$$

By using (18) together with [1], we get the desired conclusion.

7.Basic properties of the n , q **relative capacity:**

Usually, a capacity is a monotone and subadditive set function. The following theorem will show, among other things, that this is true in the case of the n,q relative capacity. We follow[2].

Next we get some estimates for the n,q relative capacity of the spherical condenser $(\tilde{B}(0,r), B(0,1))$. Lower estimates for the n,q relative capacity. The lower estimates for the relative capacity are always harder to get than the upper estimates. However, we start with the lower ones.

Let $r \in (0,1)$.We define $\tilde{W}(\tilde{B}(0,r), B(0,1)) = T(W(\tilde{B}(0,r), B(0,1)))$.

Theorem (7.1). Let $1 \leq q < \infty$ be fixed and let q' be its Hölder conjugate. Then there exists a constant $C(n,q) > 0$ such that

$$C(n,q)^{-1}\left(\ln\frac{1}{r}\right)^{-n/q'} \leq cap_{n,q}(\tilde{B}(0,r), B(0,1)) \leq C(n,q)\left(\ln\frac{1}{r}\right)^{-n/q'} \text{ for every } 0 < r < e^{-1/(n-1)}$$

We examine the relationship between Hausdorff measures and the Sobolev-Lorentz *n, q*-capacity .

Theorem(7.2). (Poincare inequality for Sobolev- Lorentz spaces) .

Let $\Omega \subset \mathbb{R}^n$ be bounded. Let $1 \leq q < \infty$ be fixed. Then there exists a constant $C(n,q)$ such that

$$\|u\|_{L^{n,q}(\Omega)} \leq C(n,q)\,|\Omega|^{1/n}\,\|\nabla u\|_{L^{n,q}(\Omega,\mathbb{R}^n)} \tag{19}$$

for every $u \in C_0^\infty(\Omega)$.

$$|u(x)| \leq \frac{1}{w_{n-1}}(I_1|\nabla u|)(x) \tag{20}$$

for every $x \in \mathbb{R}^n$. We recall that for every measurable function f in $\mathbb{R}^n$, $I_1 f$ is its Riesz potential of order 1. An application of Hardy-Littlewood-Sobolev theorem of fractional integration together with Theorem (6.2), and (20) yields the desired conclusion.

8.Results :

Corollary (8.1). Let G be a measurable subset of $\mathbb{R}^n$, $n \geq 1$, having finite measure, and let $f_m \in L^1(G)$. Then

$$\min_{c_m \in \mathbb{R}} \int_G \sum |f_m(x) - c_m| dx = \int_G \sum \left| f_m(x) - f_m^{\circ}\left(\frac{|G|}{2}\right)\right| dx \qquad (21)$$

where f_m° is defined as in (3), with Q replaced by G .

Proof. We prove (21) under the assumption that f_m is nonnegative. The general case can be dealt with analogously, on splitting f_m into its positive and negative parts. The fact that the minimum in (21) is attained is an easy consequence of the dominated convergence theorem for the Lebesgue integral.

Now, since

$$\sum f_m(x) = \int_0^{\infty} \sum \chi_{\{f_m > t\}}(x) dt \text{ , for } x \in G$$

then, for every $c_m \in \mathbb{R}^n$,

$$\int_G \sum |f_m(x) - c_m| dx = \int_{\{f_m > c_m\}} \sum \left(\int_0^{\infty} \sum \chi_{\{f_m > t\}}(x) dt - c_m \right) dx$$

$$+ \int_{\{f_m > c_m\}} \sum \left(c - \int_0^{\infty} \chi_{\{f_m > t\}}(x) dt \right) dx$$

$$= \int_0^{\infty} \int_G \sum \chi_{\{f_m > t\}}(x) dx dt - c_m |f_n > c_m| + \sum c_m \left(|G| - |\{f_n > c_m\}| \right) - \int_0^{\infty} \int_G \sum \chi_{\{f_m < c_m\}}(x) dx dt$$

$$= \int_{c_m}^{\infty} \sum |\{f_m > t\}| dt - \int_0^{c_m} \sum |\{f_m > t\}| dt + c_m |G|$$

Thus, $\int_G \sum |f_m(x) - c_m| dx$ is a locally absolutely continuous function of c_m in $\mathbb{R}$ whose derivative equals to $|G| - 2|\{f_m > c_m\}|$ for a.e. $c_m \in \mathbb{R}$. Hence, (21) follows.of course, in general, $f_m^{\circ}(|G|/2)$ need not be the unique minimizer in (21).

Corollary (8.2). Let $X(Q)$ be an r.i. space. Then

$$\sum \frac{1}{s_m} \left\| r_m^{1/n} \chi_{(0,s)}(r_m) \right\|_{\tilde{X}(0,1)} \leq \sum s_m^{-1/n'} \|_{\tilde{X}(0,1)}, s_m \in \left(0, \frac{1}{2}\right) \qquad (22)$$

Proof. Given $s_m \in (0,1/2)$, we have

$$\sum \frac{1}{s_m} \left\| r_m^{1/n} \chi_{(0,s)}(r_m) \right\|_{\tilde{X}(0,1)} \leq \sum s_m^{-1/n'} \| \chi_{(0,1)}(r_m) \|_{\tilde{X}(0,1)}, s_m \in \left(0, \frac{1}{2}\right)$$

$$\leq 2^{-1/n'} \sum \| (s_m + r_m)^{-1/n'} \chi_{(0,s)}(r_m) \|_{\tilde{X}(0,1)}$$

$$\leq 2^{-1/n'} \sum \| (s_m + r_m)^{-1/n'} \chi_{(0,1-s)}(r_m) \|_{\tilde{X}(0,1)}$$

$$\leq 2^{-1/n'} \sum \| r_m^{-1/n'} \chi_{(s,1)}(r_m) \|_{\tilde{X}(0,1)}$$

Corollary(8.3). Let $\Omega \subset \mathbb{R}^n$. Suppose $0 \leq \varepsilon \leq \infty$. If $f_j \in L^{(1+\varepsilon),(1+2\varepsilon)}(\Omega)$ and $g_j \in L^{(1+\varepsilon),(1+2\varepsilon)}(\Omega)$,then

$$\int_{\Omega}\sum\left|f_j(x)g_j(x)\right|dx \le \sum\left\|f_j\right\|_{L^{(1+\varepsilon),(1+2\varepsilon)}(\Omega)}\left\|g_j\right\|_{L^{(1+\varepsilon)',(1+2\varepsilon)'}(\Omega)}$$

Proof. We have to analyze two situations, depending on whether $0<\varepsilon<\infty$ or not. Suppose first that $0<\varepsilon<\infty$. Then by Hölder's inequality, we have

$$\sum\int_0^{\infty} f_j^{*}(s)\,g_j^{*}(s)ds = \int_0^{\infty}\sum f^{*}_{\ j}(s)s^{1/\varepsilon/(1+\varepsilon)}\,g_j^{*}(s)ds\sum\left\|f_j\right\|_{L^{(1+\varepsilon),(1+2\varepsilon)}(\Omega)}\left\|g_j\right\|_{L^{(1+\varepsilon)',(1+2\varepsilon)'}(\Omega)}$$

By using this and [1], we get the desired conclusion for $0<\varepsilon<\infty$.

We assume now without loss of generality that $\varepsilon=0$. The case $\varepsilon=\infty$ is similar. If $\varepsilon=0$ then $\varepsilon'=\infty$ and we have

$$\begin{aligned}\sum\int_0^{\infty} f_j^{*}(s)\,g_j^{*}(s)ds &= \sum\int_0^{\infty} f_j^{*}(s)s^{1/\varepsilon}\,g_j^{*}(s)s^{1/(1+\varepsilon)'}ds\\ &\le \sup_{s>0}\sum g_j^{*}(s)s^{1/(1+\varepsilon)'}\int_0^{\infty} f_j^{*}(s)s^{1/\varepsilon}\,g_j^{*}(s)s^{1/\varepsilon}ds\\ &\le \sum\left\|f_j\right\|_{L^{(1+\varepsilon)',1}(\Omega)}\left\|g_j\right\|_{L^{(1+\varepsilon)',\infty}(\Omega)}\end{aligned}$$

By using this and [1] we get the desired conclusion for $\varepsilon=0$ as well. This finishes the proof.

Corollary (8.4). The function u^m belongs to $W^{1,p}(X)$ if and only if $u^m\in L^P(X)$ and there are functions $u_i^m\in L^P(X), i=1,2,3,\ldots,$ such that $u_i^m\to u^m$ μ-a.e. and $g_i^m\in D(u_i^m)\cap L^p(X)$ such that $g_i^m\to g^m$ μ-a.e. for some $g^m\in L^p(X)$.

Proof. If $u^m\in W^{1,P}(X)$,then the claim of the lemma is clear. To see the converse, suppose that $u^m, g^m\in L^P(X), g_i^m\in D(u_i^m)\cap L^p(X)$ and $u_i^m\to u^m$ μ-a.e. and $g_i^m\to g^m$ μ-a.e. Then

$$\left|u_i^m(x)-u_i^m(y)\right|\le d(x,y)(g_i^m(x)+g_i^m(y)) \qquad (23)$$

for all $x, y\in X\setminus F_i$ with $\mu(F_i)=0, i=1,2,\ldots$ Let $A\subset X$ be such that $u_i^m(x)\to u^m(y)$ and $g_i^m(x)\to g^m(x)$ for all $x\in X/A$ and $\mu(A)=0$. Write $F=A\cup S_{i=1}^{\infty}F_i$; then $\mu(F)=0$. Let $x, y\in X/F$, $x\ne y$. From (9) we obtain

$$\left|u^m(x)-u^m(y)\right|\le d(x,y)(g^m(x)+g^m(y)) \qquad (24)$$

and thus $g^m\in D(u^m)\cap L^p(X)$. This completes the proof.

Corollary (8.5). If $u^m\in W^{1,P}(X)$ and $E\subset X$ is μ-measurable with $0<\mu(E)<\infty$, then for every

$$\int_E\sum\left|u^m-u_E^m\right|^p d\mu \le 2^p\,diam(E)\int_E g^{m\,p}\,d\mu$$

Proof. By the Hölder inequality

$$\sum\left|u^m(x)-u_E^m\right|\le\fint_E\sum\left|u^m(x)-u^m(y)\right|d\mu(y)\le\sum\left(\fint_E\sum\left|u^m(x)-u^m(y)\right|^p d\mu(y)\right)^{\frac{1}{p}}$$

An integration completes the proof, because

$$\int \sum \left|u^m(x)-u^m(y)\right|^p d\mu(y) \le \int_E \int_E \sum \left|u^m(x)-u^m(y)\right|^p d\mu(y)$$

$$\le 2^{p-1} diam(E)^p \int_E \sum \left(g^m(x)^p + \int_E g^m(y)^p d\mu(y) \right) d\mu(x)$$

$$\le 2^{p-1} diam(E)^p \int_E \sum g^{m\,p} d\mu(x)$$

Corollary(8.6). Suppose $0 \le \varepsilon \le \infty$. Then

(i) $\sum \left\| T^j f_j \right\|_{L^{((1+\varepsilon),(1+\varepsilon))}(\Omega,\mathbb{R}^n)} \le \sum \left\| f_j \right\|_{L^{((1+\varepsilon),(1+\varepsilon))}(\Omega,\mathbb{R}^n)}$ for every $f_j \in C_0(\mathbb{R}^n)$.

(ii) If $\varepsilon \ge 0$, then $\sum \left\| T^j f_j \right\|_{L^{(p,q)}(\mathbb{R}^n)} \le \sum \left\| f_j \right\|_{L^{(p,q)}(\mathbb{R}^n)}$ for every $f_j \in C_0(\mathbb{R}^n)$.

Proof. We fix $0 \le \varepsilon \le \infty$.Let $f_j \in C_0(\mathbb{R}^n)$. It is easy the discussion afterwards) that $T^j f_j \in C_0(\mathbb{R}^n)$.

Let $g_j \in L^{(1+2\varepsilon)'(1+\varepsilon)'}(\mathbb{R}^n)$ .without loss of generality we can assume that g is supported in supp$T^j f_j$ .Then it follows from Theorem (6.2) that $g_j \in L^1(\mathbb{R}^n)$. Moreover, we have

$$\int_{R^n} \sum \left|(T^j f_j)(x) g_j(x)\right| dx \le \int_{R^n} \sum \left|(T^j f_j(x) g_j(x)\right| dx$$

$$\le \int_{\mathbb{R}^n} \sum \left(\int_{SO(n)} \left(\left| f_j(Hx) \right| d\mu(H) \right) \right) |g(x)| dx \qquad (25)$$

$$\le \int_{SO(n)} \sum \left(\int_{\mathbb{R}^n} \left(\left| f_j(Hx) \right| d\mu(H) \right) \right) |g(x)| d\mu(H)$$

where we used Fubini's theorem for the equality in the sequence. It is easy to see that $\left| f_j \circ H \right|^* = \left| f_j \right|$ for every $H \in SO(\mathrm{n})$. Since μ is a probability measure, we obtain, via (25):

$$\int_{R^n} \sum \left|(T^j f_j(x) g_j(x)\right| dx \le \int_0^\infty \sum f_j^*(s) g_j^*(s) ds \qquad (26)$$

From (26) it follows:

$$\int_0^\infty \sum \left(T^j f_j^*\right)(s) g_j^*(s) ds \le \int_0^\infty \sum f_j^* g_j^*(s) ds \qquad (27)$$

By using (27) together with [1], we get the desired conclusion.

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9.References :

[1] Bennett C. and Sharpley R. (1988), Interpolation of Operators, Academic Press, New York.

[2] Heinonen J, Kilpelainen T, and Martio O. (1993) , Nonlinear Potential Theory of Degenerate Elliptic Equations, Oxford University Press, Cambridge.

[3] Andrea C.and Luboš P.(2003). Sobolev embedding into spaces of compnato ,Morrey ,and Hölder type. J. Math. Anal. Appl. 282, 128-150.

[4] Juha K, Olli M .(1996).The Sopolev Capacity on metric spaces . Annales Academic, Scientiarum Fennic, Mathematica Vol 21.367-382.

[5] Serban.C.(2007).Scaling invariant Sobolev -Lorentz Capacity on $\mathbb{R}^n$. Indiana University Mathematics Journal , Vol. 56, 2641-2669.

[6] Bennett C, Sharpley R,(1988). Interpolation of Operators, in Pure Appl. Math., Vol. 129, Academic Press, New York.

[7] Cianchi .A, Pick .L, (1998). Sobolev embeddings into BMO, VMO and L^{∞} , Ark. Mat. Vol 36 . 317-340.

[8] Kufner.A,John.O, and Fucík .S,(1977). Function Spaces, Noordhoff/Academia, Leyden/Prague .

[9] Janson .S, (1976). On functions with conditions on the mean oscillation, Ark. Mat. 14 .189-196.

[10] Maz'ya .V.G,(1985). Sobolev Spaces, Springer, Berlin.

[11] Capogna, L, Danielli D, and Garofalo. N.(1994). The geometric Sobolev imbedding for vector fields and the isoperimetric inequality- Comm. Anal. Geom. 2, 203-216.

[12] Coifman, R, and Weiss G.(1971). Analyse harmonique non-commutative sur certains espaces homogenes. Lecture Notes in Math. 242, Springer-Verlag, Berlin.

[13] Federer, H.(1969). Geometric Measure Theory. Grundlehren Math. Wiss. 153, Springer-Verlag, Berlin.

[14] Adams .D.R and XIAO .J, (2004). Nonlinear potential analysis on Morrey spaces and their capacities. Indiana Univ. Math. J. 53, 1631-1666.

[15] D. Gilbarg, N.S. Trudinger, Elliptic Partial Differential Equations of Second Order, second ed., Springer-Verlag, 1983.

[16] P. Hajtlasz, Sobolev spaces on an arbitrary metric space, Potential Anal. 5 (1996) 403–415.

[17] P. Hajtlasz, Sobolev Spaces on Metric-Measure Spaces. (Heat Kernels and Analysis on Manifolds, Graphs, and Metric Spaces (Paris, 2002)), in: Contemp. Math., vol. 338, Amer. Math. Soc., Providence, RI, 2003, pp. 173–218.

[18] J. Heinonen, Lectures on Analysis on Metric Spaces, Springer-Verlag, 2001.

[19] J. Heinonen, P. Koskela, Quasiconformal maps in metric spaces with controlled geometry, Acta Math. 181 (1998) 1–61.

[20] R. Hunt, On $L(p, q)$ measure spaces, Enseign. Math. 12 (2) (1966) 249–276.

[21] J. Kauhanen, P. Koskela, J. Mal´y, On functions with derivatives in a Lorentz space, Manuscripta Math. 100 (1) (1999)024175587–101.

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إستخدام خرائط الوسط الحسابي والإنحراف المعياري والمدى في مراقبة جودة الإنتاج (بالتطبيق على بيانات شركة فابي للصناعات الغذائية للعام ٢٠٢١م . شندي . ولاية نهرالنيل . السودان)

Use maps of the arithmetic mean, standard deviation and range in production quality control (by application to the data of Faapy Food Industries Company for the year 2021 AD , Shendi, Nahr al-Nil State, Sudan)

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المستخلص:

تهدف هذه الدراسة إلي إستخدام خرائط الوسط الحسابي والإنحراف المعياري والمدى في مراقبة جودة الإنتاج وتطبيقها على منتجات الألبان في شركة فابي للصناعات الغذائية بمدينة شندي بولاية نهرالنيل بالسودان لبيانات العام ٢٠٢١م ، وتتمثل مشكلة الدراسة في أن معظم منشئاتنا الصناعية لاتستخدم أساليب ضبط الجودة الإحصائية لمراقبة الإنتاج مما يتسبب في ظهور الخلل في الإنتاج وعدم مطابقته لكثير من المواصفات وبالتالي عدم رضاء المستهلكين . وتم إستخدام المنهج التحليلي بإستخدام برنامج Minitab 18 للوصول إلى نتائج الدراسة ، وتوصلت الدراسة إلى أن خريطة الوسط الحسابي دلت على أن عينة الدراسة مستقرة أي أن العملية تحت المراقبة الإحصائية لجودة الإنتاج لشركة فابي وأن خريطة الإنحراف المعياري دلت على أن تشتت العملية الإنتاجية لايسير وفقا للمواصفات وذلك يعني وجود إنحرافات في المراقبة الإحصائية لجودة الإنتاج .

الكلمات المفتاحية: الخط المركزي ، حد المراقبة السفلى ، حد المراقبة العلوى خريطة الوسط الحسابي ، خريطة الإنحراف المعياري ، خريطة المدى

Abstract

This study aims to use maps of the arithmetic mean, standard deviation and range in production quality control and its application to dairy products in the Faapy Food Industries Company in Shendi, Nahr al-Nil State, Sudan, for the data of the year 2021 AD. In the emergence of defects in production and its non-conformity with many specifications, and thus the dissatisfaction of consumers. The analytical approach was used using the Minitab 18 program to reach the results of the study, and the study found

that the arithmetic mean map indicated that the study sample is stable, meaning that the process is under statistical control of the production quality of Faapy Company, and that the standard deviation map indicated that the dispersion of the production process is not easy according to the specifications. It means the existence of deviations in the statistical control of production quality.

Keywords: central line, lower control limit, upper control limit, arithmetic mean map, standard deviation map, range map.

الإطار النظري :

خرائط مراقبة الجودة

مقدمة :

أصبحت الجودة ضرورة حتمية لأبد منها ويجب على أي مؤسسة أو مصنع أن تركز إهتمامها على هذا المفهوم الذي فرضتة الأسواق على جميع المؤسسات والمنظمات والشركات بسبب متطلبات ورغبات وتفضيلات المستهلك المتغيرة والمتطورة بإستمرار ، وإرضاء الزبون هو ما تسعي إليه المؤسسة[١] . حيث تعددت الدراسات والأبحاث التى ساهمت في إثراء موضوع الجودة فقد توصلنا إلى ضرورة التحسين المستمر للجودة بإستغلال الفرص المتاحة أمام المؤسسة أو المصنع ومحاولة تطبيق طرق وأدوات علمية في ذلك لتحديد المشاكل وإيجاد الحلول المناسبة لها[٢] ، ويعتبر موضوع المراقبة الإحصائية على العمليات من الموضوعات المهمة جدا في القطاع الصناعي على وجه التحديد لما له من دور مهم وبارز في الحصول على منتج يرضى المستهلك كونه يحقق المواصفات الموضوعة له والأغراض التي أنتج من أجلها ، لذلك كان لأبد من عمل دراسة تمكننا من معرفة أهم الطرق والأدوات التى تساعد في الوصول إلى التحسين المستمر وإنتاج منتجات ذات جودة عالية ومطابقة للمواصفات ، حيث تعد خرائط المراقبة من أهم الأساليب المستخدمة في الرقابة علي جودة الإنتاج نظرا لسهولة العمل بها وبساطة فهمها وإعطائها للنتائج بشكل سريع يكفل اتخاذ القرار بشأن سير العملية الإنتاجية [٣] .

اولا : خرائط مراقبة الجودة Control chart :

تعتبر خرائط التحكم في الجودة إحدى أهم تقنيات الضبط الإحصائي للجودة والمستخدمة في مجال الصناعات والخدمات ، وتستخدم بصفه عامة لتتبع مواصفات المنتج خلال مراحل الإنتاج ولتحديد الأسباب المؤدية إلى إنتاج معين وإتخاذ الإجراءات التصحيحية قبل إنتاج كمية كبيرة منه[5],[٤] .

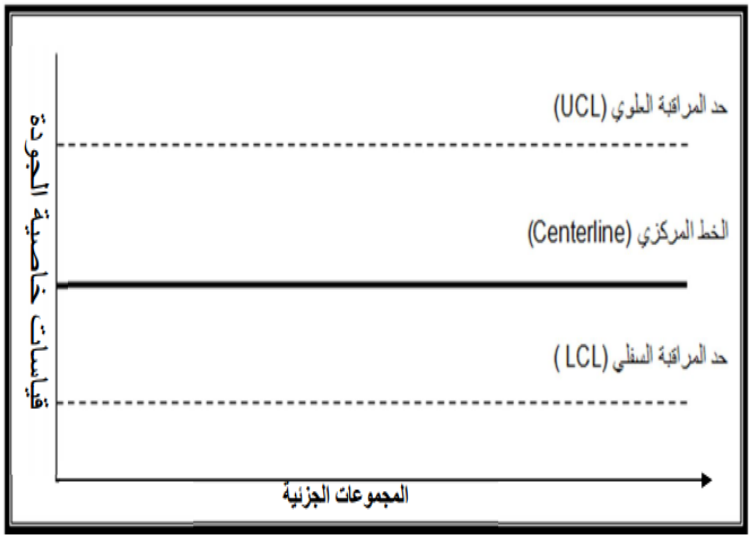
خطوات إعداد خرائط المراقبة :

يمر إعداد خريطة المراقبة بست خطوات متتالية ، هي[٦] :

١. تحديد المتغيرات المراد مراقبتها .

٢. إختيار المجموعات الجزئية الرشيدة .
٣. تحديد حجم المجموعة الجزئية .
٤. تحديد عدد المجموعات الجزئية .
٥. تحديد أداة جمع البيانات .
٦. رسم خريطة المراقبة .

شكل (١) يوضح خريطة المراقبة



المصدر : كتاب الرقابة الإحصائية على العمليات 2006م

ثانيا : الأدوات والأساليب المستخدمة في ضبط الجودة[٧] :

أ- التحسين المستمر Continuns improvement .
ب- المقارنة المرجعية .
ت- الإنتاج الآني .
ث- أدوات الجودة الشاملة .

ثالثا : أهداف الرقابة على الجودة :

يهدف نظام الرقابة على الجودة إلى تحقيق عدة أهداف أهمها :

- رفع الكفاءة الإنتاجية عن طريق زيادة عدد ساعات التشغيل والمطابقة للمواصفات .

- تقليص التكاليف المقترنة بالأداء التشغيلي .
- زيادة المبيعات ورواجها وهذا يؤدي إلى زيادة الأرباح .
- رفع الإنتاج السليم يؤدي إلى زيادة الأجر الحافز في حالة إتباع ربط الأجر بكمية الإنتاج وجودتة[٨].
- الحفاظ على جودة المنتجات والحصول على إنتاج متجانس في المواصفات[٩] .

رابعا : فوائد الرقابة على الجودة الإحصائية :

حققت العديد من المؤسسات والشركات نجاحا كبيرا من خلال تطبيقها لمبادىء إدارة الجودة في أنشطتها مما ساعد ذلك في تحسين أدائها بصورة عامة . وفيما يلى من أهم الفؤائد المحققة من تجارب هذه الشركات :

- خفض تكاليف الجودة .
- الإستفادة المثلى من الموارد المتاحة (خفض تكاليف الإنتاج ، وخفض زمن دورة الإنتاج وزيادة الإنتاجية ، وخفض عيوب الإنتاج) .
- زيادة رضا العاملين والعملاء وإنخفاض شكواهم .
- زيادة نصيب المنظمة في الأسواق .
- زيادة المبيعات والأرباح[١٠].
- الأساس للحصول على شهادات الآيزو(ISO)[١١].

خامسا: فروض خرائط المراقبة الإحصائية :

يشير فرض العدم إلى أن العملية في حالة ضبط إحصائي أو مستقرة ، أما الفرض البديل يشير إلى أن العملية خارج المراقبة الإحصائية أو غير المستقرة ، فوقوع أى نقطة داخل حدي المراقبة (العلوى أو السفلى) يعني أنه لايوجد دليل كافي لرفض فرض العدم ، مما يعني أن العملية مستقرة . في حين يشير وقوع أى نقطة خارج حدى المراقبة إلي رفض فرض العدم ، أى أن العملية خارج المراقبة الإحصائية . وعند إتخاذ القرار حول فرض العدم يوجد نوعان من الأخطاء يمكن الوقوع فيهما ، إذا رفض فرض العدم الصحيح يطلق عليه خطأ من النوع الأول (Type 1 error) ويستنتج أن العملية خارج المراقبة في حين أنها تكون تحت المراقبة ، ويرمز لإحتمال الوقوع في هذا الخطأ ب ($\propto$) . كما أن قبول فرض العدم غير صحيح يطلق عليه الخطأ من النوع الثاني (Type 2 error) ، ويستدل منه أن العملية تحت المراقبة في حين أنها خارج المراقبة ، ويرمز لإحتمال الوقوع في هذا الخطأ ب (β) وعلي الرغم من وجه الشبه بين خريطة المراقبة وإختبار الفروض إلا أنه يوجد إختلاف بينهما ففي إختبار الفروض نختبر عادة صحة الفرض من عدمها في حين نستخدم خريطة المراقبة للكشف عن أى إنحراف في حالة الضبط الإحصائي[١٢].

خريطة الوسط الحسابي $\bar{X}$-Chart :

عند بناء خريطة الوسط الحسابي لعملية معينة يتم سحب K من العينات وكل عينة تحتوي على n من الوحدات ويتم حساب حساب القيم الثلاثة لخريطة المراقبة UCL , CL ,LCL حسب ثلاث حالات [١٣]:

أ- في حالة معلومية الوسط الحسابي للمجتمع μ والإنحراف المعياري للمجتمع Sوهنا يتم حساب حدود المراقبة الثلاثة بالقوانين الأتية :

$$UCL = \mu + \frac{3S}{\sqrt{n}} \quad \rightarrow (1)$$
$$CL = \mu \quad \rightarrow (2)$$
$$LCL = \mu - \frac{3S}{\sqrt{n}} \quad \rightarrow (3)$$

ب- في حالة أن الوسط الحسابي للمجتمع مجهول (μ مجهولة) ومعلومية الإنحراف المعياري S في هذه الحالة يتم إستبدال μ ب $\bar{\bar{X}}$ ويتم حساب حدود المراقبة الثلاثة بالقوانين الأتية :

$$UCL = \bar{\bar{X}} + \frac{3S}{\sqrt{n}} \quad \rightarrow (4)$$
$$CL = \bar{\bar{X}} \quad \rightarrow (5)$$
$$LCL = \bar{\bar{X}} - \frac{3S}{\sqrt{n}} \quad \rightarrow (6)$$

حيث أن:

$\bar{\bar{X}} \equiv$ الوسط الحسابي للأوساط الحسابية

ت- أما في حالة الإنحراف المعياري للمجتمع S غير معلوم يكون هنالك ثلاثة بدائل لحساب أو تقدير الإنحراف المعياري للمجتمع :

البديل الأول : إستخدام (R- bar)

يتم حساب الحدود الثلاثة لخريطة المراقبة كما يلي :

$$UCL = \mu + (A_2\bar{R}) \quad \rightarrow (7)$$

$$CL = \mu \quad \rightarrow (8)$$

$$LCL = \mu - (A_2\bar{R}) \quad \rightarrow (9)$$

حيث أن :

$\bar{R} \equiv$ متوسط الأمدية

$A_2 \equiv$ قيمة يتم إستخراجها من جدول خاص لمعالم خرائط المراقبة

البديل الثاني : إستخدام (S- bar)

يتم حساب الحدود الثلاثة لخريطة المراقبة كما يلي :

$$UCL = \mu + \frac{3\bar{S}}{\sqrt{n}} \rightarrow (10)$$

$$CL = \mu \rightarrow (11)$$

$$LCL = \mu - \frac{3\bar{S}}{\sqrt{n}} \rightarrow (12)$$

حيث أن :

$\bar{S} \equiv$ متوسط الإنحرافات المعيارية للعينات

البديل الثالث : الإنحراف المعياري المشترك (التجميعي)

Pooled Standard Deviation

يتم حساب الحدود الثلاثة لخريطة المراقبة كما يلي :

$$UCL = \mu + \frac{3(S)pooled}{\sqrt{n}} \rightarrow (13)$$

$$CL = \mu \rightarrow (14)$$

$$LCL = \mu - \frac{3(S)pooled}{\sqrt{n}} \rightarrow (15)$$

حيث :

(S) pooled : يتم حسابها كما يلي :

$$(S)\ pooled = \sqrt{\frac{(n-1)(S_1^2 + S_2^2 + \ldots\ldots\ldots\ldots + S_k^2}{K(n-1)}} \rightarrow (16)$$

$S_1^2 \equiv$ تباين العينة الأولى

$S_2^2 \equiv$ تباين العينة الثانية

$S_k^2 \equiv$ تباين العينة الأخيرة

وغنى عن البيان أنه في حالة أن يكون متوسط المجتمع μ غير معلوم (في البدائل الثلاثة الأخيرة) فإننا نستبدلة بالمتوسط العام $\bar{\bar{X}}$ [١٤].

خريطة الإنحراف المعياري S – chart :

في خرائط الإنحراف المعياري في خرائط ضبط الجودة يتم فحص الإنحرافات المعيارية لكل عينة من العينات لتحديد ما إذا كانت هنالك عينات شاذه تخرج من النطاق المحدد لحدود الإنحرافات المعيارية في العمليات الإنتاجية [١٣] . ويشترط لإستخدام خريطة الإنحراف المعياري أن تكون عدد العينات أكبر من 9 أما إذا كان عدد العينات أقل من 9 فإننا نستخدم خريطة المدى بدلا من خريطة الإنحراف المعياري [١٥].

وهنالك حالتين لرسم خرائط الإنحراف المعياري :

أ- في حالة معلومية الإنحراف المعياري للمجتمع S يتم حساب حدود المراقبة الثلاثة كما يلى :

$$\text{UCL} = B_6 S \quad \rightarrow (17)$$
$$\text{CL} = C_4 S \quad \rightarrow (18)$$
$$\text{LCL} = B_5 S \quad \rightarrow (19)$$

حيث أن :
B_5، C_4، B_6 قيم يتم إستخراجها من جدول خاص لمعالم خرائط المراقبة .

ب- في حالة الإنحراف المعياري للمجتمع غير معلوم يتم حساب حدود المراقبة الثلاثة كما يلى :

$$\text{UCL} = B_6 \frac{spooled}{C_4} \quad \rightarrow (20)$$

$$\text{CL} = \text{Spooled} \quad \rightarrow (21)$$
$$\text{LCL} = B_5 \frac{spooled}{C_4} \quad \rightarrow (22)$$

خريطة المدى R – chart :

تعتبر خريطة المدى بديلة لخريطة الإنحراف المعياري خاصة عندما يكون عدد العينات أقل من 9 ويتم حساب حدود المراقبة الثلاثة كما يلى[13]:

$$UCL = D_4\bar{R} \quad \rightarrow (23)$$
$$CL = \bar{R} \quad \rightarrow (24)$$
$$LCL = D_3\bar{R} \quad \rightarrow (25)$$

حيث أن :

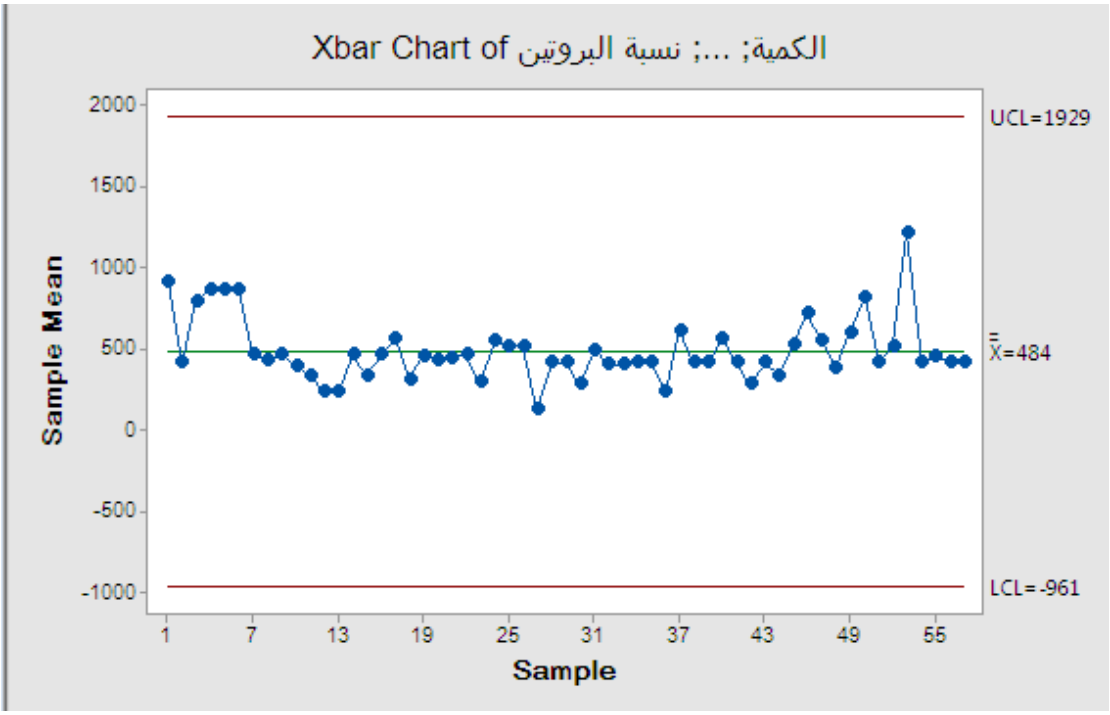
$\bar{R} \equiv$ الوسط الحسابي لقيم المدى

المناقشة والنتائج :

عينة الدراسة :

هي عبارة عن مجموعة من البيانات لمنتج الحليب في شركة فابي للصناعات الغذائية بمدينة شندي بولاية نهر النيل بالسودان خلال شهري سبتمبر وأكتوبر للعام ٢٠٢١م ، وجمعت هذه البيانات من خلال أخذ عينة عشوائية مكونة من ٥٧ مفرده لوصف حالة منتج الحليب بالشركة ، وتم إدخال هذه البيانات في برنامج Minitab لتحليلها عن طريق خرائط ضبط الجودة الإحصائية لمعرفة ما إذا كانت العملية الإنتاجية تسير وفقا لمواصفات الجودة وفي حالة إستقرار أم لا.

تحليل البيانات عن طريق خريطة الوسط الحسابي بإستخدام R - bar بإستخدام برنامج Minitab :



المصدر : إعداد الباحثتين ، برنامج Minitab 18

شكل رقم (٢) : خريطة الوسط الحسابي بإستخدام (R- bar)

من الشكل (٢) نلاحظ : أن تمركز مخرجات العملية الإنتاجية في هذا المصنع يسير وفقا لمواصفات الجودة المحددة من جانب إدارة المصنع وذلك لأن جميع نقاط العينه تقع بين الحد الاعلى لخريطة المراقبة والحد الادنى لخريطة المراقبة .

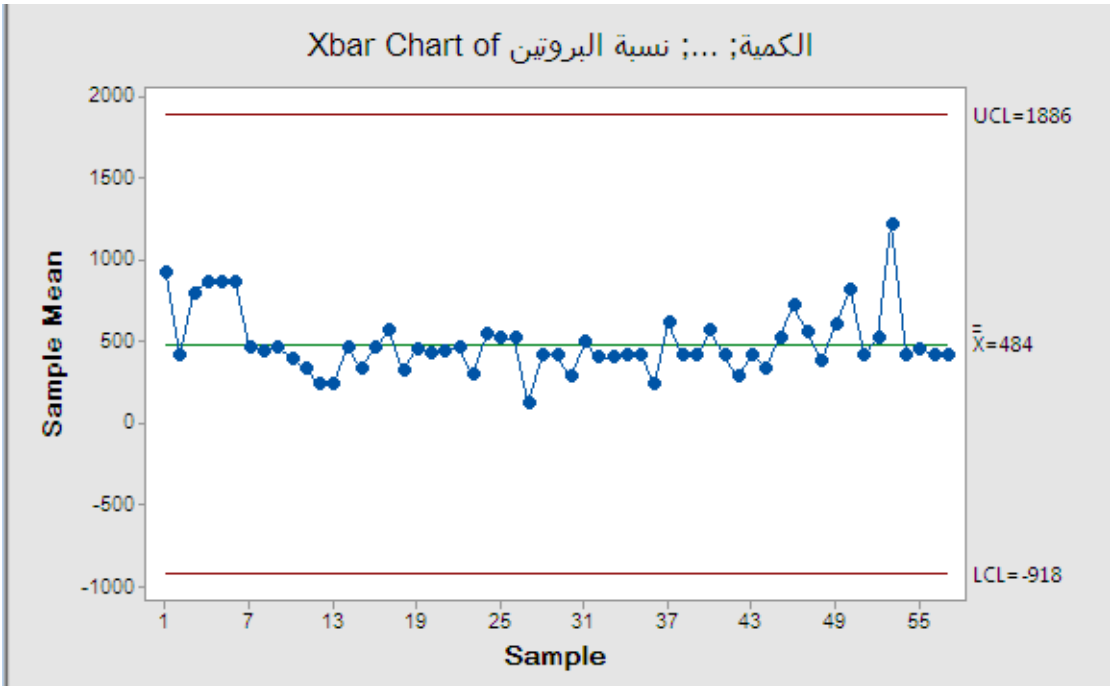
<u>طريقة حساب الحدود الثلاثة لخريطة المراقبة :</u>

- خط المنتصف (CL) : الوسط الحسابي للمجتمع يساوي 483.83 ، لذا نجد أن القيمة المقابلة لهذا الخط

CL= μ =483.83

- الحد الأعلى للمراقبة (UCL) : تم حسابه وكانت قيمته 1929 .
- الحد الأدنى للمراقبة (LCL) :تم حسابه وكانت القيمة 961- .

تحليل البيانات عن طريق خريطة الوسط الحسابي بإستخدام S- bar بإستخدام برنامج Minitab :



المصدر : إعداد الباحثتين ، برنامج Minitab 18

شكل رقم (٣) : خريطة الوسط الحسابي بإستخدام (S - bar)

من الشكل (٣) نلاحظ : أن خريطة مراقبة الجودة لتمركز مخرجات العملية في هذا المصنع تسير وفقا لمواصفات الجودة المحددة من جانب إدارة المصنع وذلك لأن جميع نقاط العينه تقع بين الحد الاعلى لخريطة المراقبة والحد الادنى لخريطة المراقبة .

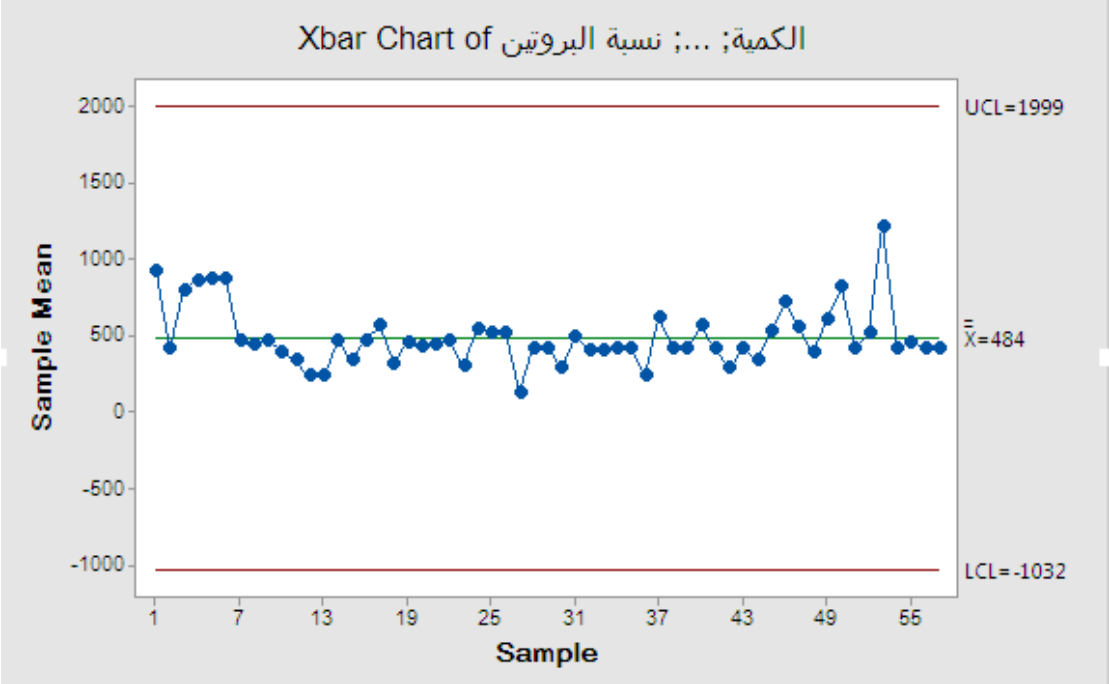
<u>طريقة حساب الحدود الثلاثة لخريطة المراقبة :</u>

- خط المنتصف (CL) : الوسط الحسابي للمجتمع يساوي 483.83 ، لذا نجد أن القيمة المقابلة لهذا الخط

$$CL = \mu = 483.83$$

- الحد الأعلى للمراقبة (UCL) : تم حسابه وكانت قيمته 1886 .
- الحد الأدنى للمراقبة (LCL) : تم حسابه وكانت قيمته 918- .

تحليل البيانات عن طريق خريطة الوسط الحسابي بإستخدام الإنحراف المعياري المشترك بإستخدام برنامج Minitab :



المصدر : إعداد الباحثتين ، برنامج Minitab 18

شكل رقم (٤) : خريطة الوسط الحسابي بإستخدام (Pooled Standard Deviation)

من الشكل (٤) نلاحظ : أن خريطة مراقبة الجودة لتمركز مخرجات العملية في هذا المصنع تسير وفقا لمواصفات الجودة المحددة من جانب إدارة المصنع وذلك لأن جميع نقاط العينه تقع بين الحد الاعلى لخريطة المراقبة والحد الادنى لخريطة المراقبة .

طريقة حساب الحدود الثلاثة لخريطة المراقبة :

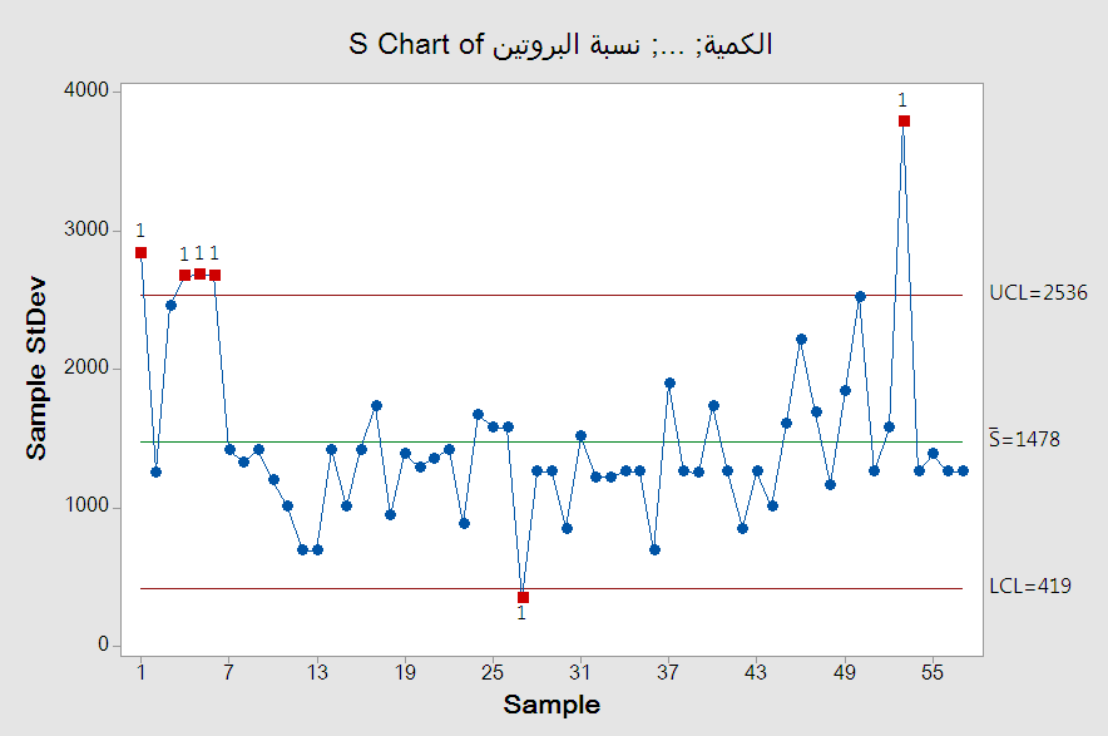
- خط المنتصف (CL) : الوسط الحسابي للمجتمع يساوي 483.83 ، لذا نجد أن القيمة المقابلة لهذا الخط

$$CL = \mu = 483.83$$

- الحد الأعلى للمراقبة (UCL) : تم حسابه وكانت قيمته 1999 .

- الحد الأدنى للمراقبة (LCL) : تم حسابه وكانت قيمته 1032- .

تحليل البيانات عن طريق خريطة الإنحراف المعياري بإستخدام S – bar بإستخدام برنامج Minitab :



المصدر : إعداد الباحثتين ، برنامج Minitab 18

شكل رقم (5) : خريطة الإنحراف المعياري بإستخدام (S - bar)

من الشكل (٥) نلاحظ : أن خريطة مراقبة الجودة توضح أن تشتت العملية الإنتاجية لا يسير وفقا للمواصفات ، أى توجد إنحرافات عن الوضع المثالي للمراقبة الاحصائية لجودة الإنتاج .

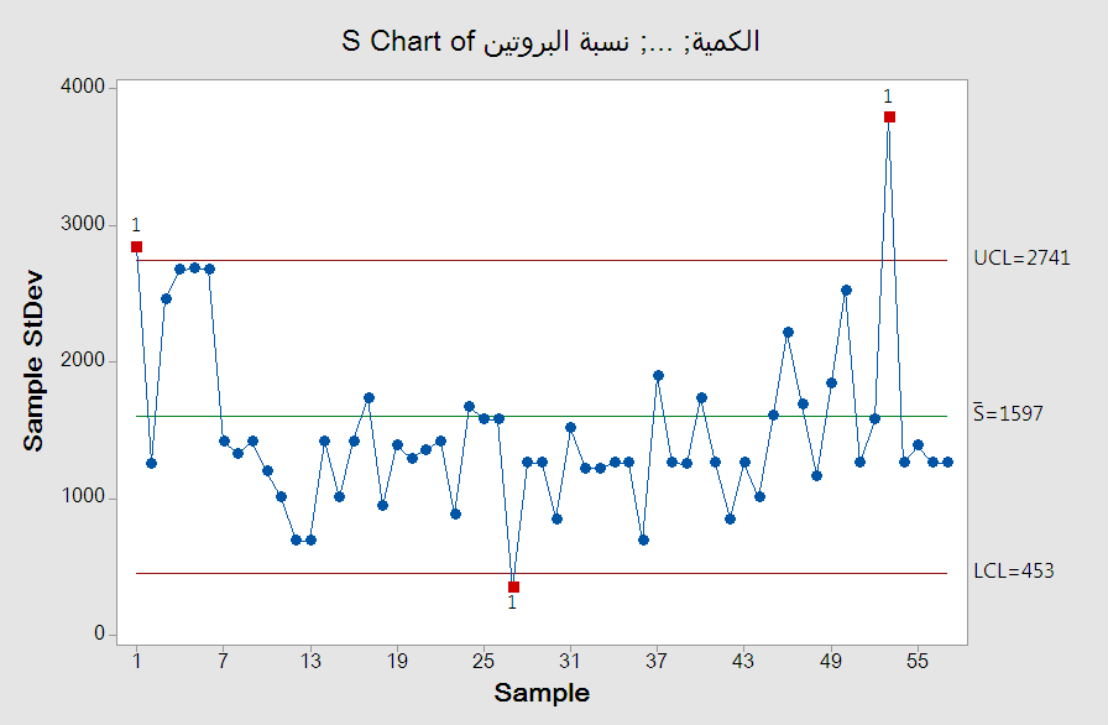
<u>طريقة حساب الحدود الثلاثة لخريطة المراقبة :</u>

- خط المنتصف (CL) :

CL = $\overline{S}$ = 1478

- الحد الأعلى للمراقبة (UCL) : تم حسابه وكانت قيمته 2536 .
- الحد الأدنى للمراقبة (LCL) : تم حسابه وكانت قيمته 419 .

تحليل البيانات عن طريق خريطة الإنحراف المعياري بإستخدام الإنحراف المعياري المشترك بإستخدام برنامج Minitab :



المصدر : إعداد الباحثتين ، برنامج Minitab 18

شكل رقم (٦) : خريطة الإنحراف المعياري بإستخدام (S) pooled

من الشكل (٦) نلاحظ : أن خريطة مراقبة الجودة توضح أن تشتت العملية الإنتاجية لا يسير وفقا للمواصفات ، أى توجد إنحرافات عن الوضع المثالي للمراقبة الإحصائية لجودة الانتاج .

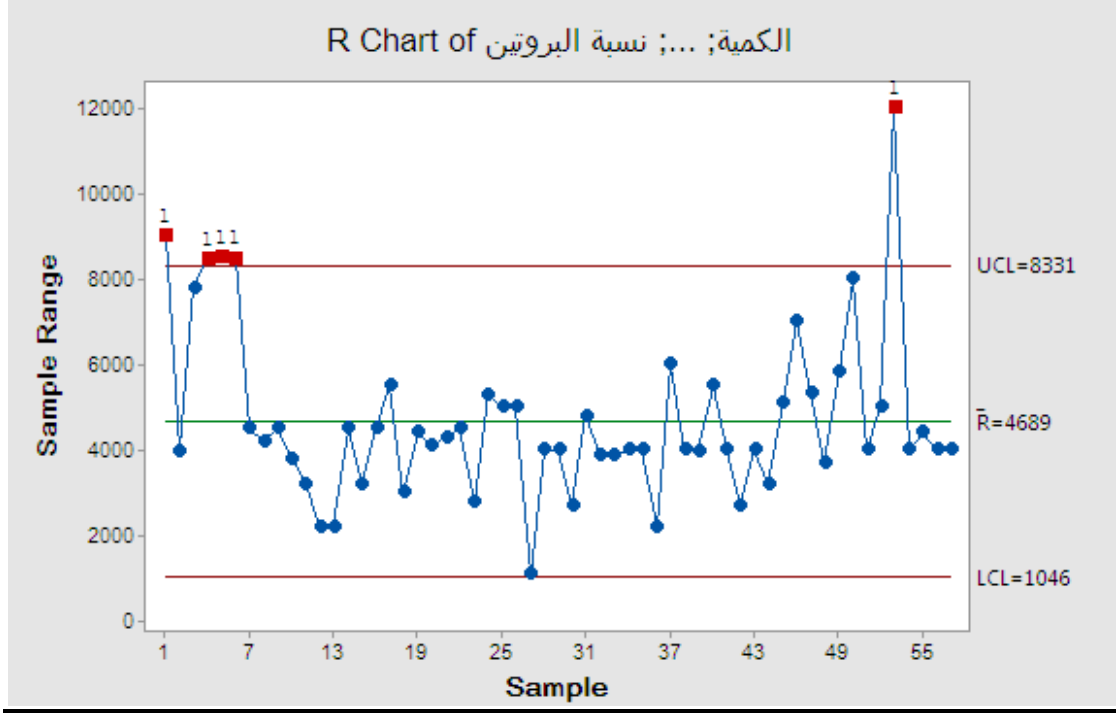
<u>طريقة حساب الحدود الثلاثة لخريطة المراقبة :</u>

- خط المنتصف (CL) :

CL = $\overline{S}$ =1597

- الحد الأعلى للمراقبة (UCL) : تم حسابه وكانت قيمته 2741 .
- الحد الأدنى للمراقبة (LCL) : تم حسابه وكانت قيمته 453 .

تحليل البيانات عن طريق خريطة المدى بإستخدام برنامج Minitab :



المصدر : إعداد الباحثتين ، برنامج Minitab 18

شكل رقم (٧) : خريطة المدى

من الشكل (٧) نلاحظ : أنه في خريطة المدى (R - chart) يوجد نقاط تقع خارج حدى المراقبة وبالتالي فإن دقة العملية الإنتاجية خرجت عن الحدود المثلى للمراقبة الاحصائية لجودة الانتاج .

<u>طريقة حساب الحدود الثلاثة لخريطة المراقبة :</u>

- خط المنتصف (CL) :

CL = $\overline{R}$ = 4689

- الحد الأعلى للمراقبة (UCL) : تم حسابه وكانت قيمته 8331 .
- الحد الأدنى للمراقبة (LCL) : تم حسابه وكانت قيمته 1046 .

الإستنتاجات :

١. خريطة الوسط الحسابي دلت على أن عينة الدراسة مستقرة أى أن العملية تحت المراقبة الإحصائية لجودة الإنتاج لشركة فابي للصناعات الغذائية .

٢. خريطة الإنحراف المعياري دلت على أن تشتت العملية الإنتاجية لا يسير وفقا للمواصفات وذلك يعني وجود إنحرافات في المراقبة الإحصائية لجودة الإنتاج .

٣. خريطة المدى دلت على أن دقة العملية الإنتاجية لاتقع ضمن الحدود المثلى لدقة المراقبة الإحصائية لجودة الإنتاج .

التوصيات :

١- إستخدام خرائط الوسط الحسابي والمدى والإنحرف المعياري في المراقبة الإحصائية لجودة المنتجات بشركة فابي والمؤسسات الإنتاجية المختلفة .

٢- تحديد العوامل والمتغيرات والأسباب التى أدت إلى وجود إنحرافات في العملية الإنتاجية لشركة فابي للصناعات الغذائية وذلك من خلال خريطة الإنحراف المعياري بالرغم من أن العملية الإنتاجية كانت مستقرة وتسير وفقا لمواصفات المراقبة الإحصائية لجودة الإنتاج في خريطة الوسط الحسابي لتصبح العملية الإنتاجية للشركة مستقبلا تقع ضمن الحدود المثلى لدقة وجودة الإنتاج .

٣- إستخدام وسائل وطرق إحصائية حديثة لمراقبة جودة الإنتاج بالشركة مثل معيار six-sigma .

٤- نوصي الشركة بتوفير بيانات عن نسبة الوحدات المعيبة في المنتجات لمعرفة ما إذا كان يوجد خلل في العملية الإنتاجية أم لا حتي لا تتجاوز نسبة الوحدات المعيبة الحد الأعلى للمراقبة .

المصادر والمراجع :

١. تهاني محمد الخليفة الطيب الحسن (٢٠٢٠) . " دور خرائط المراقبة في ضبط جودة المنتجات " . دراسة تطبيقية في شركة أبو كليوة ، رسالة ماجستير في إدارة الجودة الشاملة ، كلية الدراسات العليا ، جامعة السودان .

٢. محمد عبدالرحمن إسماعيل (٢٠٠٦) . " الرقابة الإحصائية على العمليات " .

٣. علي أبشر فضل المولى سليمان (2010) . " إستخدام خرائط ضبط الجودة الإحصائية في مراقبة الإنتاج " . دراسة تطبيقية في مصنع سعيد للمواد الغذائية ، رسالة ماجستير في الإحصاء ، كلية العلوم ، جامعة السودان .

٤. سامح عبدالمطلب عامر؛ علاء محمد سد قنديل (٢٠١١) . " تخطيط ومراقبة الإنتاج في المؤسسات الصناعية والخدمية " ، دار الفكر للنشر والتوزيع – الطبعة الأولى ،عمان ، الأردن .

٥. بشرى محمد سامي ؛ حاكم محسن محمد (٢٠٠٧) . " إستخدام أساليب وأدوات الجودة في ضبط العملية الإنتاجية في منظمات الأعمال الصناعية " ، مجلة جامعة كربلاء العلمية ، المجلد الخامس (العدد الرابع) .

٦. أحمد إبراهيم حسين (٢٠١٩) . " إستخدام خرائط الجودة للرقابة على جودة مياه الشرب " . مجلة العلوم الإقتصادية والإدارية . المجلد ٢٥ (العدد ١١٥) .

٧. محمد خالد أحمد ؛ نصيف عبداللطيف نصيف ؛ زيد عامر محمد . إستخدام خرائط المراقبة في ضبط الجودة للخطوط الإنتاجية في معمل بابل للبطاريات . مجلة كلية التراث الجامعية . العدد الحادى والعشرون .

٨. إسماعيل إبراهيم القزاز (٢٠١٥) . " ضبط الجودة النظرية والتطبيق " الطبعة الأولى .

٩. محمد عبدالرحمن إسماعيل (٢٠٠٦) . " الرقابة الإحصائية على العمليات " . الرياض . معهد الإدارة العامة .

١٠. فاطمة الزامكى (٢٠٠٣) . " إستخدام الأساليب الإحصائية في ضبط جودة الإنتاج " حالة تطبيقية في الشركة اليمنية للمطاحن وصوامع الغلال عند إحدى شركات هائل سعيدأنعم التجارية .

١١. قاسم المحياوي نايف علوان (٢٠٠٦) . " إدارة الجودة الشاملة ومتطلبات الآيزو " . دار الثقافة للنشر والتوزيع .

١٢. ضحى محمود أحمد محمود ؛ لينا عبدالقادر ؛ لينا حسين العبيد (٢٠١٦) . " تطبيق خرائط ضبط الجودة بإستخدام SPSS " بكالريوس الشرف في الإحصاء ، كلية العلوم ، جامعة السودان .

١٣. أسامة ربيع أمين (٢٠٠٨) ."خرائط مراقبة الجودة الإحصائية وتطبيقاتها علي الحاسب الألي Minitab " ، القاهرة .

١٤. أسامة ربيع أمين (٢٠٠٧) . " التحليل الإحصائي للبيانات بإستخدام برنامج Minitab " ، القاهرة .

١٥. بدوي عثمان محمد (٢٠١٨) . " إستخدام خرائط ضبط الجودة الإحصائية لقياس جودة الخدمة من وجهة نظر الطلاب " دراسة تطبيقية في جامعة الباحة بالمملكة العربية السعودية ، مجلة العلوم الإقتصادية والإدارية ، المجلد ٢٤ (العدد١٠٢).

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Immunohistochemical Detection of P53 and Ag NOR Score among Sudanese Patients with Prostate Cancer in Military Hospital 2019-2020

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ABSTRACT

Prostate cancer is the second most common and fifth most aggressive neoplasm among men worldwide. PC is a manifested heterogeneous disease, ranging from slow growing and indolent to aggressive with high risk of fatal outcome. The study investigated the detection of P53 expression by using immunohistochemical method and Ag NOR score in prostate cancer and to correlate between them among Sudanese patients. Forty six paraffin block samples were collected from samples previously diagnosed as prostate cancer from Military hospital in Khartoum state within 2019-2020, from the block two sections was cut at 3µm thickness by rotary microtome. One for P53 immunohistochemical staining method and the other for Ag NOR score sliver staining method. Patient's age ranged between 55 and 89 years with mean age of 72±7.654 years, most prostate cancer patients were at sixth and seventh decades. The positive expression of P53 were seen in 15/46 (32.61%) samples while negative expiration in 31/46 (67.39%) samples. The P53 expression was (0%, 2.17%, 6.52%, 6.52%, 15.22% and 4.35%) in Gleason score (5, 6, 7, 8, 9 and 10) respectively, there was insignificant statistical correlation between P53 expression and Gleason score (P-value 0.051). Ag NORs score was (2.66) among P53 positive samples and (2.20) in P53 a negative samples, there was a significant statistical correlation between Ag NORs

score and P53 expression (P-value 0.011). Ag NORs score was (1.88, 2.33, 2.24, 2.36, 2.75, and 2.14) in Gleason score (5, 6, 7, 8, 9 and 10) respectively, this result shows insignificant statistical correlation between Ag NORs score and Gleason score (P-value 0.355).

Keywords: Prostate cancer, P53, Ag NORs.

Introduction

Prostate cancer (PC) is a manifested heterogeneous disease, ranging from slow growing and indolent to aggressive with high risk of fatal outcome [1]. In 2020, according to the world Health Organization (WHO), prostate cancer is the third most common diagnosed malignancy. With 1,414,259 cases (7.3% of the total), prostate cancer is preceded only by lung and colorectal cancer with 2,206,771 and 1,148,515 cases [2].The incidence rate of PC in Sudan ranked the third most common cancer and the first most commonly diagnosed cancer among male patients. Pc is the seventh leading cause of cancer death in Sudan[3].Risk factor of PC include Age, race, ethnicity, positive family history, hormones, obesity, diabetes and other controversial factors like smoking, sexual activity and exercise [4]. Localized cancer is generally asymptomatic. Symptoms occur when benign prostatic tissue compress and obstruct the urethra resulting in frequency hesitancy and poor urine flow. Involvement of the perineal or suprapubic nerves can lead to pain, hematuria can also occur as the result of local spread of cancer [5].Two tests are commonly used to screen for prostate cancer. They are a digital rectal examination (DRE) and a prostate specific antigen (PSA) test. Imaging techniques are used to determine whether or not the PC is still contained with the prostatic capsule or has spread [6].Treatment options of localized and locally advanced of PC are surgery, chemotherapy and hormonal therapy [5].The tumor suppressor gene P53 function is to block cell cycle progression At the G1-S interphase in the event of DNA damage [7]. In prostate cancer, p53 is mutated in a range of 2.5–40% of tumors [8] Alteration of p53 may be more frequent through copy number alteration

rather that mutation in prostate cancer [9]. Additionally, p53 has been suggested to be a predictor of tumor recurrence and metastasis [10] and p53 loss seems to increase as disease progresses [11]. AgNORs, a synonym for silver stained Nucleolar Organizing Regions (NORs) of DNA located on the short ends of acrocentric chromosomes are emphasized in actively proliferating cells. AgNORs is a useful method to identifying and grading of prostate carcinoma. The mean AgNORs counts shows positive correlation with Gleason score and p53 immunohistochemistry in some study [12].

Materials and Methods

A tissue microarray **(**TMA) was constructed from paraffin-embedded prostate cancer specimens from 46 blocks. Hematoxylin and eosin stained full sections were reviewed to select representative areas of tumor in the **area** of an initial donor block from which cores was acquired for the microarray. Duplicate cores of 2mm diameter were taken from each lesion and placed into recipient blocks. After construction, 3µm section was cut and stain with hematoxylin and eosin to verify histological diagnosis. Then 2 sections of 3µm thickness were cut from each TMA blocks by rotary microtome, one section mounting in positively charged slides for immunohistochemical staining and other on ordinary microscope slide for sliver stain.

Results

The study includes 46 prostate adenocarcinoma samples, the age of study population ranged between 55 and 89 years with mean age of 72±7.654 years. Age groups (50-60 years) include 3(6.52%) patients, (61-70 years) include 20 (43.48%) patients, (71-80 years) include 17(36-96%), and (81-90years) include 6 (13.04%).

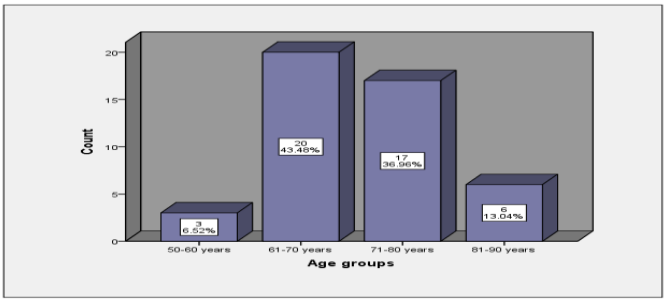
Most PC patients aggregate in age groups (61-70 years) and (71-80 years), as indicated in (Graph 1).

The positive expression of P53 were seen in 15 (32.61%) samples while negative expiration in 31 (67.39%) samples, as indicated in (Graph 2).

The Ag NORs score in P53positive PC samples was (2.66) while in P53 a negative sample was (2.20). This result shows significant statistical association (P-value 0.011), as indicated in (Table 1).

The P53 positive expression was revealed in one sample (2.17%) in Gleason score 6, in 3 samples (6.52%) in Gleason score 7, 2 samples (4.35%) in Gleason score 8, 7 samples (15.22%) in Gleason score 9 and 2 samples (4.35%) in Gleason score 10, while P53 negative expression was revealed in one sample (2.17%) in Gleason score 5, 2 samples (4.35%) in Gleason score 6, in 13 samples (28.26%) in Gleason score 7, 8 samples (17.39%) in Gleason score 8,2 samples (4.35%) in Gleason score 9 and 5 samples (10.87%) in Gleason score 10. This result shows insignificant statistical association (P-value 0.051), as indicated in (Table 2).

Graph 1:Shows the age groups distribution among the study population.



Graph 2: the frequency of P53 expiration among the study samples.

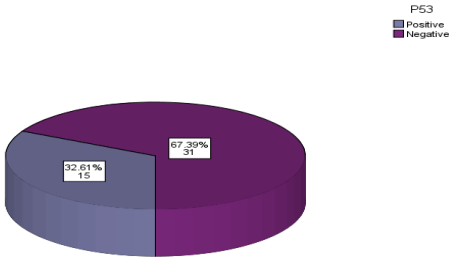


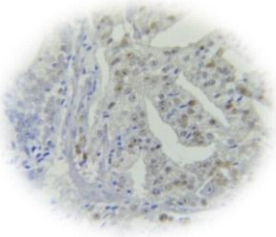
Table 1: Shows the relation between P53 expression and mAgNORs.

P53 expression	Positive	Negative	P value
mAgNORs	2.66	2.20	0.011

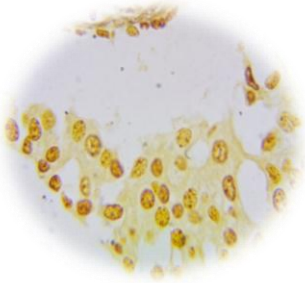
Table 2: Shows the relation between Gleason score and P53 expression.

Gleason score	P53 expression	
	Positive	Negative
Gleason score 5	0 (0%)	1 (2.17%)
Gleason score 6	1 (2.17%)	2 (4.35%)
Gleason score 7	3 (6.52%)	13 (28.26%)
Gleason score 8	2 (4.35%)	8 (17.39%)
Gleason score 9	7 (15.22%)	2 (4.35%)
Gleason score 10	2 (4.35%)	5 (10.87%)
P-value	0.051	

Microphotograph1: positive mutant P53 tumor marker in prostate tissue by 40x magnification.



Microphotograph 2: Shows high mAgNORs in prostate cancer by 40x oil high magnification.



Discussion:

P53 is a protein that acts as a tumor suppresser gene, located in the nucleus of cell throughout the body where it attaches directly to DNA. It regulates cell division by keeping cell from growing and dividing (proliferation) too fast or uncontrolled way. Ag NORs is a chromosomal region that contains ribosomal gene and association with nucleolus following nuclear division. The estimation of Ag NORs score in tumors has therefore found wide application in tumor histopathology in the assessment of growth potential of tumors.

In this study the peak frequency of PC patients found at sixth and seventh decades this observations was similar to study of Khethmal, *et al*. [12], who found that the maximum cases of PC in Age groups (61-70 years) and (71-80 years), the frequency 27 and 16 respectively, also Giona,[13], found that PC in UK rise steeply from around age 50-54, peak in 75-79 years before dropping in the oldest age groups.

Another important relations was that Ag NORs score in P53positive PC samples was show significant statistical association (P-value 0.011) this result compatible with [12], who found that a maximum percentage of positive cases in high Ag NORs score count showing significant statistical association (P-value 0.012). Therefore, Ag NORs score may act as an adjuvant to the other diagnostic markers

and may provide a significant cell kinetic evaluation of prostatic lesions especially PIN with a parameter to provide a better definition [14]. Also (Ibrahim, *et al*, 2015) agrees my result when search about malignant prostate samples in 40 cases to discover the relation between Ag NORs count and malignant cells their found Ag NORs score in Prostate adenocarcinoma. While this study is incompatible with (Munda, *et al*. 2009) that insignificant result between Ag NORs, P53 and Gleason score (P value 0.0280) because used small sample size (17 cases). In this study maximum percentage of P53 positivity was found in high Gleason score in Gleason score 9 and in Gleason score 10 while there was no positive sample in Gleason score 5 this observation shows that P53 positivity indicate possibility of high grad of disease. This result similar to [12], who found P53 positive frequency were higher in Gleason score 9 (18 samples (75%)).Also (Diaconescu and Toma. 2012) obtained to AgNORs count has been proved to be a significant predictor in several human tumors it is well known that nucleoli increase in size and number in prostate carcinoma. Thus, it seems reasonable to expect that Ag NORs numbers might increase with more aggressive, higher-grade prostatic lesions when studied on 65 needle cores biopsies of prostatic adenocarcinoma.

References:

1. **Euceda, L.R**., Andersen, M.K., Tessem, M.B., Moestue, S.A., Grinde, M.T. and Bathen, T.F. NMR-Based Prostate Cancer Metabolomics. In: Culig z. (ed.). Prostate Cancer Methods and Protocols. Springer Nature. New York: **(2018)**. 237-258.
2. **Sung, H**., Ferlay, J., Siegel, R.L., Laversanne, M., Soerjomataram, I., Jemal, A., *et al*. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA: a cancer journal for clinicians.**(2021)**.

3. **Sudan Cancer Fact Sheet**". Sudan – Global Cancer Observatory. International Agency for Research on Cancer. March, **(2021)**.
4. **O'Malley, P**. Epidemiology and Etiology. In: Robinson, B.D., Mosquera, J.M., Ro, J.Y. and Divatia, M. (eds.). Precision Molecular Pathology of Prostate Cancer. Springer. Switzerland:**(2018)**. 13-26.
5. **Kirby, R.S**., Patel, M.I. and Poon, D.M.CProstate Cancer.10th edition. S. Karger Publishers Limited. UK: . **(2020)**. 27-91.
6. **Lawrenson, A.G**. An ABC of Prostate Cancer Today. 3rd edition. S. Karger Publishers Limited. Australia: **(2019)**. 37-106.
7. **Reinhardt, H.C**. and Schumacher, B. The p53 network: cellular and systemic DNA damage responses in aging and cancer. *Trends in Genetic*. **(2012)**. **28**(**3**): 128–136.
8. **Beltran, H**., Yelensky, R., Frampton, G.M., Park, K., Downing, S.R., MacDonald, T.Y., et al. Targeted next-generation sequencing of advanced prostate cancer identifies potential therapeutic targets and disease heterogeneity. *European Urology*.**(2013)**. **63**(**5**): 920–926.
9. **Taylor, B.S**., Schultz, N., Hieronymus, H., Gopalan, A., Xiao, Y., Carver, B.S., et al. Integrative genomic profiling of human prostate cancer. *Cancer Cell*. **(2010)**. **18**(**1**): 11–22.
10. **Baca, S.C**. and Garraway, L.A. The genomic landscape of prostate cancer. *Front Endocrinol*. **(2012)**. **3**: 69.
11. **Baca, S.C.**, Prandi, D., Lawrence, M.S., Mosquera, J.M., Romanel, A., Drier, Y., et al. Punctuated evolution of prostate cancer genomes. *Cell*. **(2013)**. **153**(**3**): 666–677.
12. **Khethmal, P**., Thomas, T. and Augustine, J. Ag NOR Staining in Prostatic Carcinoma-Comparative Study with P53 and Gleason. *Journal of Medical SCR*. (**2018**). **6**(**9**): 925-931.

13. **Giona, S**. The epidemiolgy of prostate cancer. In: Bott, S.R.J and Ng, K.L (eds.). prostate cancer. Exon puplecations. Australia: **(2021)**. 1-15.
14. **Khanna, A**., Patil, R. and Deshmukh, A. Assessment of the potential of pathological stains in human prostate cancer. *Journal of Clinical Diagnosis Research*.**(2014)**. **8**(**1**) 124-128.
15. **Ibrahim, K**, Martine. P. R and Michael, C, H. Molecular pathology of prostate cancer.*Surgical pathology*. **(2021).** 387-401.
16. **Munda. M,** Hajginjak. T, Kavalar. R and Stiblar Martincic. D. P53, Bcl-2 and AgNOR Tissue markers: Model Approach in predicting prostate cancer characteristic. *Journal of international MR.* **(2009). (3)** 1868-1876.
17. **Diaconescu. D** and Toma. S. Significance of nucleolar organizer Regions in prostate Adenocarcinoma. *Journal of Medical SCR.* **(2012).** 5 **(54)** 5-6.

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AN EVALUATION OF CONSISTENCY MODELS IN NOSQL DATABASES

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ABSTRACT

This study focuses on the various consistency models are used in ***NoSQL*** databases. ***NoSQL*** databases are designed to handle large volumes of unstructured or semi-structured data, and they often use distributed architectures to achieve high scalability and availability. However, maintaining consistency across this type of database can be challenging due to the distributed nature of the database and the concurrent access of multiple users or applications. This study explores the different types of consistency models used in ***NoSQL*** databases. The study examines the strengths and weaknesses of each model and how they ensure data consistency and integrity in distributed databases. The findings of this study can help database administrators and developers choose the appropriate consistency model for their ***NoSQL*** database based on their specific requirements and use cases.

KEYWORDS: *NoSQL, NoSQL-Database, DBMS, Consistency , eventual consistency*

1. INTRODUCTION

1.1 BACKGROUND

In this days, the data was growing rapidly with time, for example, the amount of data volumes was generated by Twitter and Facebook users in each day was estimated by 12 and 500 TB [1] [2]. The Relation Databases can't handle this amount of data [3]. Therefore, an enterprise companies tend to find new types of databases that meet the requirements for handling and processing this massive of data that generated every day. ***NoSQL*** (Not-Only-SQL) is a new database to handle the massive data by supporting cluster architecture has recently become very popular. Google and Amazon are considered pioneers in producing these types of databases and their products are today considered one of the most distinguished products based on the concept of ***NoSQL***.

This type of database is based on distributed database system models, and ***CAP*** Theorem Presented by Eric Brewer for management database systems ***DBMs***. Consistency, Availability and partition tolerance submitted by **Eric Brewer** since 2000. ***Consistency*** refers to the fact that, at any one time, all copies of the data in the system seem identical to an outsider. Availability describes how the system as a whole keeps running even when a node fails. It is necessary for

partition-tolerance that the system function even in the face of random message loss. Similar to network flaws [4].

In related database management systems, ACID is preferred to. ***Atomicity***: The state in which all of the transaction's operations will either succeed or fail. ***Consistency***: The absence of inconsistent data in any transaction or its effects. A transaction will act as though it is the sole action taking place when it is ***isolated***. ***Durability***: The inability for an operation to be undone after it has been carried out [4]. Most of References are divided the ***NoSQL*** databases models into: (1) Key-value ***NoSQL*** model, (2) Column-Family ***NoSQL*** model, (3) Document ***NoSQL*** model, and (4) Graph ***NoSQL*** model.

NoSQL DBMSs also demand eventual consistency, which implies that initially, not all redundant nodes will have the most up-to-date data, but eventually, all servers will have the same data, in order to increase performance. ***NoSQL*** DBMSs support multi-level consistency when various applications have varying needs for consistency. N must always be greater than or equal to C, where C denotes the consistency level that must be met for a read/write operation and N is the number of replicated nodes. [5].

There were seven sections in this article. Introduction is found in section one. The related work is presented in section 2, and the consistency in ***NoSQL*** DBMS is covered in section 3. The approach is introduced in section 4, and the findings and discussions are presented in part 5. There were 5 sections in this essay. Introduction is found in section one. The related work is presented in section 2, and the consistency in ***NoSQL*** DBMS is covered in section 3. The approach is introduced in section 4, and the findings and discussions are presented in part 5 and 6.

1.2 MOTIVATION

NoSQL Database are weak support for the *ACID transactional* guarantees and strong data consistency features, because this challenge the developers have solve this problem within code of the applications and may cause the difficulties in the application development life cycle and also reduce the efficiency of the production development.

1.3 CONTRIBUTION

In this study we present the consistency models in ***NoSQL*** databases. The researcher contributions are stated, (1) To present a consistency models in ***NoSQL*** Specially in Key-value data model. (2) Proposed a best model of consistency in may applied in ***NoSQL*** data store. (3) Fill the gap of the study in the consistency models

2. RELATED WORKS:

Various representative studies have frequently evaluated eventual consistency in ***NoSQL*** databases, frequently taking the performance impact into account. To assess how read and write operations, database replication, and eventual consistency of ***NoSQL*** DBMSs are impacted, the authors of [2] recommend adopting a probabilistic technique. recommend adopting a probabilistic technique. Although the authors give model validation with a small relative error, performance and availability issues are not taken into account in the works. Mathematical models to specify and assess ultimate consistency on data storage systems have been provided by the study of Attiya et al. [6] Performance, however, is not taken into account. Using DynamoDB to explore the impact of operation delay, such as write operation, on eventual consistency was done in the work by Bailis et al. [7]. Assessing the implications of operation delay, such as a write operation, on eventual consistency using DynamoDB. They also provide a method for calculating consistency that accounts for the number of database replicas. In evaluating the performance of three ***NoSQL*** DBMSs (MongoDB, Cassandra, and Riak), Klein et al. took into account the number of clients. Results from experiments suggest that strong consistency may result in a 25% decrease in system performance. [8]. According to Huang et al., queue length should be used as a metric for consistency. DBMS Cassandra has been utilized in tests. [9]. In [10] The researchers conducted several studies to find out how database consistency impacts energy usage. Results indicate that energy use is highly influenced by effort. Liu et al. attempted to determine how long it would take to update data in databases with eventual consistency. In the study [11] the researchers offer a probabilistic approach. Osman et al.'s offer a Petri Net Model for evaluating the Cassandra DBMS's performance while taking into consideration different redundancy strategies and cluster sizes. The model delivers values that are close to those of the actual system, according to the results, but they do not address system availability. [12].

3. NoSQL Consistency

An operation sequence that usually complies with the ACID properties is referred to as a *transaction*. If a transaction is successful, it is said to commit; if not, it is called to abort [13].

A single valid state for all database instances can be characterized as *consistency* in database management systems ***DBMS***. A *database management system consistency* can be defined as a single acceptable state for all database instances as long as the data remain the same across all redundant database servers. [14, 15]. Because a DBMS must guarantee that the returned data is the most recent for readings and must confirm that the write operation has been successfully

performed on each requested server, this has an influence on performance. Since there are more database replicas present in distributed systems, availability is also impacted by consistency policy in a manner similar to how accessibility is. In order to boost efficiency and availability, NoSQL databases use eventual consistency, which permits temporary inconsistency (i.e., not all redundant servers will immediately have the most recent data) and permits a database replica to return its available data (which may not be the newest). There will finally be consistency across all redundant servers [16]. ***NoSQL*** DBMSs permit the adoption of different consistency levels (i.e., the bare minimum of redundant servers holding the most recent data), which are adjusted in accordance with an application's needs [17]. This contributes to closing the inconsistency. Fewer servers need to be upgraded because of fault tolerance and increased availability. Another ***NoSQL*** trait is strong consistency, which always returns the most recent data.

According to the most recent studies, consistency models can be categorized into a variety of categories, including strong consistency, weak consistency, eventual consistency, causal consistency, read-your-writes consistency, session consistency, monotonic reads consistency, and monotonic writes consistency.

1) ***Weak-Consistency Model***:

   This model, as the name indicates, reduces consistency. It specifies that a read operation does not guarantee the return of the most recently stored value. It also does not ensure the sequence of events [18]. The time interval between a write operation and the point at which each read operation provides the updated data is referred to as the inconsistency window [19]. Because there is no need to include more than one replica or node in a client request, this paradigm results in a highly scalable system.

2) ***Eventual Consistency Model***:

   A consistency model that ensures if there is no additional updates on a given item, all the reads to that item will eventually return the same value [19]. Replicas frequently arrive with the same data state. Read operations might not always return the most recent version while this procedure is in progress. The connection lags between replicas and their sources, system load, and the number of replicates involved will affect the inconsistency interval. [18]. This method is half-way between a strong-consistency model and a weak-consistency model. Many ***NoSQL*** databases provide Eventual Consistency as a feature. The world's most popular companies that use Cassandra can provide availability and network partitioning to such a degree that it does not hinder functionality. Facebook, the company that originally developed Cassandra, is one of them.

3) ***Strong Consistency Model***:

The identical value will be returned by any read from any replica thanks to a robust consistency model. All clients will utilize the identical data entry and data, and each transaction must appear to be committed instantly. The write action must commit before a read operation may access the updated version of an instance. Every storage system instance accepts a particular global sequence of events. [19] , [20].

4) ***Casual Consistency Model***:

Any operations that recognize the update on an element are required to take the modified value into account. The eventual consistency model will be used in the event that another process does not acknowledge the write operation [18]. Although less dependable than sequential consistency, causal consistency is more dependable than eventual consistency. When the Eventual Consistency model is reinforced to be Causal Consistency, the system's availability and network partitioning properties are decreased. [18].

5) ***Read-Your-Writes Consistency Model***:

With the help of the read-your-writes consistency model, it is made sure that a replica is at least current enough to include changes made by a single transaction. Transactions are applied sequentially, therefore by guaranteeing that a replica has a particular commit applied to it, we can make sure that all transaction commits that took place prior to the given transaction have already been committed to the replica. If a process updates an object, that process will always take into account the modified value. Other processes will eventually read the modified value. Therefore, read-your-writes consistency is achieved when the system guarantees that every attempt to read a record that has been modified will return the updated value.

6) ***Session Consistency Model***:

A process will follow a read-your-writes consistency model for the length of a session if it makes a request to the storage system while it is operating within that session. All reads are current with the session's writes using session consistency, although writes from other sessions may need to wait. Although everything arrives in the correct order from prior sessions, the data is not always guaranteed to be up to date. This offers excellent consistency at half the cost of good performance and availability.

7) ***Monotonic Read Consistency Model***:

Every time a process reads a value, it returns that value or one that is more recent [15]. It implies that the same item is read by the same process consistently and in the same order. However, this does not guarantee that read operations between processes on the same object will be ordered monotonically. Because of this, monotonic readings ensure that a process that reads r1, r2, and r2 cannot experience a state that is earlier than the writing

represented in r1; reads, by nature, cannot travel backward. Monotonic readings do not apply to operations carried out by different processes; they only apply to those carried out by the same process. There are full monotonic readings available: Even during a network split, all nodes can advance [21].

8) ***Monotonic Write Consistency Model***:

Before any more write operations by the same process on the same object, a process-initiated write action on that particular object must be completed [19]. In other words, the same process writes to the same object consistently in the same order. However, this does not guarantee that write operations between processes on the same object will be ordered monotonically. The effect of this is that monotonic writes guarantee that if a process writes w1, then w2, then all processes will observe w1 before w2. Monotonic writes do not apply to operations carried out by different processes; they only apply to those carried out by the same process. All monotonic writes are available: Even during a network split, all nodes can advance [22].

9) Time-Line Consistency Model:

Yahoo created this consistency model especially for YAHOO PNUTS in order to solve the inefficiencies of serializable transactions of the big data and its relation with their geo-replication. Furthermore, it seeks to reduce the shortcomings of eventual consistency [23]. ***NoSQL*** databases are support eventual consistency instead of strong consistency. They do not support database transactions which ensure strong data consistency [24].

Each type of ***NoSQL*** models support many level of Consistency for example the eventual consistency supported may levels of consistency For the confirmation of an activity at consistency level **ONE**, just one node or server is required (such as a write or read). For level 2 operations, **TWO** nodes are needed, and while reading, the most current data from both servers is taken into consideration. The **QUORUM** policy [25], which requires that the least integer bigger than 50% of the database nodes be used to determine consistency, is compatible with a level like this. Like the **ALL** policy, Level Three asks confirmation from each node. [26]. The latest information is constantly accessible thanks to reading (high consistency) [27].

Table (1): *NoSQL* Consistency Models

Consistency Model	Grantees	
Weak Consistency Model	A read operation will not really support serialization and doesn't guarantee that it will provide the value that was most recently saved in memory.	
Session Consistency Model	Consistency with read-your-writes is only guaranteed during a session.	
Read-Your-Writes Consistency Model	An operation always receives the most recent update on read operations.	
Monotonic Reads Model	Every time return the same value as the last reading, or one that is more recent.	
Monotonic Writes Consistency Model	Prior to performing any more writes, a write operation must always complete.	
Casual Consistency	Order of actions overall with a causal connection	
Strong Consistency	Serializability	A set of operations is composed of concurrent computations of a group of serialization units.
	Linearizability	Every operation is immediately seen in the overall, sequential order of events, or it is handled as a single operation.
Eventual Consistency	Eventually, the state of the updates will be consistent across all replica nodes.	
Time-line Consistency	The actions are performed on the same record by all replica nodes in the same "correct proportion".	

Table (2) Consistency Model in *NoSQL* Databases

***NoSQL* Database**	**Data Model**	**Consistency Model**	**Applications/Services**	**API**
Amazon Dynamo	Key-Value	Eventual Consistency	E-Commerce Platforms like Amazon Stores (**AWS A**mazon **W**eb **S**ervices)	Multiple Consistency Level
Cassandra	Column-Family	Eventual Consistency	Facebook, Netfelx, inbox search, eBay, Sound Cloud, Rack Space Cloud	Multiple Consistency Level (ONE, TWO, ALL, QURAM)
Raven DB	Document	Eventual Consistency	Toyota	Multiple Consistency Level
MongoDB	Document	Eventual Consistency	SAP AG Software Entreprise, MTV, Vodafone, AMAR BANK	CRUD API
Raik	Key-Value	Eventual Consistency	Yammer Social Network, Github	Multiple Consistency Level
Yahoo PNUTS!	Multi-Model	Timeline Consistency	Yahoo Mail	Multiple Consistency Level
Apache HBase	Column Family	Strong Consistency	Facebook messenger, using Hadoop for large set of application	JSON API
Microsoft Azure	BOLB Tables	Strong Consistency	Office 365, OUTLOOK, Bing	RESTfull API
Redis	Key-Value	Strong Consistency	Flicker, Instagram	JSON API
Google Spanner	MultiModel	Strong Consistency	Google F1	SQL-Like

Many applications demand either a rigorously strong type of consistency or just static eventual consistency. However, consistency requirements are not evident for another type of applications since they are dependent on data access behavior dynamical, client demands, and the results of reading inconsistent data such as ecommerce platforms because these kinds of applications, the fast accessibility and availability are critical. Strong consistency techniques may therefore be unaffordable. Although they are preferred for some applications, great levels of uniformity are not always required. In situations like these, undesirable results are caused by either immobile eventual or strong sorts of consistency. When storage systems are dispersed geographically, strong consistency guarantees

become unaffordable due to high network latencies. As a result, applications requiring high availability and performance are best served by weaker consistency semantics, such as eventual consistency.

4. Methodology

The one of the contribution is to select the best type of the consistency if we setup the eventual consistency. And determine how the cost of replicated NoSQL data storage varies depending on the consistency level being used. As a result, we add to our earlier research by figuring out how much it will cost to use ScyllaDB.

4.1 ScyllaDB

ScyllaDB is a distributed *NoSQL* wide-column database for data-intensive applications that require high performance and low latency, its sharded cluster, replica set or standalone, It is an open source *NoSQL* database and support cloud [28].

The number of replicas (in a cluster) that must acknowledge a read or write operation before the coordinator node may judge the operation was successful is determined by a Consistency Level (CL). That means the CL maybe is the important factor for the NoSQL database that used the eventual consistency.

Table (3) describe Scylla Consistency levels [28]

Consistency Level	With Replicas Must Response	Consistency	Availability
ANY (Write Only)	The closest replica, according to the snitch. After an indicated handoff, write succeeds if all replica nodes are down. Assures never-failing writes while offering low latency.	Lowest (Write)	Highest (Write)
ONE	The Snitch's assessment of the closest replica. The requirements for consistency are not overly strict.	Lowest (READ)	Highest (READ)
TWO	The closest two replicas as determined by the Snitch.		
THREE	The closest three replicas as determined by the Snitch		
QUORUM	A simple majority of all replicas across all datacenters. This CL allows for some level of failure		
ALL	All replicas in cluster	Highest	Lowest
LOCAL_QUORUM	Confined to the same datacenter as the coordinator.	Low in multi-data centers	
EACH_QUORUM (WRITE ONLY)	A simple majority in each datacenter.	Same across datacenter	
LOCAL_ONE	Same as ONE, but confined to the local datacenter.		
SERIAL	Returns results with the most recent data. Including uncommitted in-flight LWTs. Writes are not supported, but read transactions are supported.	Linearizable	
LOCAL_SERIAL	Same as SERIAL, but confined to a local datacenter. Writes are	Linearizable for the local DC	

Consistency Level	With Replicas Must Response	Consistency	Availability
	not supported, but read transactions are supported.		

4.2 Experimental Setup

We deploy a single replica set in Amazon Elastic Compute Cloud (AWS) to conduct the tests (EC2). With 30 nodes on the USA (us-east-1) site and 5 nodes in the same geographical region and different availability zones, we deployed ScyllaDB on two data zones. Each node has the following specifications:

- **250 GB NVMe SSD,**
- **32 GB of Memory,**
- **8-cores INTEL CORE.**
- **Standard architecture of 1000 Gbit/s dark fibers**
- **OS: Linux Ubuntu 18.4**

With ScyllaDB, we used a replication factor of three copies, with two of them allocated to Zones 1 and 5.

4.3 Workloads

For testing the eventual consistency and casual consistency we had initialize a workload which would perform multiple sequential operation for a single session rather than independent point quires, we used a workloads based on social media of twitter. Which involve each client doing mix of read and writes (read tweets, and write tweets) or just a serializable of read (insights, status checks) in the session. A performance will done with enabling the transactions, and verifying the setting for the consistency, read performance, write performance, as well as the number of threads.

4.4 Benchmarks

We need a benchmark tool that makes use of the features of various workloads in order to run the experiment and assess the consistency levels; in this example, we use the Yahoo Cloud Service Benchmark (YCSB) 1.12.0. YCSB can be utilized with a variety of programs, including Additionally, YCSB displays genuine cloud features like scale-out, elasticity, and high availability, and we use it to execute Workload A, a workload with a high read-to-update ratio (60:40). After replication, our workload in both environments consists of 10 million operations on 5 million rows for a total of 50.84 GB of data.

5. Results and Discussion

Many applications that demand low latency writes can't wait for the response of replication of each write and use write all for doing writes for all nodes that's mean some of writes may be not written and rolled back.

Figure (1) Shows that Comparisons between two types of eventual consistency had applied to ScyllaDB, and its throughputs. In this figure the results show that the applied of the configuring the ALL of eventual Consistency is the best in threads and throughputs rather than Quorum.

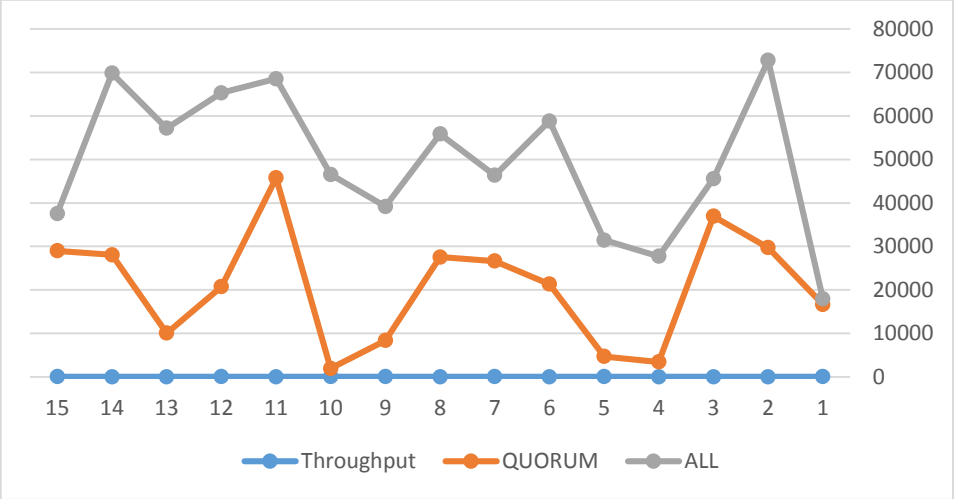

Figure (1): Describe the Throughputs Vs. two types of eventual consistency

Figure (2): Describe the Read/Write Operation Throughputs

On the other hand, the second figure shows that the reading and writing factor with the response time. It is clear from this that the best performance in balancing the load between the reading and writing process is when the consistency settings are applied in configuration of QUORUM consistency in the replica set.

6. Conclusion

This Study was aimed to draw a key for the types of consistency of NoSQL databases. Because NoSQL was used widely at this time and select one of the best models of consistency the eventual consistency and test it with one of the *NoSQL data model* is the column model.

7. Future works

In this study we test and implementation of the eventual consistency for the column NoSQL database. We recommend that study the other types of consistency with other types of *NoSQL* data model. And study the effect of each types of consistency over the truncations throughputs.

References

[1] M. G. (. S. Sakr (ed.), Large Scale and Big Data:Processing and Management, Boca Raton,: Auerbach Publications, 2014.

[2] U. G. A. P. E. T. Aleksey Burdakov, "Estimation Models for NoSQL Database Consistency Characteristics," in *24th Euromicro International Conference on Parallel, Distributed, and Network-Based Processing*, 2016.

[3] U. G. A. P. A.V. Burdakov, "Comparison of table join execution time for parallel DBMS and MapReduce," in *Software Engineering / 811: Parallel and Distributed Computing and Networks / 816: Artificial Intelligence and Applications Proceedings*, Innsbruck, Austria, 2014.

[4] R. H. S. Jablonski, "NoSQL Evaluation A Use Case Oriented Survey," in *internation conference on cloud and services computing*, 2011.

[5] E. B. E. T. a. M. N. d. O. J. C. Gomes, "Performability Model for Assessing NoSQL DBMS Consistency," in *IEEE International Systems Conference (SysCon)*, Orlando, FL, USA, 2019.

[6] F. E. a. A. M. H. Attiya, "Limitations of highly-available eventually-consistent data stores," *IEEE Transactions on Parallel and Distributed Systems*, vol. 28, no. 1, pp. 141-155, 2017.

[7] S. V. M. J. F. J. M. H. a. I. S. P. Bailis, "Probabilistically bounded staleness for practical partial quorums," *Proc. VLDB Endow.*, vol. 5, no. 8, pp. 776-787, 2012.

[8] J. W. P. S. Y. J. B. a. J. Z. X. Huang, "An experimental study on tuning the consistency of nosql systems," *oncurrency and Computation: Practice and Experience*, vol. 29, no. 12, pp. 29-41, 2017.

[9] I. G. N. E. P. D. K. P. a. C. M. J. Klein, "Performance evaluation of nosql databases: A case study," in *in Proceedings of the 1st Workshop on Performance Analysis of Big Data Systems*, New York, NY, USA, 2015.

[10] S. I. Y. L. G. A. M. S. P. a. L. B. H. E. Chihoub, "Exploring energy-consistency trade-offs in cassandra cloud storage system," *International Symposium on Computer Architecture and High Performance Computing* , pp. 146-153, 2015.

[11] S. N. J. G. M. R. R. I. G. a. J. M. S. Liu, Quantitative Analysis of Consistency in NoSQL Key-Value Stores, Cham: Springer International Publishing, 2015, pp. 228-243.

[12] R. Osman and P. Piazzolla, "Modelling Replication in NoSQL Datastores," *Cham: Springer International Publishing*, pp. 194-209, 2014.

[13] C. F. d. V. R. P. J. O. Coelho FACL, "pH1: A Transactional Middleware for NoSQL," *IEEE 33rd International Symposium on Reliable Distributed Systems Available*, 2014.

[14] O. G. A. a. M. O. I. M. A. Mohamed, "Relational vs. nosql databases: A survey," *International Journal of Computer and Information Technology*, vol. 3, no. 3, pp. 598-601, 2014.

[15] J. R. G. Paz, "Introduction to azure cosmos db," in *Microsoft Azure Cosmos DB Revealed: A Multi-Model Database Designed for the Cloud*, Berkeley, CA: Apress, 2018, pp. 1-23.

[16] E. R. a. J. W. L. Perkins, Seven databases in seven weeks: a guide to modern databases and the NoSQL movement, Pragmatic Bookshelf,, 2018.

[17] R. O. a. W. J. K. G. Haughian, "Benchmarking replication in cassandra and mongodb nosql datastores," in *Database and Expert Systems Applications*, Cham: Springer International Publishing,, 2016, pp. 152-166.

[18] W. (. ,. 5. 4.-4. Vogels, "Eventually consistent: Building reliable distributed systems at a worldwide scale demands trade-offs between consistency and availability.," *Communications of the ACM*, vol. 52, no. 1, pp. 40-44, 2009.

[19] P. B. a. A. Ghodsi, "Eventual consistency today: Limitations, extensions, and beyond," *Queue*, vol. 11, pp. 03-20, 2013.

[20] P. a. M. V. Viotti, "Consistency in non-transactional distributed storage systems.," *ACM Computing Surveys (CSUR)*, vol. 49, no. 1, pp. 1-34, 2016.

[21] Jepsen., "Monotonic Reads.," 2022. [Online]. Available: https://jepsen.io/consistency/models/monotonic-reads. [Accessed 01 01 2023].

[22] J. M. Writes. [Online]. Available: https://jepsen.io/consistency/models/monotonic-writes. [Accessed 02 01 2023].

[23] H. E. Chihoub, "Managing Consistency for Big Data Applications on Clouds: Tradeoffs and Self-Adaptiveness," *THÈSE / ENS CACHAN - BRETAGNE*, 2013.

[24] A. O. M. Y. J. T. María Teresa González-Aparicio, "Transaction processing in consistency-aware user's applications deployed on NoSQL databases," *Human Centric Computer Information System*, vol. 7, no. 7, pp. 2-18, 2017.

[25] S. L. R. C. a. O. H. S. P. Kumar, "Consistencylatency trade-off of the libre protocol: A detailed study," *Advances in Knowledge Discovery and Management*, vol. 7, pp. 83-108, 2018.

[26] L. L. a. S. S. E. Casalicchio, "Energy-aware autoscaling algorithms for cassandra virtual data centers," *Cluster Computing*, vol. 20, no. 3, pp. 2065-2082, 2017.

[27] G. Harrison, "Consistency models," in *Next Generation Databases: NoSQL, NewSQL and Big Data*, Berkeley, CA: Apress, 2015, pp. 127-144.

[28] ScyllaDB, "ScyllaDB Documentation - Consistency," 19 01 2023. [Online]. Available: https://docs.scylladb.com/stable/cql/consistency.html. [Accessed 19 02 2023].

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Hairy cell leukemia with atypical presentation and hematemesis; a case report

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Abstract

Introduction: Hairy Cell Leukemia (HCL) is a rare lymphoid neoplasm categorized as a lymphoproliferative disorder being B-cell clonal neoplasm characterized by V600E *BRAF* mutation in >80% of cases, B cell expression of CD20, CD22y CD11c, and T cell expression of CD103, CD25, CD123, CD72 y FMC7. HCL classically presents with pancytopenia, bone marrow infiltration, splenomegaly and hepatomegaly with subsequent ailments due to the trilineage failure. However, several clinical rarities of the HCL have been reported frequently in the literature. **Case:** We report a 45 years old Sudanese man who presented with a history of long-standing fever, chronic generalized fatigability and dyspnea, night sweating and significant weight loss. Associated with peripheral neuropathic pain and bone pain and more recently hematemesis of fresh, non-clotted, painless blood. Physical examination of the patient was positive for jaundice, splenomegaly and hepatomegaly. Upper GI endoscopy was negative for any lesions, abdominal US showed no evidence of portal HTN nor stigmata of hepatic cirrhosis or veno-occlusive diseases. Coagulation profiles were normal, and full blood count with peripheral blood picture revealed pancytopenia with hairy cells. Bone marrow cytometry showed a heterogeneous population with strong CD45 and moderate SS (hairy cells =19.7%) The lymphocyte population was positive for B-cell marker: CD20 (strong) and negative for CD3. **Discussion:** HCL presentation with hematemesis is considered extremely uncommon and unique to encounter; several unusual presentations of HCL has been described but this one is considered a rarity. Absence of organomegaly, skeletal and neurological involvement are all considered atypical presentations and fully present in our patient's case. These variations in the clinical picture of HCL are highly associated-with by concomitant aberrancies in the immunophenotypic aberrancies which requires cytometric/immunohistochemical patterns. **Conclusion:** This report reflects the highly complexed and overlapping pathological and clinical picture of HCL which resembles a significant dilemma and challenge for early clinical recognition and pathological diagnosis of the condition. High clinical and diagnostic agilities is recommended to extract such high rarities of presentation

Keywords: Hairy Cell Leukemia, Hematemesis, Pancytopenia, BRAFp.V600E

Introduction

Hairy Cell Leukemia (HCL) is an unusual, indolent, low-grade mature B cell tumor with a typical clinical, immunophenotypic, morphological and more recently described molecular (BRAF p.V600E mutation) profile [1]. It was first described as a clear entity and received a distinct pathological description by Bouroncle and colleagues in 1958 [2,3]. Now, and with 2 to 3% representation of all leukemias types, HCL has an estimated incidence of 600 to 1600 cases per year with a male to female, Caucasian ethnicity, and middle age predominance of distribution [4,5]. Since it's recognition, several molecular and biological features have been frequently implicated in the pathogenesis, disease progression and clinical variation of HCL, specifically (*BRAF* V600E) kinase-activating mutation, which is somatically and clonally present in almost all patients through the entire disease spectrum and clinical course [6,]. By aberrantly activating the RAF-MEK-ERK signaling pathway, BRAF V600E shapes key biologic features of HCL, including its specific expression signature, hairy morphology, and antiapoptotic behavior [6,7]. Several studies have targeted the epidemiology and risk factors involved the etiology of HCL with the vast majority pointing out environmental and occupational exposures as potential contributors in the pathogenesis of the condition specifically exposure to fuel, organic dissolvent, farming pesticides and herbicide [8]. And while World Health Organization (WHO), classifies HCL as a lympho-proliferative disease within mature B-cell neoplasia, Immuno-phenotyping of HCL obtained via flowcytometry comprehends B cell expression of CD20, CD22y CD11c, and T cell expression of CD103, CD25, CD123, CD72 y FMC7. [9]

Clinically, HCL presents with symptoms and signs attributable to pancytopenia which is caused by marrow failure following infiltration of the bone marrow by leukemic cells; causing anemia, and increased frequency and severity of infections [10]. Symptoms and signs due to organs infiltration are also common to encounter and include splenomegaly, hepatomegaly (less common), with accompanying constitutional symptoms of fever, fatigability, night sweat and weight loss of varying degrees. [10,11]

The clinical picture of un-explained hematemesis, peripheral neuralgia, and generalized bone pain is considered bizarre and widely atypical for hairy cell leukemia. We aim by introducing such rare traits of a well-recognized pathology to greatly contribute to both scientific and clinical literature of leukemia, for better understanding of the disease and subsequent advancement in the preventive, diagnostic, prognostic and curative measures.

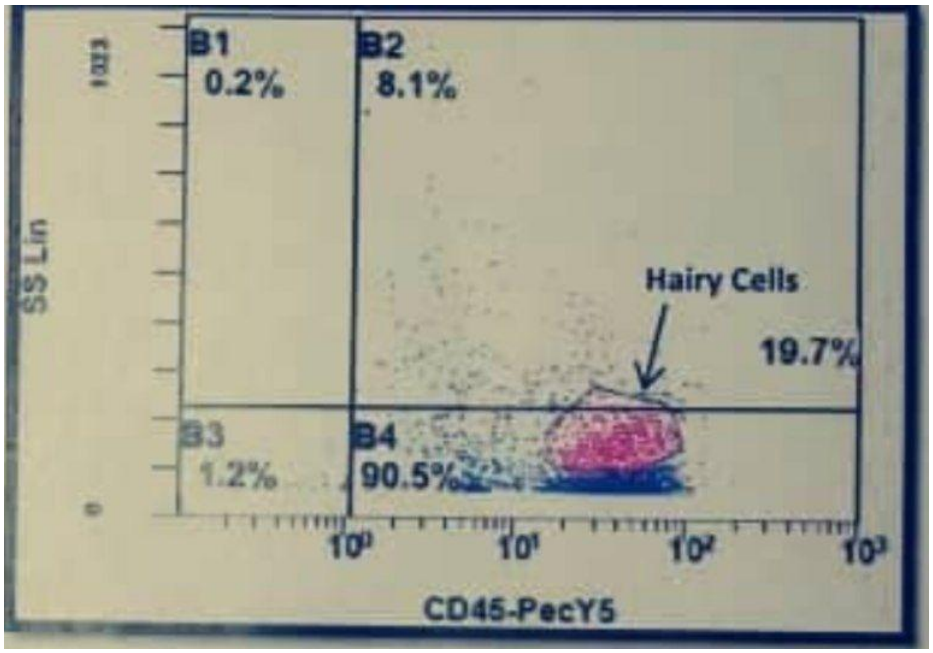
Case Presentation:

We report a 45 years old Sudanese man from Al-Alyab village in river Nile state, who presented with a history of chronic generalized fatigability associated with peripheral neuropathic pain that is paroxysmal, bricky in nature (pins and needles) and of blotchy distribution throughout the body with no associated hypoesthesia or hypoalgesia and no potentiality to be evoked nor exacerbated by any of the patient's routine activities. The patient recalls a worsening generalized fatigability up to 1 year prior to presentation, followed by development of excruciating attacks of previously outlined neuropathic pains and a concomitant bone pains for the past 6 months. Bone pain is deep, dull and core in nature. Distributed primarily over long bones of the limbs, with minimal joint involvement as with no joint effusion, redness or restriction of movement.

Constitutional symptoms resembled a significant fraction of the patients' complaints. A long-standing fever, exertional fatigability and dyspnea, night sweating and significant weight loss with multiple attacks of mild to moderate upper respiratory tract and gastrointestinal infections. The patients' complaints have followed a worsening course for the past three months period; during which the patient suffered multiple bouts of hematemesis of fresh, non-clotted, painless blood of varying amount and no associated abdominal symptoms

On examination, the patient looks wasted, pale, and jaundiced with huge splenomegaly and hepatomegaly and there are no features suggestive of liver cirrhosis or chronic liver disease. Upper Gastrointestinal endoscopy was done and revealed no gastric or peptic ulceration or esophageal varices. Abdominal ultrasound revealed moderate hepatosplenomegaly with moderate right side pleural effusion.

The viral screening was negative (HCV, HBs Ag, HIV 1 and 2), coagulation profiles were normal, and full blood count with peripheral blood picture revealed pancytopenia with hairy cells. Bone marrow examination showed MPS with a high suspension of HCL then immediately the patient was sent for flow cytometry where it showed CD45/55 histogram showed a heterogeneous population with strong CD45 and moderate SS (hairy cells =19.7%) **[Figure 1]**. The lymphocyte population was positive for B-cell marker: CD20 (strong) and negative for CD3. Diagnosis was confirmed and the patient was referred to the oncology department to initiate the standardized regimen of chemotherapy.



[Figure 1]: Flow cytometry test showed positive B-cell marker (CD 20 strong) and negative CD3 compatible to hairy cells leukemia

Discussion:

Hairy Cell Leukemia (HCL) is an uncommon, indolent lymphoid neoplasm that falls under the categorization of lymphoproliferative disorders as B-cell clonal neoplasm; making only about 2% of total leukemia cases worldwide [1,3]. There has been a considerable rise in the scientific literature and reports aiming to contemplate the pathogenesis and disease progression and modulating factors of HCL, particularly the recent discovery of the presence of the V600E *BRAF* mutation in the vast majority of cases of classic Hairy cell leukemia has suggested that the pathogenesis of this disorder lies in the RAS-RAF-MAPK signaling pathway. Constitutive activity of this pathway causes increased cellular proliferation and survival, and, ultimately, malignancy [12]. In addition, several other studies referred to *CDKN1B* to have a consistent inactivation in 16% of patients with classical HCL. Making it the second most commonly mutated gene in HCL. [6,12,13,14]

HCL classically presents with pancytopenia, bone marrow infiltration, splenomegaly and hepatomegaly with concomitant system ailments related to each (abdominal pain from organomegaly, anemia and anemic heart failure and septic

attacks and from marrow failure) [5,7]. However, splenomegaly may not be present in acute phase of the illness, and patients may not have pancytopenia. The incidence of the disease with no splenomegaly in various series ranged from 0% to 40% [7]. For these relatively significant percentages, several report and studies concluded that the mere absence of hepatosplenomegaly should not exclude or overlook HCL in the clinical differential diagnosis. [15,16]

Another HCL-associated features that are typically present in our patient and have been frequently reported in the literature are bone involvement and neuropathic pain [17,18]. Although, skeletal bone involvement is considered to some extent a rarity, such encounters have been found in 3% of cases, showing primarily lytic lesions affecting multiple sites with preferences to ends of the long bones – with an associated non-deforming arthropathy occasionally - and with almost always extensive involvement of the bone marrow [19,20]. One particular association that has been frequently reported with the atypical presentations of HCL is the low hairy cell counts obtained in peripheral picture and bone marrow aspirates; ranging from relatively low to almost scanty levels [21].

And while the patient we're reporting exhibited almost all the classical and diagnostic features of HCL, presentation with hematemesis is considered extremely uncommon and unique to encounter; especially with the uncertainty of the origin of the hematemesis having both upper GI endoscopy and coagulation studies normal with no evidence of any of the well-recognized risk factors or associations of upper GI bleeding. Such rarity could be explained by and by the well documented autoimmune phenomena that are frequently reported with HCL; including vasculitis, anti-phospholipid syndrome and thrombotic tendencies, rendering the superficial mucosal and submucosal vessels; fragile and highly prone to stress and shearing forces, and also the tumor-induced uncontrolled microvascular angiogenesis and varying states of endothelial dysfunction [22,23].

These vast variations in the clinical picture and pathological presentations of HCL are highly associated-with a strong-correlation by concomitant aberrancies in the immunophenotypic aberrancies. For this careful interpretation and special considerations should be taken when obtaining flow cytometric/immunohistochemical patterns in such cases to prevent misdiagnosis and further unwanted complications [9,17,24]

Conclusion

This report illustrates an unusual presentation of HCL with hematemesis. HCL is an indolent, low-grade mature B cell tumor with a typical clinical, immunophenotypic, morphological pattern that classically present with bone marrow infiltration, trilineage bone marrow failure and hepatosplenomegaly. Unusual or atypical clinical presentations are not uncommon to encounter in HCL and several of which have been reported; including bony involvement, asymptomatic course with ruptured viscus, neurological involvement and several others. For this, careful consideration should be taken in the management and stratification of HCL from early clinical suspicion to diagnosis and management,

Declaration of conflict of interest

No conflict of interest

Ethical approval

Obtained from federal Ministry of Health

Patient consent

Written consent was obtained from patient for the publication of this case report and any accompanying images. A copy of the written consent is available for review by Editor in chief of this journal.

Authors Contribution Statement:

Dr. Osama khder is the prime investigator, supervised the entire clinical and scientific duties; provided the framework for optimum theoretical, methodological, monitoring and evaluation approaches.

Dr. Mansour siddeeg Suraj , Dr. Abrar Almubark Abdalhafiz Abdalbasit , Dr. Afaf Ali Abdalrahim Alamin were directly responsible for data management, data acquisition and analysis and theoretical conceptualization,.

Mohammed Elmujtba Adam Essa Adam and Dr. Ahmed Babikir were responsible for data interpretation, analytical duties, manuscript preparation, initial and final draft delivery and communication with the concerned parties.

References

1. Paillassa J, Maitre E, Troussard X. Hairy Cell Leukemia (HCL) and HCL Variant: Updates and Spotlights on Therapeutic Advances. Current oncology reports. 2022 Apr 11. PubMed PMID: 35403971.
2. Grever M, Blanchy S, Andritsos A (2014) Hairy cell leukemia: update on molecular profiling and therapeutic advances. Blood reviews 28: 197-203.
3. Troussard X, Maitre E, Cornet E. Hairy cell leukemia 2022: Update on diagnosis, risk-stratification, and treatment. American journal of hematology. 2022 Feb 1;97(2):226-36. PubMed PMID: 34710243.
4. Bohn JP, Neururer S, Pirklbauer M, Pircher A, Wolf D. Hairy Cell Leukemia Patients Have a Normal Life Expectancy-A 35-Year Single-Center Experience and Comparison with the General Population. Cancers. 2022 Feb 28;14(5). PubMed PMID: 35267550. Pubmed Central PMCID: 8909617.
5. Arora N, Nair S, Pai R, Nair S, Ahmed R, Abraham A, et al. V-raf murine sarcoma viral oncogene homolog B (BRAF) mutations in hairy cell leukaemia. Indian Journal of Pathology and Microbiology. 2015;58(1):62.
6. Tiacci E, Pettirossi V, Schiavoni G, Falini B. Genomics of Hairy Cell Leukemia. *J Clin Oncol*. 2017 Mar 20. 35 (9):1002-1010.
7. Sandes AF, de Lourdes Chauffaille M, Oliveira CRM, Maekawa Y, Tamashiro N, Takao TT, et al. CD200 has an important role in the differential diagnosis of mature B-cell neoplasms by multiparameter flow cytometry. Cytometry Part B: Clinical Cytometry. 2014;86(2):98-105.
8. Teras LR, DeSantis CE, Cerhan JR, Morton LM, Jemal A, Flowers CR. 2016 US lymphoid malignancy statistics by World Health Organization subtypes. *CA Cancer J Clin*. 2016 Sep 12.
9. Rudolf-Oliveira M, Pirolli M, Santos de Souza F, Michels J, Santos-Silva C (2015) Hairy cell leukemia variant: the importance of differential diagnosis. Rev Bras HematolHemoter 37:132-135.
10. Shaffer AL, 3rd, Young RM, Staudt LM. Pathogenesis of human B cell lymphomas. Annual review of immunology. 2012;30:565-610. PubMed PMID: 22224767. Pubmed Central PMCID: 7478144.
11. Shao H, Calvo KR, Gronborg M, Tembhare PR, Kreitman RJ, Stetler-Stevenson M, et al. Distinguishing hairy cell leukemia variant from hairy cell leukemia: development and validation of diagnostic criteria. Leukemia research. 2013 Apr;37(4):401-9. PubMed PMID: 23347903. Pubmed Central PMCID: 5575750.

12. Dietrich S, Hüllein J, Lee SC, Hutter B, Gonzalez D, Jayne S, Dyer MJ, Oleś M, Else M, Liu X, Słabicki M, Wu B, Troussard X, Dürig J, Andrulis M, Dearden C, von Kalle C, Granzow M, Jauch A, Fröhling S, Huber W, Meggendorfer M, Haferlach T, Ho AD, Richter D, Brors B, Glimm H, Matutes E, Abdel Wahab O, Zenz T. Recurrent CDKN1B (p27) mutations in hairy cell leukemia. Blood. 2015 Aug 20;126(8):1005-8. doi: 10.1182/blood-2015-04-643361. Epub 2015 Jun 11. PMID: 26065650.

13. Taylor J, Xiao W, Abdel-Wahab O. Diagnosis and classification of hematologic malignancies on the basis of genetics. Blood. 2017 Jul 27;130(4):410-423.

14. Kreitman RJ, Arons E. Update on hairy cell leukemia. Clin Adv Hematol Oncol. 2018 Mar;16(3):205-215.

15. Rahman K, Kumari S, Singh MK, et al. Atypical presentation of hairy cell leukemia: significance of CD200 on flow cytometry. *J Cancer Res Ther*. 2018;14:1130–4. doi: 10.4103/0973-1482.188432

16. Alfaraj M, Alsaeed H. Hairy cell leukemia: a case report of atypical presentation without splenomegaly. *Blood Res.* 2017;52:139–41. doi: 10.5045/br.2017.52.2.139.

17. Yonal-Hindilerden I, Hindilerden F, Bulut-Dereli S, Yıldız E, Dogan IO, Nalcaci M. Hairy Cell Leukemia Presenting with Isolated Skeletal Involvement Successfully Treated by Radiation Therapy and Cladribine: A Case Report and Review of the Literature. Case Rep Hematol. 2015; 2015: 803921.

18. Rossi D, Franceschetti S, Cerri M, Conconi A, Lunghi M, Capello D, et al. Hairy cell leukaemia complicated by anti-MAG paraproteinemic demyelinating neuropathy: resolution of neurological syndrome after cladribrine treatment. Leukemia research. 2007 Jun;31(6):873-6. PubMed PMID: 17007925.

19. Tadmor T, Polliack A. Unusual clinical manifestations, rare sites of involvement, and the association of other disorders with hairy cell leukemia. Leuk Lymphoma. 2011; 52: 57-61.

20. McKay MJ, Rady KL, McKay TA. Hairy cell leukaemia variant with periarticular joint infiltration and excellent radiotherapy response. Annals of translational medicine. 2017 Apr;5(7):162. PubMed PMID: 28480198. Pubmed Central PMCID: 5401679.

21. Venkatesan S, Purohit A, Aggarwal M, Manivannan P, Tyagi S, Mahapatra M, Pati HP, Saxena R. Unusual presentation of hairy cell leukemia: a case series of four clinically unsuspected cases. Indian J Hematol Blood Transfus. 2014 Sep;30(Suppl

1):413-7. doi: 10.1007/s12288-014-0442-9. Epub 2014 Aug 17. PMID: 25332634; PMCID: PMC4192250.

22. Dasanu CA, Van den Bergh M, Pepito D, Alvarez Argote J. Autoimmune disorders in patients with hairy cell leukemia: are they more common than previously thought? Curr Med Res Opin. 2015 Jan;31(1):17-23. doi: 10.1185/03007995.2014.971358. Epub 2014 Oct 17. PMID: 25265129.

23. Hasler P, Kistler H, Gerber H. Vasculitides in hairy cell leukemia. Seminars in arthritis and rheumatism. 1995 Oct;25(2):134-42. PubMed PMID: 8578313.

24. Pattnaik SA, Padhi S, Chhabra G, Panigrahi MK, Das PK, Bhola RK, Mishra S. Atypical presentation of hairy cell leukemia: a report and comprehensive review. Blood Res. 2020 Jun 30;55(2):123-127. doi: 10.5045/br.2020.2020069. PMID: 32408416; PMCID: PMC7343552.

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RESEARCH ARTICLE

Hematinix Status IN Breast Cancer Patients in Sudan

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Abstract

Breast cancer is a major public health problem in both developed and developing countries (1) with more than one million new cases diagnosed annually.(2) Breast cancer remains a common and frequency fatal disease More than (1.2 million) women are diagnosed with breast cancer annually worldwide. In developed countries, most patients (>80%) with breast cancer present with operable disease that can apparently be entirely resected surgically. (3) This is a prospective cross-sectional descriptive study based on laboratory data of (136) patients with breast cancer carried out from (2012-2017) in Nuclear Medicine and Cancer Research centre - Shendi University and Nuclear Medicine and Cancer Research Centre - Aljazeera University, which aimed to evaluate hematinix status in breast cancer patients in Sudan. The investigations were performed on serum sample obtained from venous blood sample drawn in plain container for vitamin B12, folic acid and ferritin by using ELISA techniques.

Regarding the hematinix status in breast cancer patients, the mean of vitamin B12, folic acid and ferritin was (364.6 pg/ml), (7.5 ng/ml) and (189.9 ng/ml) respectively. The study conducted that ferritin level was elevated in breast cancer patients with highly statistical significant differences regarding anemic status, vitamin B12 and folic acid levels were within normal range in study population

Keywords: Breast cancer, Vitamin B12, Folic acid, Ferritin.

INTRODUCTION:

Breast cancer is the uncontrolled growth of abnormal cells in the breast. As with other forms of cancer, breast cancer is considered to be a result of malfunctioning DNA due to damage or inherited

mutation. Breast cancer is a disease that typically develops in women; however, it is also possible, although rare, for breast cancer to develop in men. According to the World Health Organization (WHO), more than (1.2 million) people worldwide will learn breast cancer this year. [4]

The risk of breast cancer is low in the low-income regions of Sub-Saharan Africa and in Asia, including Japan where the probability of developing breast cancer by the age of (75 years) is (1/3rd) that of other high-income countries. [5]

Clear increases in the incidence of, and mortality from, breast cancer were observed up to the early 1980s in both high-income and low-income countries. The subsequent advent of early detection and screening programmes in high-income countries altered the reported rates of both incidence and mortality, masking trends in the underlying risk for the disease. Mortality rates for breast cancer in Western Europe and North America are in the order of (15–25/100 000) women, being slightly more than a (1/3rd) of the incidence rate, which is approximately (50–60 /100 000). [5]

METHODS:

This is a prospective cross-sectional descriptive study based on laboratory data of (136) patients with breast cancer carried out from (2012-2017) in Nuclear Medicine and Cancer Research centre - Shendi University and Nuclear Medicine and Cancer Research Centre - Aljazeera University. The investigations were performed on serum sample obtained from venous blood sample drawn in plain container for vitamin B12, folic acid and ferritin by using ELIZA technique.

Vitamin B12 quantitative test is based on the principle of the enzyme linked immunosorbent assay. An antibody directed against vitamin B12 is bound on the surface of a microtiter plate. Vitamin B12 containing samples or standards and a vitamin B12-peroxidase conjugate are given into the wells of the microtiter plate. Enzyme labelled and free vitamin B12 compete for the antibody binding sites. After one hour incubation at room temperature, the wells are washed with diluted washing solution to remove unbound material. A substrate solution is added and incubated for 20 minutes, resulting in the development of a blue colour. The colour development is inhibited by the addition of a stop solution, and the colour turns yellow. The yellow colour is measured photometrically at 450 nm. The concentration of vitamin B12 is indirectly proportional to the colour intensity of the test sample. [6]]

Folic acid is bound to the surface of the microtitre plate. Samples, standards and a mouseanti-folic acid antibody are added to the wells. During following 1 hr incubation at room temperature competition takes place between folic acid fixed on the plate and folic acid in the solution. Unbound material is washed away and an anti-mouse-IgG-HRP antibody is added, which binds only to mouse

antibody bound on the plate. This technique offers the advantage that the HRP enzyme is not affected by interfering substances. After 1 hr incubation at room temperature any unbound material is washed away carefully and a colourless substrate is added. Blue colour is formed during following 20 min incubation which is stopped after 20 min by acid addition. Solution turns from blue to yellow. Optical density is measured at 450 nm with a plate reader, and the folic acid concentration is calculated against the standard curve. The colour intensity is indirect proportional to the concentration of Folic Acid in the sample, i.e. the less Folic Acid was in the sample the more conjugate could be bound and this causes a deeper colour.(6)

Ferritin Quantitative Test is based on a solid phase enzyme-linked immunosorbent assay (ELISA). The assay system utilizes one rabbit antiferritin antibody for solid phase (microtiter wells) immobilization and a mouse monoclonal anti-ferritin antibody in the antibody-enzyme (horseradish peroxidase) conjugate solution. The test sample is allowed to react simultaneously with the antibodies, resulting in the ferritin molecules being sandwiched between the solid phase and enzyme-linked antibodies. After a 45-minute incubation at room temperature, the wells are washed with water to remove unbound-labeled antibodies. A solution of TMB Reagent is added and incubated at room temperature for 20 minutes, resulting in the development of a blue color. The color development is stopped with the addition of Stop Solution, and the color is changed to yellow and measured spectrophotometrically at 450 nm. The concentration of ferritin is directly proportional to the color intensity of the test sample. (7)

RESULTS:

The age of women in the study was ranged between (17 to 85) years with mean of (50.2) years, most of study populations were in the age between thirty to sixty years old as demonstrate in (figure .1).

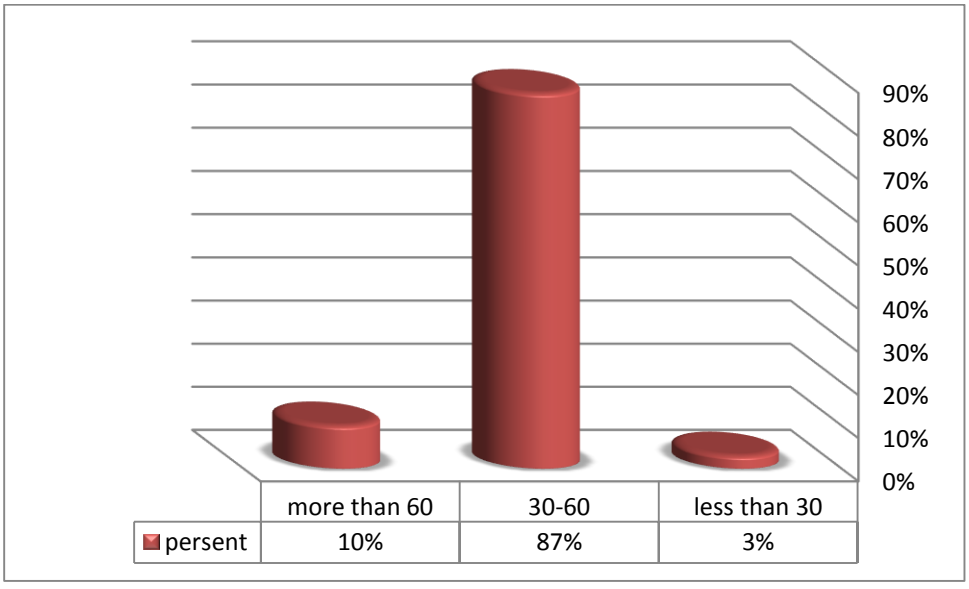

Figure (1): Distribution of age per years among study group

The nutritional substance level in breast cancer patients were illustrated in (table 1), as the mean of vitamin B12, folic acid and ferritin was (364.6 pg/ml), (7.5 ng/ml) and (189.9 ng/ml) respectively.

Table (1): Nutritional substances in breast cancer patients:

Parameter	Mean	Normal range
Vitamin B12	364.6	200.0-835.0 pg/ml
Folic acid	7.5	2.0 – 20.0 ng/ml
Ferritin	189.9	10.0-120.0 ng/ml

The mean of vitamin B12 level in anaemic and non anaemic breast cancer patients was (400.4 pg/ml), (331.1 pg/ml) respectively, while the mean of folic acid level in anaemic and non anaemic breast cancer patients was (8.3 ng/ml), (6.8 ng/ml) respectively, and the mean of serum ferritin level in anaemic and non anaemic breast cancer patients was (274.5 ng/ml), (119.9.1 ng/ml) respectively as displayed in (table 2).

Table (2): Nutritional substances in anaemic and non anaemic breast cancer patients:

Parameter	Status	Mean	Standard deviation	P.value
Vitamin B12	Anaemic	400.4 pg/ml	154.4	0.004
	Non anaemic	331.1 pg/ml	43.0	
Folic acid	Anaemic	٨.٣ ng/ml	3.8	0.077
	Non anaemic	٦.٨ ng/ml	4.1	
Ferritin	Anaemic	274.5 ng/ml	٣١.٦	0.001
	Non anaemic	119.9 ng/ml	١٤.٠	

DISCUSSION:

Breast cancer is the most frequently diagnosed and the leading cause of cancer death in women globally. Over the past few decades its incidence has increased but a fall in mortality has been observed due to improvement in survival which is associated with earlier disease detection, a multidisciplinary approach to treatment and biological changes that have made the disease more susceptible to hormonal therapy.

Regarding to the relationship between nutritional substance and anaemic status and different types of anaemia in breast cancer patient, the present study revealed that the mean of vitamin B12 level in microcytic, normocytic and macrocytic anaemic breast cancer patients was (411.3 pg/ml), (383.8 pg/ml) and (463.0 pg/ml) respectively, no statistically significant variation was observed with P.value of (٠.٧٨٨), while the mean of folic acid level in microcytic, normocytic and macrocytic anaemic breast cancer patients was (9.0 pg/ml),(7.5 pg/ml) and (8.1 pg/ml) respectively, no statistically significant variation was observed with P.value of (٠.٤٦٨), and the mean of ferritin level in microcytic, normocytic and macrocytic anaemic breast cancer patients was (286.1 ng/ml), (235.4 ng/ml) and (1000.0 ng/ml) respectively, no statistically significant variation was observed with P.value of (٠.١١٠). The folic acid level did not differ significantly between anemic (8.3 ng/ml) and non-anemic cancer patients (6.8 ng/ml), as the p value was (0.077). The mean of vitamin B12 level in anemic and non-anemic cancer patients was (400.4 pg/ml), (331.1 pg/ml) respectively with p value of (0.004), although the two means were fall within normal range of B12, so there was statistically significant difference, the slightly increase of vitamin B12 level among anaemic compared with non anaemic may be due abnormal vitamin B12 absorption and metabolism.

The present study revealed that the mean of serum ferritin level in anaemic and non-anaemic breast cancer patients was (274.5 ng/ml) and (119.9.1 ng/ml) respectively, with p value of (0.001), so there was highly statistical significant difference. The elevated serum ferritin level among breast cancer patients was in agreement with Sandhya Mishra and his colleagues in India [(8)], the reasons for high serum ferritin levels in patients with malignant disease are still far from clear. The evidence suggests that, while patients with early breast cancer have serum ferritin concentrations somewhat higher than normal, this could result from the non-specific effect of malignancy on RE iron metabolism. Jones and his colleagues pointed out that neoplasia is commonly associated with an abnormality of iron metabolism which manifests itself by a low serum iron concentration, an increase in RE iron and the anaemia of chronic disease . [(9)]

CONCLUSION:

From this study we can conclude that, the ferritin level was elevated in anemic patients with highly statistical significant differences regarding anemic status. Vitamin B12 and folic acid levels were within normal range in study population.

REFERENCE:

1. Parkin DM, Bray F, Ferlay J, Pisani P. Global cancer statistics, 2002. CA: a cancer journal for clinicians. 2005;55(2):74-108.

2. Pisani P, Bray F, Parkin DM. Estimates of the world-wide prevalence of cancer for 25 sites in the adult population. International journal of cancer. 2002;97(1):72-81.
3. Beeson D, Lippman A. Egg harvesting for stem cell research: medical risks and ethical problems. Reproductive BioMedicine Online. 2006;13(4):573-9.
4. Sandhu TKM, Goel P, Singh H. Image Denoising using Multiscale Ridgelet for application on Mammographic image. International Journal of Engineering Research and Applications (IJERA) Vol.1:537-41
5. Parkin DM, Bray F, Ferlay J, Pisani P. Estimating the world cancer burden: Globocan 2000. International journal of cancer. 2001;94(2):153-6
6. Ma E, Iwasaki M, Junko I, Hamada GS, Nishimoto IN, Carvalho SMT, et al. Dietary intake of folate, vitamin B 6, and vitamin B 12, genetic polymorphism of related enzymes, and risk of breast cancer: a case-control study in Brazilian women. BMC cancer. 2009;9(1):122.
7. Güner G, Kirkali G, Yenisey C, Töre IR. Cytosol and serum ferritin in breast carcinoma. Cancer letters. 1992;67(2):103-12.
8. Kerpsack JT, Finan MA. Thrombocytosis as a predictor of malignancy in women with a pelvic mass. The Journal of reproductive medicine. 2000;45(11):929-32.
9. .Ikeda M, Furukawa H, Imamura H, Shimizu J, Ishida H, Masutani S, et al. Poor prognosis associated with thrombocytosis in patients with gastric cancer. Annals of surgical oncology. 2002;9(3):287-91.

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Nursing teaching staff' knowledge and attitude regarding peer assisted learning at governmental faculties of nursing, Khartoum state 2022

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Abstract

Introduction: Peer assisted learning (PAL) is nontraditional strategy of learning that has a lot of creativity and innovation used to assist others to learn, and so doing learning by themselves is more effective **Methods**: 93 nursing teaching staff completed an online questionnaire out of 108 nursing teaching staff which was recruiting in seven governmental faculties of nursing in Khartoum state at the time of the study, the response rate was 86% (93). Data were collected using structure questionnaire after validation is confirm, which explored nursing teaching staff' knowledge about peer assisted learning. Frequencies distributions (mean, median, mode, SD. Minimum and maximum), weighted average to determine answer direction and one sample T test were used. **Results**: The study found that almost the nursing teaching staff responses significantly goes toward agree about the statement that test their knowledge about peer assisted learning as learning strategy, with (p value0.00). The study also showed that most of the nursing faculty did not use it in their teaching and learning strategies.**Conclusion:** Nursing teaching staff demonstrated positive knowledge and attitude towards peer assisted learning as learning strategy

Keywords: Peer assisted learning (PAL) - Knowledge – Attitude – Nursing – Teaching staff - Governmental faculties of nursing.

Introduction:

Learning is a complex process motivated by human nature that tends to search and discover new things and desire to upgrade learning level. This complexity can be facilitated as the differences between the learners and learning environment are considered. An open learning environment free from stress, pressure, fully mutual trust among students, in addition to easy informal communication, are motivating factors for students to increase learning outcomes. Many researchers found that working in groups allows students to be more active and fully engaged in the learning process.[1,2] Peer assisted learning (PAL) is one of the methods that increase student engagement, The social theorist stated that the individual relationship is either cooperative or competitive relationship. [3] PAL is nontraditional strategy(4) used to assist others to learn, in cooperative manner, Topping and his colleague in 1998 defined PAL as acquiring knowledge and skill through active support from other matched peers. [5] In PAL; one of the students plays the role of instructor (tutor) in providing information related to a topic, while the rest of the students become tutees. The teachers in the PAL act as guidance, provide answers to non-answered questions and help facilitate discussion and interaction.[6] Tutors are appointed according to their excellence in a specific topic,[4] literatures support that Peer learning can be peer-to-peer, that from the same level, or near peer from the above level, that is senior students tutoring junior students. [7] PAL has positive effects on examination score; student satisfaction; personal and professional development,[8] and peer tutoring can also encompass areas of social needs exhibited by students.[9] Nursing education is aimed to graduate competent and qualified nurses, capable to meet the needs of the contemporary healthcare.[10] Nurses are assumed to be self-dependent, leaders and at the same time accountable for their action.[11]. PAL has been

recognized as a valuable learning strategy enhancing these characteristics.[12] Douglas and others in 1997 and Lynn with others in 1999 studied the effectiveness of peer tutoring program in reading their finding showed that students engaged in PAL improve reading ability greater than compared to counterparts not involved in PALS.[13,14] In the field of medical education PAL approach is well known and familiar to both teachers and students.[15,16] All studies conducted on peer learning strategy have proven its effectiveness in acquiring knowledge as well as mastering various skills.[12,17] Many studies worldwide have evaluated the perception of students towards PAL and found that the students had positive perception about PAL as a method of teaching and learning.[18,19] In an ethnographic study to investigate the roles and relationships between the peer tutors and tutees to uncover their perceptions of peer tutoring and their perceived effects, the study prove that peer learning contributes to develop and increase a successful relationship between tutors and tutees.[20] Thinking about introducing a new approach requires knowledge about students and their capacity, resources and material, culture and environment, supervision and assessment as well as careful estimation of financing needs and cost. The researchers prove that the PAL approach helps to tackle all of these issues and requires less cost as there is no need for equipment.[5] Although the PAL approach offers many benefits, but it may show some drawbacks such as student's noise, complaints and cheating.[5] According to researchers application of PAL may face many challenges to both educators and students whether in classroom or clinical setting. In study carried out at Batterjee medical college; Saudi Arabia 2021 to identify the challenge of PAL in online clinical skills training of ophthalmology module in, the results revealed a group of challenges from the students' prospective, which are Learning environment, scheduling, psychological problems in terms of behavioral issues and personality changes, interaction deficit with peers, tutor, learning desires, and desire for feedback on

performance.[21] Sevanhhuysed and her colleagues in 2015 utilizing a focus group discussion to explore the experience of clinical educators PAL model. They found that the clinical educators were challenged by the mandated frequency of tasks and they perceived PAL as extra load. In addition to the learning experience, they have to aid in the logistics of learning situation arrangement.[22] A result of a randomized trail published in the journal of physiotherapy 2016 about educators and student's preference regarding the teaching model showed that educators and students prefer the traditional clinical education to PAL with similar students' performance outcomes in both models.[23] However, the findings in literature support that, PAL is still effective and interest method on student's learning and retention of knowledge, attitude and skill levels.[24] PAL can make substantial contribution to students by improving engagement in a learning process, and generally it is valuable and advisable strategy to be adopted in nursing curricula as it enhance social relationship and help students develop a better understanding of cultural diversity and acceptance. [6]

Materials and methods:

A descriptive cross – sectional-Institutional-based design was adopted in this study. It was conducted in Khartoum state, at governmental faculties of nursing, which include seven nursing faculties. Khartoum. Faculty of nursing Al-Neelain, University of Technology. Omdurman, Academy of Health Sciences. Bahray and Elzaim Azhary. A one hundred and eight (108) nursing teaching staff were eligible for participation as total coverage; ninety-three (93) teaching staff was responded to the questionnaire, with response rate 86%. The data were gathered using structured questionnaire, which was developed after extensive search in the literature. The tool has four parts. The first part contained the socio-demographic characteristics. The second part,

consist of two main axes that include questions related to knowledge twenty items. And attitude of the nursing teaching staff, which consist of five items. Five points Likert -scale was used to measure the response of the participants ranged from strongly agree to strongly disagree. The tool was reviewed by two experts in the field of medical education (External & internal), in addition to an expert statistician (contents, structure & suitability for analysis), the questionnaire was modified accordingly, then the developed tool was piloted for its validity and to determine the clarity of tool items and to estimate the time needed. Cronbach's Alpha to test the reliability was don which was. 0.830. The participants were invited and gathered in one of the social media groups. The self-administration technique was used, utilizing the free Google forms software to collect data. The link of the questionnaire was sent and remained open for 3 weeks. Frequencies distributions and charts were used to analyse demographic information; for section two frequencies distributions, descriptive (mean, SD), weighted average to determine answer direction and one sample T test were used; for section three & four the frequencies distributions (mean, median, mode, SD. Minimum and maximum were used. Data were presented in tables and figures, utilizing statistical package for social sciences (SPSS) version (23)

Results:

Table (1): Gender& years of experience distribution (N =93)

Gender		Frequency	Percent
	Male	4	4.3
	Female	89	95.7
	Total	93	100.0
Years of experience			
	3-7 years	42	45.2
	8-12 years	20	21.4
	13-17 years	14	15.1
	18 years and above	17	18.3
	Total	**93**	**100.0**

Table (2): Distributions and the results of nursing teaching staff Knowledge related Students' Benefits of PALS (N =93)

No.	First axes Nursing Students' Benefits related Knowledge towards PALS	Frequencies & ratio	Strongly disagree	disagree	Neutral	Agree	Strongly agree	Respond average	SD	Answer Direction
1	Methodology support learner	**f**	5	1	8	42	37	4.13	1.002	**Agree**
		%	5.4	1.1	8.6	45.2	39.8			
2	Small group learning method	**f**	4	7	4	60	18	3.87	0.958	**Agree**
		%	4.3	7.5	4.3	64.5	19.4			
3	Other students acting as mentors for facilitating	**f**	3	7	12	51	20	3.84	.959	**Agree**
		%	3.2	7.5	12.9	54.8	21.5			
4	Is participative activities	**f**	3	0	4	53	33	4.22	0.806	**Strongly Agree**
		%	3.2	0	4.3	57.0	35.5			
5	Encourages collaborative, rather than competitive learning ills	**f**	3	0	4	36	50	4.40	0.849	**Strongly Agree**
		%	3.2	0	4.3	38.7	53.8			
6	Benefits all students regardless of current academic competency	**f**	6	2	7	51	27	3.98	1.021	**Agree**
		%	6.5	2.2	7.5	54.8	29.0			
7	Gives privacy to practice the subject, make mistakes and build up confidence	**f**	2	7	12	46	26	3.94	.953	**Agree**
		%	2.2	7.5	12.9	49.5	28.0			
8	Encourages learner autonomy	**f**	3	0	10	48	32	4.14	.855	**Agree**
		%	3.2	0	10.8	51.6	34.4			

9	Enjoyable activities for students	**f**	6	9	16	49	13	3.58	1.056	**Agree**
		%	6.5	9.7	17.2	52.7	14.0			
	First axes result	**f**	**4**	**4**	**9**	**48**	**28**	**4.01**	**٠.939**	**Agree**
		%	**4.18**	**3.94**	**9.20**	**52.08**	**30.60**			

Table (3: The distributions and the results of nursing teaching staff' Knowledge related PAL strategy

No.	Second axes Nursing PAL Strategy related Knowledge	Frequencies & ratio	Strongly disagree	disagree	Neutral	Agree	Strongly agree	Respond average	SD	Answer Direction
1	Voluntary activities help learners	f	4	10	13	48	18	3.71	1.038	Agree
		%	4.3	10.8	14.0	51.6	19.4			
2	Is non-remedial activities	f	10	27	24	29	3	2.87	1.076	Unsure
		%	10.8	29.0	25.8	31.2	3.2			
3	Content - based and process- oriented	f	2	0	11	50	30	4.14	0.788	Agree
		%	2.2	0	11.8	53.8	32.3			
4	PAL strategy have empirical evidence to support its effectiveness	f	2	5	12	48	26	3.98	.909	Agree
		%	2.2	5.4	12.9	51.6	28.0			
5	Can be used in place of an existing instructional activity	f	1	1	20	49	22	3.97	.773	Agree
		%	1.1	1.1	21.5	52.7	23.7			
6	Gives opportunity to increase academic performance	f	3	2	7	43	38	4.19	.912	Agree
		%	3.2	2.2	7.5	46.2	40.9			
7	Used in place of an existing instructional activity	f	5	19	26	38	5	3.20	1.006	Unsure
		%	5.4	20.4	28.0	40.9	5.4			
8	Pro-active, not reactive	f	9	21	30	28	5	2.99	1.068	Unsure
		%	9.7	22.6	32.3	30.1	5.4			
9	Targets high risk courses, not high- risk	f	3	3	23	46	18	3.78	.907	Agree

	groups	%	3.2	3.2	24.7	49.5	19.4			
10	Decreases drop-out rates/aids retention	**f**	2	4	6	48	33	4.14	.880	**Agree**
		%	2.2	4.3	6.5	51.6	35.5			
11	Integrates effective learning strategies within the course content	**f**	3	2	10	39	39	4.17	.940	**Agree**
		%	3.2	2.2	10.8	41.9	41.9			
	Second axes result	**f**	**4**	**9**	**17**	**42**	**21**	**3.74**	**٠.936**	**Agree**
		%	**4.30**	**9.20**	**17.80**	**45.53**	**23.17**			

Table (4): The iterative distributions and the results of Nursing Teaching Staff Attitude towards PAL Strategy

No.	Third axes Nursing Teaching Staff Attitude towards PAL Strategy	Frequencies & ratio	Strongly disagree	disagree	Neutral	Agree	Strongly agree	Respond average	SD	Answer Direction
1	You use PAL in place of an existing instructional activity	f	5	5	13	55	15	3.75	.974	Agree
		%	5.4	5.4	14.0	59.1	16.1			
2	You identify and develop instructional materials to be used with PAL	f	4	7	13	53	16	3.75	.974	Agree
		%	4.3	7.5	14.0	57.0	17.2			
3	You develop a strategy for selecting students and/or assigning them to groups	f	4	9	13	48	19	3.74	1.031	Agree
		%	4.3	9.7	14.0	51.6	20.4			
4	You developed strategies to monitor students' performance during PAL	f	3	7	7	50	26	3.96	.977	Agree
		%	3.2	7.5	7.5	53.8	28.0			
5	You developed strategies to evaluate the effectiveness of PAL	f	4	5	11	49	24	3.90	.990	Agree
		%	4.3	5.4	11.8	52.7	25.8			
	First axes result	f	**4**	**7**	**11**	**51**	**20**	**3.82**	**٠.989**	**Agree**
		%	**4.30**	**7.10**	**12.26**	**54.84**	**21.5**			

Table (5): Test results (One Sample T-test) to indicate the level of nursing teaching staff's knowledge and attitude towards PALS.

The field	Mean	Std. Deviation	T-Test	Sig. (2-tailed)	The level Nursing teaching staff' knowledge and attitude towards PALS
Nursing teaching staff' knowledge and attitude towards PALS	3.854	0. 50746	16.225	0.000	High

Table (6): Using of PAL in nursing educational (N =93)

		Responses		
Using (PAL) strategy in teaching		N	Percent	Percent of Cases
If you use this strategy can you provide any example(s) of how you use PALS in your practice	I don't use it	79	84.9%	84.9%
	Yes	6	6.5%	6.5%
	Used in seminar	4	4.3%	4.3%
	log book	1	1.1%	1.1%
	By small groups	3	3.2%	3.2%
Total		**93**	**100.0%**	**100.0%**

Discussion

Nursing is a complex profession that requires an innovative and creative teaching and learning approaches to inspire, motivate and enhance students involved in the process of learning, which leads to preparing them for the future profession and taking full advantage of the learning outcomes. [25] The dominant teaching model in nursing curricula in studied faculties of nursing is

mainly reliant upon the conventional education; that is, the teacher center, with new and little approaches that involve students in the learning process such as TBL and PBL, this finding is similar to Sevanhhuysed and his colleague finding , they studied the educators and students preference regarding traditional clinical education to PAL, they found similar students' performance outcomes in both models, and both educators and students were more satisfied with traditional education. [23] Previous studies have documented that the PALS have a long history as a pedagogical approach in kindergarten, primary and secondary schools and even for those with disabilities. [26] And in medical education; prior works have documented the effectiveness of peers when involved in the process of learning in improving the academic performance, enhancing the learning outcomes, and reducing distraction of information as well as improving social skills; Bugaj and Topping, for example, reports that this strategy is a well-established concept in the medical training in general and nursing in particular. However, these studies have not focused on the teacher's perception and knowledge nor barriers that may challenge its implementation. In this study we explore the knowledge and attitude of the Sudanese nursing teaching staff towards peering assisted leaning, and how they use this method. We found that in virtually the nursing teaching staff responses significantly goes toward agree about the statement that test how well they know the benefits students get when applying the PAL strategy (P value 0.00); also most responses of teaching staff about general knowledge related PAL as strategy is positive (P value 0.00), however 21%of respondents unsure that PAL can be used in place of an existing instructional activities. And 32% of respondents are unsure whether PALS is a proactive or reactive approach. The current study shows positive teaching staff' attitude towards peer assisted learning with (P value 0.00); this results aligned with the role of teaching staff when conducting PAL as they function as coordinator in designing, planning, curriculum alignment,

delivery, and evaluation in addition to responsibility to make sure all opportunities are made available for students to practice these teaching skill, [7, 27] which requires that they be familiar with this strategy. This study found that 84% of respondents they did not use this methods with their students because they believed that peer-mediated learning challenged with an ethical aspect, traditional culture may not accept new approaches and it takes time to prepare for session. Almost these responses in the line with Sevanhhuysed et al' beliefs, where they found that the clinical educators challenged by the mandated frequency of tasks in the PAL model, and they perceived PAL as extra load and burden for them [22]., while the rest of respondents said that they used it in a seminar, small group, and others, these findings are contrary to what is available in literature. This method became popular, dominant and familiar to the teachers with positive perception as well as to students. [5, 15] The literature search produced little research on teachers' knowledge and attitude about PAL as a learning method. To my knowledge, this is the first study to explore nursing teaching staff's knowledge, attitude towards PAL in nursing education in Sudan. Our results provide base data to attract the attention of teaching staff in medical education in general and nursing in particular to adopt and implement this strategy in education.

ETHICAL APPROVAL:

A written ethical agreement was obtained from the research ethics committee at International University of Africa (REC). Hence verbal consent was attained individually from each nursing teaching staff after full explanation and details about the study and its aim; confidentiality and data privacy were guaranteed.

References:

1. Ibrahim Iael, Sleem Wf. Team Based Learning: An Innovative Teaching Strategy for Enhancing Students' Engagement International Journal for Innovation Education and Research. 2018;6.

2. Branson S, Boss L, Fowler DL. Team-based learning: Application in undergraduate baccalaureate nursing education. Journal of Nursing Education and Practice. 2016;6(4):59.

3. Gillies rm, Fashman a. Co- oprative learning :the social and intellectual outcomes of learning in group. London Routledge Falmer; 2003.

4. W.Herrman J. Creative Teaching Strategies for the Nurse Educator. United States of America: F. A. Davis Company 2008.

5 . Topping K, Ehly S. Peer-Assisted Learning. New York Routledge 2009.

6. Wessel A. Peer Learning Strategies in the Classroom Journal on Best Teaching Practices 2015; 2(1).

7. Burgess A, van Diggele C, Roberts C, Mellis C. Planning peer assisted learning (PAL) activities in clinical schools. BMC Medical Education. 2020;20(2):1-7.

8. Ryder G, Russell P, Burton M, Quinn P, Daly S. Embedding peer support as a core learning skill in higher education. Journal of information literacy. 2017;11(1).

9. . Glynn LG, MacFarlane A, Kelly M, Cantillon P, Murphy AW. Helping each other to learn–a process evaluation of peer assisted learning. BMC medical education. 2006;6(1):1-9.

10. Felton A, Royal J. Skills for nursing practice: Development of clinical skills in pre-registration nurse education. Nurse education in practice. 2015;15(1):38-43.

11. . Furlong E, Smith R. Advanced nursing practice: policy, education and role development. Journal of clinical nursing. 2005;14(9):1059-66.

12. Goldsmith M, Stewart L, Ferguson L. Peer learning partnership: An innovative strategy to enhance skill acquisition in nursing students. Nurse Education Today. 2006;26(2):123-30.

13. Fuchs D, Fuchs LS, Mathes PG, Simmons DC. Peer- assisted learning strategies:making classrooms more responsive to diversity. American Eductionl Reserch Journal. 1997;34(1).

14. Fuchs LS, Fuchs D, Kazdan S. Effect of peer assisted learning strategies on high school students with serious reading problems. Remidial and Special Education 1999;20(5).

15. . Guraya SY, Abdalla ME. Determining the effectiveness of peer-assisted learning in medical education: a systematic review and meta-analysis. Journal of Taibah University Medical Sciences. 2020;15(3):177-84.

16. Bugaj TJ, Blohm M, Schmid C, Koehl N, Huber J, Huhn D, et al. Peer-assisted learning (PAL): skills lab tutors' experiences and motivation. BMC medical education. 2019;19(1):1-14.

17. . Jawhari AA, Safhi MA, Magadmi MM, Alobaidi RH, Alghamdi KM, Basyouni RN, et al. Effect of Peer-Assisted Learning on Enhancing Clinical Research Skills Among Medical Students: Students' and Tutors' Perceptions. Advances in Medical Education and Practice 2021;12.

18. Jawhari AA, Safhi MA, Magadmi MM, Alobaidi RH, Alghamdi KM, Basyouni RN, et al. Effect of Peer-Assisted Learning on Enhancing Clinical Research Skills Among Medical Students: Students' and Tutors' Perceptions. Advances in Medical Education and Practice 2021;12.

19. Tenzin UW, Tshering N. A study of effectiveness of peer assisted learning strategy (PALS) as remedial program in 7th grade science Research Journal of Recent Sciences. 2019;8(3)

20. Chan NN, Phan C, Aniyah Salihan N, Dipolog-Ubanan G. Peer Assisted Learning in Higher Education: Roles, Perceptions and Efficacy. Pertanika Journal of Social Sciences & Humanities. 2016;24(4).

21. Nisar S, Mahboob U, Khan RA, Rehman D. Challenges of peer assisted learning in online clinical skills training of ophthalmology module. BMC medical education. 2021;21(1):1-6.

22. Sevenhuysen S, Farlie MK, Keating JL, Haines TP, Molloy E. Physiotherapy students and clinical educators perceive several ways in which incorporating peer-assisted learning could improve clinical placements: a qualitative study. Journal of Physiotherapy. 2015;61(2):87-92.

23. S S, EH S, FarlieMK, RaitmanL, NicksonW, KeatingJL, et al. Educators and students prefer traditional clinical education to a peer-assisted learning model, despite similar student performance outcomes: a randomised trial. Journal of Physiotherapy 2014;60.

24. Abedini M, Mortazavi F, Javadinia SA, Moonaghi HK. A new teaching approach in basic sciences: Peer assisted learning. Procedia-Social and Behavioral Sciences. 2013;83:39-43.

25. Dyson S. Critical Pedagogy in Nursing. . School of Health and Education Middlesex University London U, editor. UK

26. L. K, McMaster, Fuchs D, Fuchs. LS. Research On Peer-Assisted Learning Strategies: The Promise And Limitations Of Peer-Mediated Instruction,. Reading and Writing Quarterly 2006.

27. Burgess A, McGregor D, Mellis C. Medical students as peer tutors: a systematic review. BMC medical education. 2014;14(1):1-8.

Shendi University Journal of Applied Science, Issue (10) , June 2023 (11): p 131-140

Awareness and Attitude of Female About Harassment in Dar Almaali Secondary School River Nile state Sudan

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Abstract

Background: Harassment is identified by it is unlikelihood in term of social and moral reasonableness. In the legal sense, these are behaviors that appear to be disturbing , upsetting or threatening. **objectives** The main goal of this study to assess awareness and attitude regarding harassment among female in Dar Almaali secondary school in Shendi town .**Method:** This descriptive cross sectional community-based study was conducted in Shendi city Dar Almaali school for girls during the period extended from(November2021 to June 2022) .. Hundred female were selected usingSystematic samplingtechnique . Data of study variables were collected using pre-prepared questionnaire and scale to assess attitude ,and the resultswere analyzed using the Statistical Package of social sciences(SPSS)version(24) and presented in form of table and graphs. **Results**: The study showed that two third of study group had good knowledge about definition of harassment ,perpetrators of harassment, Harassment images and subjected to harassmentwhile most of them (98%) they aware about place of harassment . 72% and more than half of study group had positive attitude regarding harassment and female dress style as reason of harassment respectively . About reaction to harassment their positive attitude distributed in many response like multiplication, reporting to relative and ignoring. **conclusion**: the finding of the study pointed out that students had good knowledge about definition , causes and images of harassment and positive attitude regarding female dress style as reason of harassment. **Recommendation**: Ministry of Education should create awareness programs using social media,posters and short films to publish content that prevents the spread of harassment among student.

Key wards : attitude , awareness, **female , harassment** , **Student**

Introduction

Harassment covers wide range of behaviors of an offensive nature. It is commonly understood as behavior that demeans, humiliates or embarrasses aperson,and it is characteristically identified by its unlikelihood in terms of social and moral reasonableness. In the legal sense, these are

behaviors that appear to be disturbing,upsetting or threatening.[1]. When these behaviors become repetitive,itis defined as bullying.Thecontinuity or repetitiveness and aspectof distressing,alarming or threatening may distinguish it from insult[2].

Physical harassment behavior intimidates, embarrasses, threatens and makes the uncomfortable.Is an act where someone inappropriately touched you against your will. Physical harassment in the workplace is also known as workplace violence. Verbal harassment It is a type of harassment that makes employees feel less comfortable, humiliated, threatened and intimidated. Most of the time, people find it challenging to identify verbal harassment because of different reaction from people. In the is situation where the individual exposes themselves to another person without the consent of the victim is called Visual harassment. [2,3,4,5].

If a type of harassment involving the use of explicit or implicit sexual overtones, including the unwelcome and inappropriate promise of rewards in exchange for sexual favors.in this situation called Sexual harassment .Can also be called bullying Or personal harassment WhenThe victim subjected to un wanted remarks, insults, offensive and derogatory statements. Simply, it's bullying in its most basic form and it's not illegal but can be damaging nevertheless.[6].

Harassment directs multiple repeating obscenities and derogatory comments at specific individuals focusing, for example, on the targets race, religion, gender, nationality, disability, or sexual orientation. This often occurs in chat rooms, through newsgroups, and by sending hate e-mail to interested parties.Called Online harassment[7].. While Street harassment Is a form of harassment, primarily sexual harassment that consists of unwanted sexualized comments, provocative gestures, honking, wolf-whistling, indecent exposures, stalking, persistent sexual advances, and touching by strangers, in public areas such as streets, shopping malls and public transportation. Phenomena of offensive, belittling or threatening behavior directed at an individual worker or a group of workers. Called Workplace harassment, it can be verbal, physical, sexual,racial, or bullying.[7,8].

A culture that implies acceptance , Poorly managed policies and proceduresExcessive stress , Indecent dressing , Exposure to sexual materials ,use of illicit drugsandactivities in secluded environments are the main Causes of harassment[1,7,9].

Victims of sexual harassment often suffer emotional and psychological harm, including stress, depression, and anxiety. They often experience decreased confidence and self-esteem.Fear and decreased confidence can cause some people to withdraw from the workplace and disengage

from co-workers. They are more likely to be tardy, absent, distracted, and neglect duties.. The hostility created by harassment causes absenteeism, low morale, gossip, animosity, stress, and anxiety among staff.The intensity of workplace harassment is positively correlated with the level of alcohol use and Post traumatic stress disorder: it is commonly known as a "war wound"[1,2,10].

WHO republished prevalence of harassment in different region varies from country to other , it is averages out to one every 1-2 minutes . In Africa as general women ages 16-19 are four time more likely than the general population to be victims of harassment or sexual assault . South Africa has the highest rape rate in the world 66,196 incidents in per100,000 people according to a survey conducted by the south Africa medical research council while 27,3 is prevalence rate in Egypt [11].

Materials and Methods

Study design:

Descriptive cross-sectional community based study was conducted in period extended from (November2021 to June 2022) aimed to assess awareness and attitude of female secondary school about harassment.

Study area and setting :

The study was carried out in Shendi town which is located in the River Nile State. It is bounded by Khartoum state to the south, Elddamer locality to the north, River Nile to the west and Kasala state to the east. The total area of the city is about 72Km^2. It is situated on the main River Nile. The study conducted in Dar –Almaali female secondary school which locatedin square 14 near to mosque Alroddaa, established in 2002 , there're 8 classes in the school (first and second level have 4 class and third level have 4 classes).

Study population

included female student of Dar Almaali school their age ranged between (13-17) years. Total number of students 320(first level include 80 students second level 70 and third level 170)

Sampling technique and sample size :

Systemic samplingtechnique was the method used for sampling (Table 1), the total number of the female selected for the study was 100.

Table 1: study population according to class level

Class level	Formula	Sample size	Population %
First level	(80/320)*100	25	80 (25%)
Second level	(70/320)*100	22	70 (22%)
Third level	(170/320)*100	53	170 (53%)
Total		100	320 (100%)

Data collection tool

The data was collected through Astructured questionnaire and scale of adaptation, which was formulated by the researcher, based on the literature review

1- A structured questionnaire sheet included:

Part I : Demographic characteristics of the study group

Part II: female knowledge about harassment

2- scale of attitude ; which include four point of adaptation level(Strong agree, agree ,Strong disagree, disagree) used to assess attitude of study group.

Data collection Technique

- The objectives of the study were explained to the head masters and teachers.

The questionnaire was completed by the students after explanation of the objectives and their consent.pilotingwas done ,then the researchers distributed questionnaire for students . The student fill questionnaire by them self .

Data analysis

Statistical Package of social sciences(SPSS)version(24) were used and scoring system to estimatedknowledge as good , faire or poor .

The score of three to four points (75- 100%)is rated as good

The score of two points the knowledge is faire (50%)

The score of one point or zero (0-25%) the knowledge is poor .

Data presentation

Tables and figures were used to present the results

Ethical consideration: The data collection started after taken permission from the faculty research committee then director of Dar Almaali secondary school and female student themselves.

Results

Table (1): Distribution of the study group according to their awareness about Definition& types of Harassment

N=100

Definition of Harassment	*Frequency*	*Percentage*
Good knowledge	63	63%
Faire knowledge	29	29 %
Poor knowledge	8	8%
Types of harassment		
Good knowledge	29	14 %
Faire knowledge	51	51 %
Poor knowledge	20	20 %
Total	100	100 %

Table (2): Distribution of the study group according to their awareness about Causes & place of harassment

N=100

Causes of harassment	***Frequency***	***Percentage***
Good knowledge (Improper upbringing)	41	41%
Faire knowledge (Tight and illegal clothing)	38	38%
Poor knowledge (Alcohol and drug abuse mental illness)	21	21%
Place of harassment		
The streets	55	55 %
Public markets	30	30 %
Public transport	13	13 %

Place of study (schools)	2	2%
Total	100	100 %

Table (3): Distribution of the study group according to their awareness about perpetrators of harassment,Harassment images&subjected to harassment

N=100

Perpetrators of harassment	***Frequency***	***Percentage***
Good knowledge	69	69 %
Faire knowledge	24	24 %
Poor knowledge	7	7 %
Harassment images		
Intended touch	39	39%
Vocabulary (sounds of kisses and whistles).	23	23 %
Gestures (biting the lips, sticking out the tongue	22	22 %
Direct and indirect speech	16	16%
subjected to harassment		
Good knowledge	60	60 %
Faire knowledge	34	34 %
Poor knowledge	6	6 %
Total	100	100%

Table(4) : Attitude of Study group regarding important point of harassment

Items	Strong agree		Agree		Strong disagree		Disagree	
	F	P	F	P	F	P	F	P
Harassment is awed spread phenomenon	70	70	24	24	6	6	0	0
Harassment is a crime	77	77	22	22	0	0	1	1
Harassment is a mental illness	66	66	22	22	12	12	0	0
Girls and women are the reason why men harass them	38	38	33	33	17	17	12	12
Watching pornographic films reason of harassment spread	72	72	26	26	2	2	0	0
Ignoring is the best protection against harassment	49	49	26	26	17	17	8	8

Table(5): Attitude of study group regarding female dress style and reactions toharassment

N=100

Items	Strong agree		Agree		Strong disagree		Disagree	
	F	P%	F	P%	F	P%	F	P%
female dress, style and morals a reason for being harassed								
Gestures and chewing gum in an exciting way	65	65%	24	24%	11	11%	5	5%
staggering in walking and swaying	59	59%	32	32%	7	7%	2	2%
fluency in speech	42	42%	42	42%	10	10%	6	6%
laughing out loud in the streets	57	57%	27	27%	7	7%	9	9%
female reactions to harassment								
cursing and ostracism	43	43%	27	27%	14	14%	16	16%
Multiplication	45	45%	31	31%	15	15%	9	9%
Ignore	39	39%	32	32%	18	18%	11	11%
report to a relative	40	40%	44	44%	4	4%	12	12%
About being harassed on the way to school								
changing the road	52	52%	19	19%	16	16%	13	13%
change of school	12	12%	19	19%	38	38%	31	31%
frequent absences	6	6%	17	17%	43	43%	34	34%
If you see a harassment situation								
I will ignore the matter, it doesn't concern me.	14	14%	6	6%	48	48%	32	32%
I will intervene to end the harassment	54	54%	35	35%	3	3%	6	6%
I will report the harasser	55	55%	29	29%	5	5%	11	11%

Discussion

InThis study two third (63%) of study group had good knowledge about definition of harassment , while only 29% have faire knowledge . this information similar to (Croch, M. A.et al , [1] which state that :harassment it is violating some body or privacy) and (harassment it is feeling uncomfortable and insecure and form of unwanted words , respectively . approximately third (29%) had good knowledge about types of harassment , this information similar to literature which state that (Phenomena of offensive, belittling or threatening behavior directed at an individual worker or a group of workers Called Workplace harassment, it can be verbal, physical, sexual, racial, or bullying.[7,8]. Majority of study group had good and faire

knowledge about causes of harassment because they think improper upbringing are the main cause followed by tight and illegal clothing , while most of them (98%) they aware about place of harassment as public area (transport , markets and streets) as in table 2.

about two third of study group had good knowledge about perpetrators of harassment, Harassment images & subjected to harassment this information agree with literature which state that ;Mainperpetratorsstrangers , Classmate, lover or fiancé while Intended touch is one top of harassment images [10]

Regarding attitude the study revealed that More than two third of study group 72% and about half of them their attitude regarding harassment were positive because they strongly agree with watching pornographic films are reason of spread of harassment and ignoring is the best protection against harassment (as in table 4) . while more than half had positive attitude regarding female dress style as reason of harassment because they strongly agree to Gestures and chewing gum in an exciting way , staggering in walking and swaying and laughing out loud in the streets ,this agree with Ahmed Fouad study which reported that (67%) of study population had positive attitude toward street verbal harassments [12]

About reaction to harassment their positive attitude distributed in many response like multiplication, reporting to relative and ignoring . while their reaction if they see situation of harassment concentrated on ignoring and reporting about harasser

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Reference

1-Croch, M. A.(2019). Thinking about sexual Harassment: A Guide for perplexed. New York oxford University , 70-105.

2-www.eeoc.gov"Harass – Definition of harass by Merriam-Webster". Available from Merrian-webster.com. watched on 6:AM on10 Octoper 2021.

3-McDonald, p. (2020) .workplace sexual harassment: international journal of Management , 14(1), 1-17.

4-Timmerman , G. Bajema, C.(2020) .Incidence and methodology in sexual harassment: Northwest Europe women's Studies International Forum , 22(6), 673-681

5- Schneider, K. T., Swan, S., Fitzgerald, L. F. (2021) .Job –related and psychological effects of sexual harassment in the workplace: Journal of Applied Psychology , 82(3), 401-415.

6- Fineran Susan.(2022) Adolescents at work: Gender Issue and Sexual Harassment & Violence Against Women ,953-967.

7-Maeve Duggan,PEW Research center . Online Harassment (cited 2020 accessed on October 2021); Available from: http://www.pewinternet.org//online-harassment

8- www.eeoc.gov. "Harassment". watched on 9:00PM. on 6 June 2022.

.

9-Antecol, H.Cobb-clark, D.(2021). Does sexual harassment training change attitude? :A view from the federal level" Social science Quarterly , 84(4), 826-842.

10-Tehrani, N. (2022) .Bullying A source of chronic post traumatic stress:British Journal of Guidance and Counseling, 32 (3), 357-366.

11- "world population review data " republished by WHOin 13 /5/2022;Available from: www.// http / Pubmid. watched on 9:00PM. on 6 May 2023

12- Ahmed Foud , M. A.(2021) , Bab Elhara for science research // http /opera , Wikipedia , watched on 3Pm 9 September, 2019 .

Shendi University Journal of Applied Science, Issue (10) , June 2023 (12): p 141-154

Efficiency and Utilization of Long-Lasting Insecticide Nets (LLINs) in Selected Villages of ALRahad Locality, Gedarif State, Sudan2014

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Abstract

A cross-sectional study was conducted in6 selected villages of ALRahad locality in Gedarif state, eastern Sudan. The study aimed to evaluate the efficiency and utilization of (LLINs) which it was distributed in 2012**.** Six villages of the ALRahad locality were selected for the study. For bio-efficacy, each village was selected as a systematic random sample, after any five houses two LLINs were randomly taken, and 60 LLINs were collected with clear labels for each LLIN (PermaNet2.0®). The mosquito chosen for the bioassay test was a susceptible Dongola colony of Anopheles *arabiensis*, LLINs were transported to the National public health laboratory (NPHL) in Khartoum. A total 373 of households were randomly selected as study representative samples. Questionnaires adopted by WHO were used as study tools**.** The results showed that 61% of the households used nets immediately after sunset**.** Only 40% of the families with nets were infected with malaria in the last 2 yr. The bioassay study revealed that 66.7% of the test colony was knocked down after 1hr and 52% died after 24 hr. The highest mortality (90%) was found in Jarmi village, while the minimum was in Rumbik village (25.5%). The study concluded that the efficacy of LLINs was moderate due to poor practice, and inappropriate utilization (61%). Distributing LLINs together with intensive awareness-raising about use and storage is recommended.

Keywords: Anopheles arabiensis, Bioassay, bio-efficacy, LLITNs, and Utilization.

1. Introduction

Malaria is an entirely preventable and treatable mosquito-borne illness. In (2013), 97 countries had ongoing malaria transmission. An estimated 3.4 billion people are at risk of malaria, of from which 1.2 billion are at high risk. In high-risk areas, more than one malaria case occurs per 1000 population. There were an estimated 207 million cases of malaria in (2012) and an estimated 627, 000 deaths. Around 90% of all malaria deaths occur in sub-Saharan Africa (SSA). In (2012), malaria killed an estimated 482, 000 children under five years of age. That is

1300 children every day or one child almost every minute. Between (2000) and (2012), the scale-up of interventions helped to reduce malaria incidence rates by 25% globally, and by 31% in the WHO African Region. The global malaria mortality rate was reduced by 42% during the same period, while the decrease in the WHO African Region was 49% [1]. This scale-up of malaria interventions saved an estimated 3.3 million lives. Approximately 90%, or 3 million, of these are in the under-five age group in SSAA [1]

Malaria is transmitted through a single bite from infected female *Anopheles* mosquitoes (Diptera: Culicidae). There are five types of human malaria parasites, namely *Plasmodium vivax*, *P. malariae* (World-wide), *P. ovale*, and *P. falciparum*, which is the most common tropical and subtropical is the prevalent species, at the same time, the most deadly type of malaria infections[2]. Last species discovered is *P. knowlesi* is a primate malaria parasite commonly found in Southeast Asia and transmitted by the bite of an Anopheles mosquito. It causes malaria in long-tailed macaques (*Macacafascicularis*), but it may also infect humans, either naturally or artificially[3]. An insecticide-treated net(ITNs) is a mosquito net that repels, disables and/or kills mosquitoes coming into contact with insecticide on the netting material. There are two categories of ITNs: conventionally treated nets and long-lasting insecticidal nets: Conventionally treated net is a mosquito net that has been treated by dipping in a WHO-recommended insecticide. To ensure its continued insecticidal effect, the net should be re-treated after three washes, or at least once a year. A long-lasting insecticidal net is a factory-treated mosquito net made with netting material that has insecticide incorporated within or bound around the fibres. The net must retain its effective biological activity without re-treatment for at least 20 WHO standard washes under laboratory conditions and three years of recommended use under field conditions[4].The durability of Long-Lasting Insecticidal Nets (LLINs) in the field has become a critical issue for the success of malaria control in areas where LLINs are being applied for malaria prevention for two main reasons: first, it has been shown by various modeling exercises that increasing LLIN durability by one or two years on average would have a huge impact on the cost of malaria prevention, inthe order of 500-700 million US dollars over 5 years; and second, there are increasing data suggesting that there is a wide variation of LLIN performance between different locations or populations This implies a need to acquire country or region specific data on LLIN performance to feed into management decisions[5].The scaling up of LLINs is one of the important strategies of the National Vector

Control Programme (NVCP) towards control of malaria. The LLIN is a factory pre-treated mosquito net which retains its insecticidal activity even after 20 standards WHO washes and has a minimum life of 3 years when used under field conditions. The LLINs are generally more effective than conventional Insecticide Treated Nets (ITN), because they have an even and quality-controlled application of insecticides. They are also more cost-effective in the long term, as they do not require re-treatments like the conventional ITNs [6].ITNs were developed in the 1980s, and LLINs were developed and introduced to the market about a decade later in the late-1990s. LLINs have a clear advantage over ITNs due to a much longer residual efficacy, thus eliminating the need to re-treat every six months. While LLINs have replaced ITNs in most countries, ITNs are still available in certain retail markets, particularly in Asia. Donors almost exclusively fund LLINs over ITNs[7].The objective of the Sudanese National Malaria Control Strategy (NMCS) 2011-2015 was to reduce the morbidity and mortality of malaria by 50% by 2015 all over Sudan (compared to reported cases in 2009). In 2011, in comparison with 2009، the incidence of reported confirmed cases decreased by 36%, and the reported number of deaths by 46%. Reported total malaria incidence has decreased by in 2011in comparison to 2000[8]. Malaria endemicity is influenced by various factors, which include agricultural activities, migration movements, wars, limited resources, drug resistance, mosquito density, larval breeding sites, temperature, insecticide resistance, environment and socio-economic [9].

In Gedarif State, eastern Sudan, malaria cases arise after the rainfall season. The prevalence of malaria in Gedarif state is 49,812 in (2012), 25,143 cases in (2013) and 50,978 cases in (2014). During the Malaria Indicator Survey (2012), Gedarif state was considered a high incidence among the states (10.9%), carried predominantly by *A.arabiensis* mosquitoes[10]. The malaria control program (MCP) in Gedarif State, Ministry Of Health, is working hard to control this problem. They have started distributing long-lasting insecticide-treated nets (LLINs) for all groups, since (2011). In (2014), all groups of inhabitants for the entire state were covered with LLINs [11]. The main vector control methods include the use of insecticide-treated nets(ITNs) and indoor residual spraying (IRS). Both interventions rely on the continuing susceptibility of *Anopheles* to a limited number of insecticides. However, insecticide resistance, in particular pyrethroid-DDT cross-resistance (CR), is a challenge facing malaria vector control(VC) in Gedarif State, because pyrethroids represent the only class of insecticides approved for treating

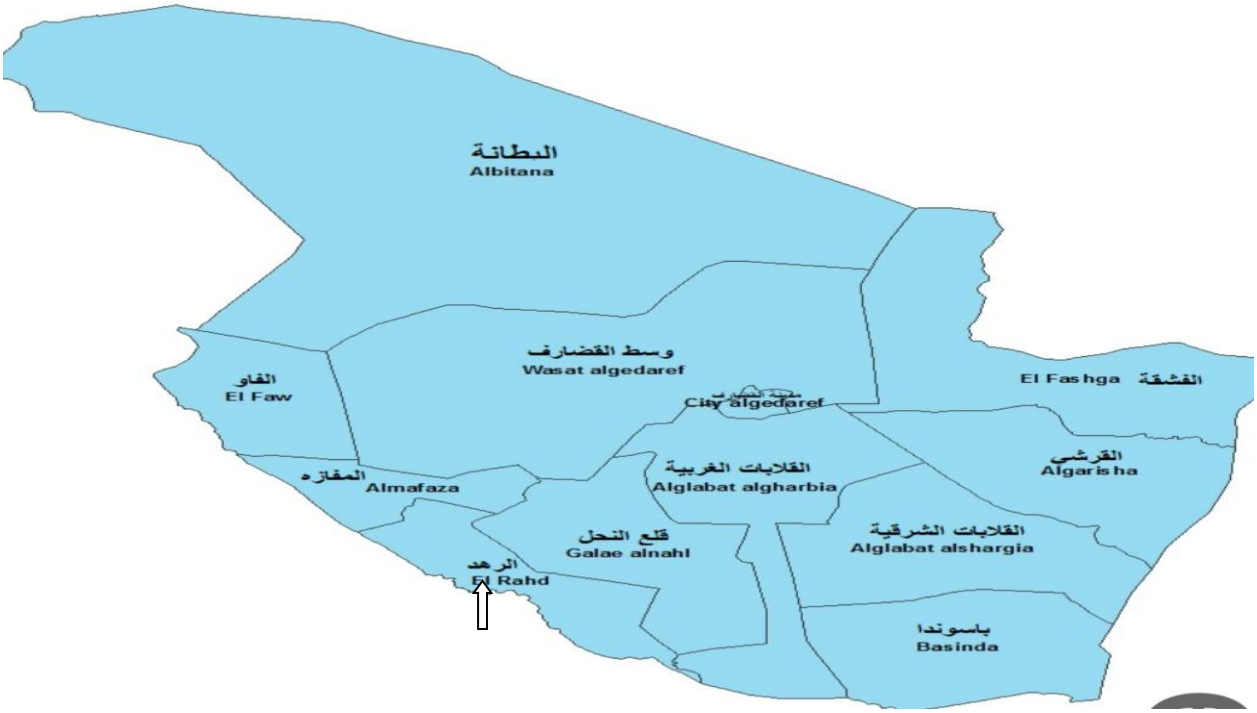
bed nets, and also is commonly used for IRS. Chemical control has always been the main strategy of vectors control in Gedarif State [12].

2. Materials and Methods

ALRahad locality is one of 12 localities of Gedarif State Eastern Sudan.

The locality is bordered by ALFao locality in north, Sennar state in the west, Gala alnahl locality east and galabat algarbia in the south .

ALRahad locality divided in to 3 administrative. The population of the locality is estimated as 224000 consisting of most of the tribes of Sudanese. The majority (65.9%) of the population works in agriculture. The vegetation of the state is poor savannah. The soil is clay and muddy. The Rahad River pass through the locality from the south to north. Average of the rainfall is approximately 612 mm. More than 75% of houses in Gedarif state are huts.(gatia).



Map of Gedarif state, Eastern Sudan

Sampling techniques and Sample size

Stratified sampling technique was adopted for the study First three administrative units of the locality were selected: according to their population size, then two villages from each were randomly selected. The sample size of the households was calculated according to the following formula:

$n=z^2xqxp/ d^2$

Whereas:

n =sample size, z=1.96, p=Prevalence rate, q=1-p, d=error 0.05 or 0.0025

$n=1.96^2X1-50/100 X 50/100/ (0.05)^2$

3.8 X- 0.49X 0.5/0.0025 = 372.4Household, i.e. Household (HHs).

The number of households interviewed in each village was calculated as percentage of nets distributed over the total number of nets distributed in the six selected villages.

Table (2.1) : Distribution of household that selected from studt area .

Village	Administrative unit	Population	No. of HHs	No. of nets distributed	%	No. of HHs interviewed
Hilat Elkhalifa 2	Hawata	2,455	344	1343	18	67
Alslam	Hawata	1,906	329	1053	15	56
Romek	Bazora	536	100	294	4	15
Komur Albasher	Bazora	1,988	327	1104	15	56
Jarmai	Wad Elshaer	5,660	988	3204	42	157
Wad Abuazaz	Wad Elshaer	808	145	441	6	22
Total		13,353	2,233	7,439	100	373

The data was collected using a well-structured questionnaire to study the attitude and practice of community HHs regarding LLINs through a community survey. For the bio-efficacy tests,

each village was selected as a systematic random sample, i.e. after any 5thhouse,2 LLINs were randomly taken.

We were collected60 LLINs for bioassay of susceptible colony of An. arabiensis in national public health laboratory(NPHL) conducted clear label for each net, including type, condition, time of distribution, number of washings, and storage. Bioassay was carried out according to WHO procedure [13]. For the method of the bioassay (Refer to the Reference 13)

Data were collected by a team of four trained interviewers by the authors.

The collected data was entered to excel sheet software and analysed using suitable inferential statistics, in addition to descriptive statistic (mean, median, percentage). Bioassay was subjected Abbott's formula for correcting the mortalities.

Results

The questionnaire results showed that in about 54.6% of the families there is one women in productive age, and >72% of the families have at least one child under 5 yr (range: 0- >3 children under 5 yr) (Fig.1). More than 80% of families found to have LLINs (Fig.2).

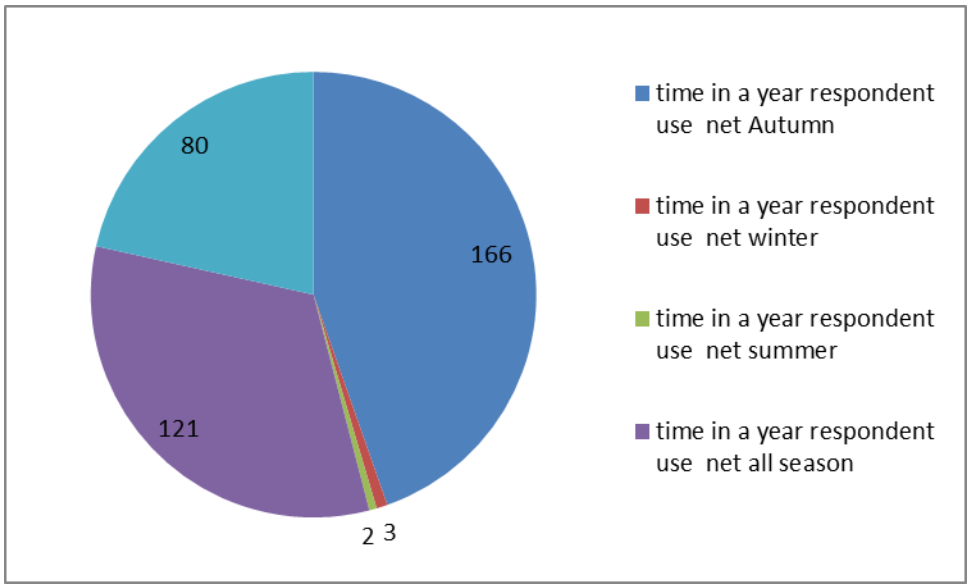


Fig. 1: time in a year households used LLINs, Rahad Locality

(Fig.1). About 61.49% of the owners use the nets immediately after sunset (i.e. between 5:30 and 6:30 pm, winter summer, respectively). Approx. 13.9% use nets after Isha prayer (between 7:30 to 8:00 pm). However, around 3% use nets after midnight.With regard to the time (season) of the

use of the nets, only 32.35% use them in all season , 44.38% use nets during the rainy-season only (Autumn), 0.8% use them during winter, and 0.5% during the summer season

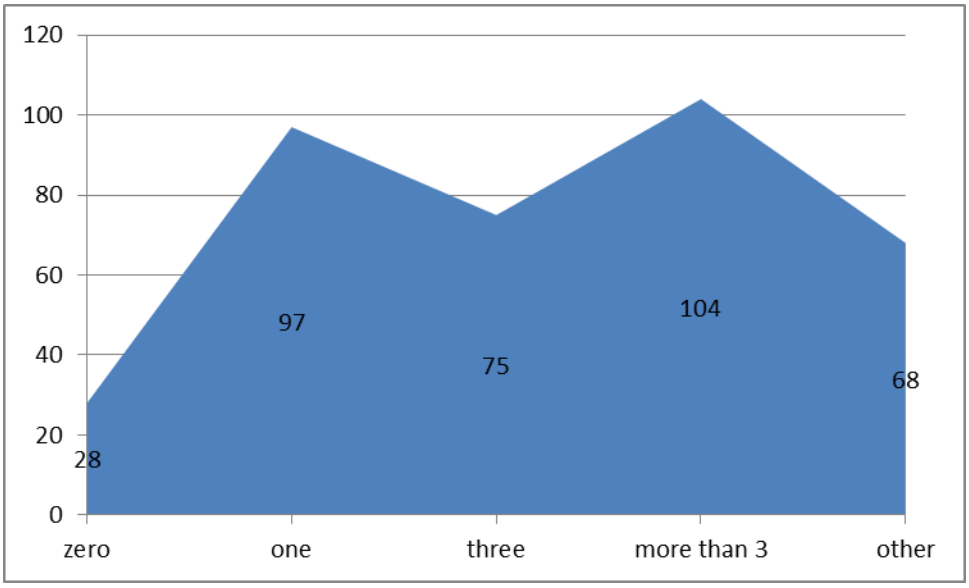


Fig. 2. Frequency of washing LLINs by families /yr in the villages of Rahad locality,Gadarif State, Eastern Sudan .

The response to washing the nets question showed that 7.5% did not wash the nets, 26% washed them once, 20% washed them 3 times, 27.9% more than 3 times, others did not mention the figures (18.27%) ((Fig. 2). After washing the nets, 59.4% of the respondents confessed to dry them in under the sun and 19.6% under shaded areas. The rest of the HHS did not respond to the question.

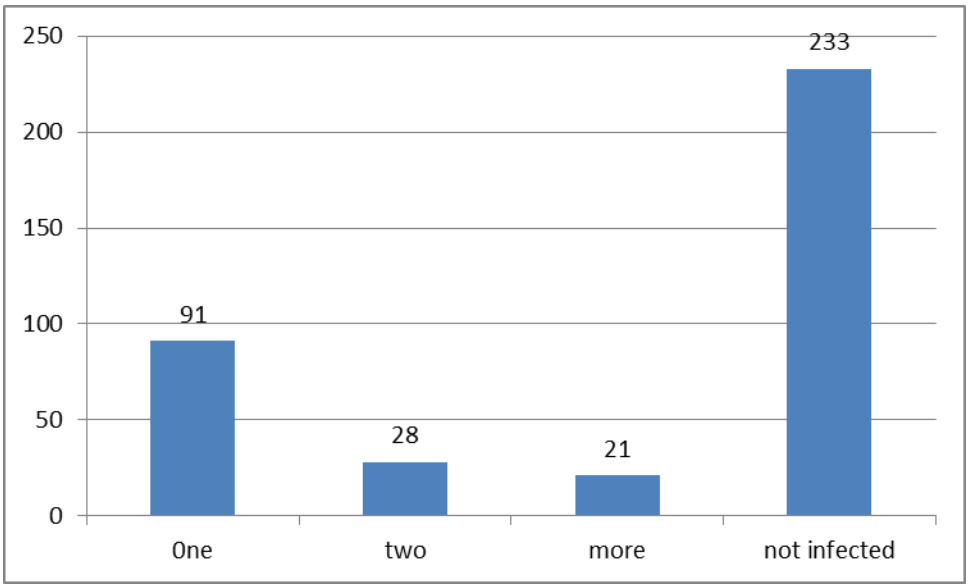


Fig3.: members of families infected by malaria after distributed LLINs2012.

The majority (40%) of families infected with malaria parasite during last 2years after distributed LLINs and 26% of families had one cases only with malaria parasite during a last 2years after distributed LLINs (Fig.3).

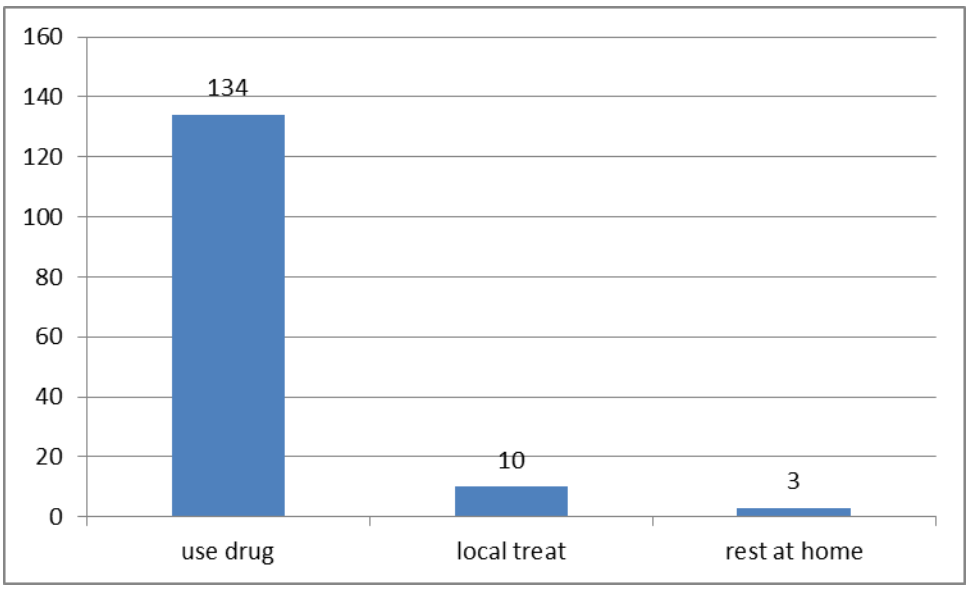


Fig4.: explain treatment seeking behavior of families after infected by malaria disease.

The majority 91% used drug after consultation of medical doctor.

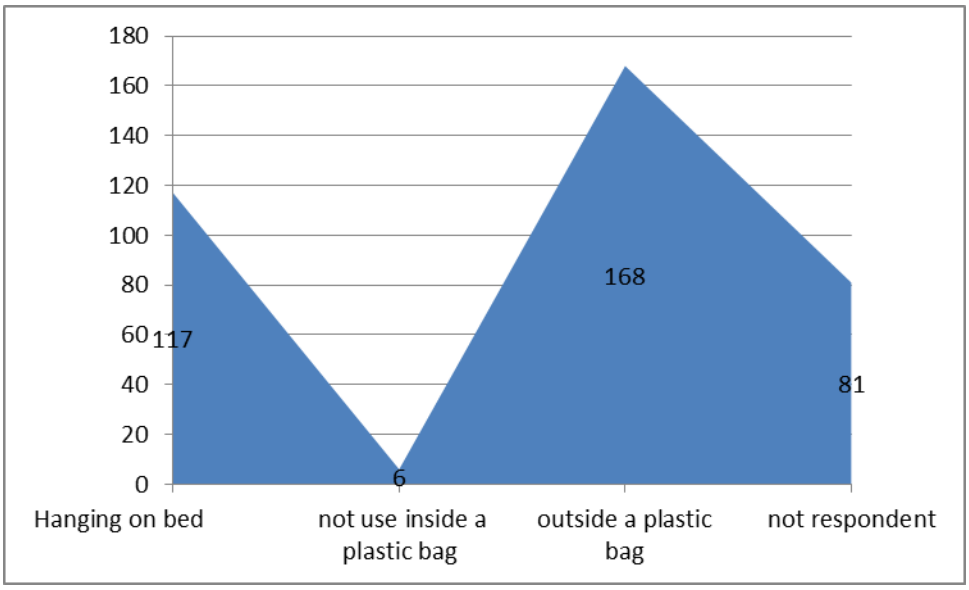


Fig5.: explained situation of LLINs during observation , village, , Rahad locality,2014.

More than 45% of bed net be outside of plastic bag that mean utilized.

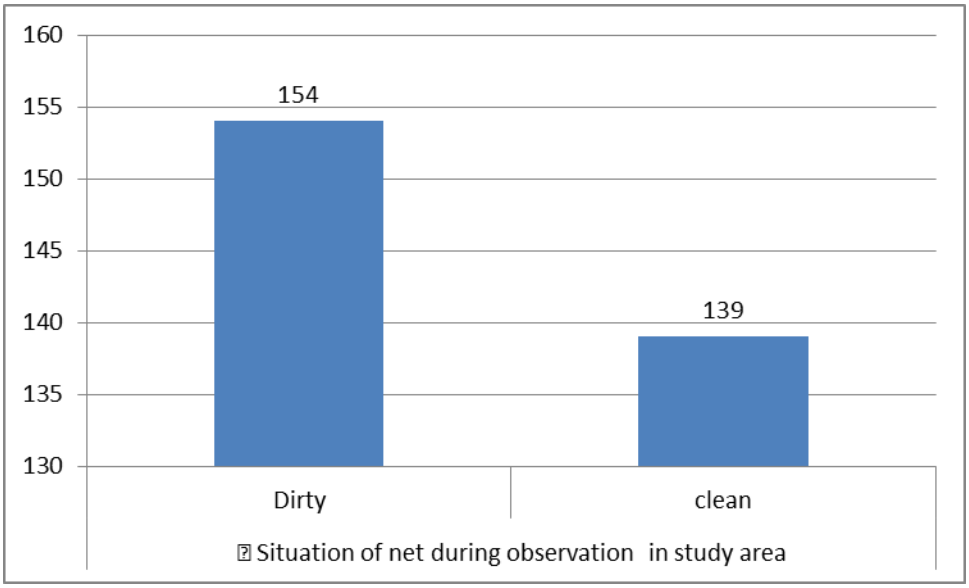


Fig.6 .: explain condition of LLINs during visit, villages, , Rahad locality,2014 .

More than 51% of LLINs dirty.

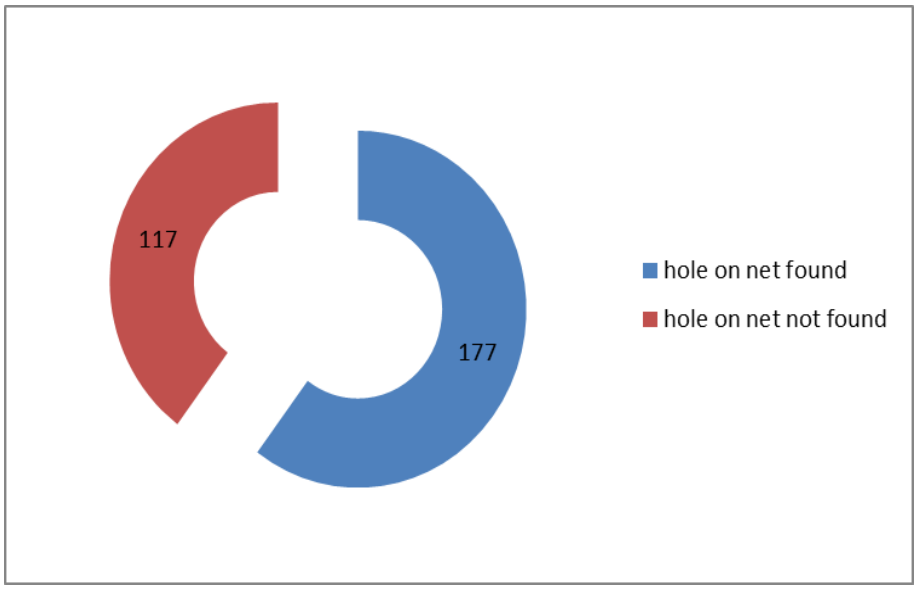


Fig7.: explain a hole or not in it LLINs, villages, ,Rahad locality,2014.

More than 59.5% of LLINs it holed during observation.

Table. 3-1: Bioassay test against susceptible colony of An. *arabiensis* exposed to LLINs utilized in study area is showed 52.5% mortality.

NO	Village	No. of mosquito exposed	Kdafter1hr	No. dead after 24hr	No. alive after24hr	Kd%	Mortality (%)
1	**Jarmi**	250	160	188	62	75	90.0
2	**Wad Aboazaz**	250	102	101	149	49	38.0
3	**Rumbik**	250	80	53	197	39.5	25.5
4	**KumrAlbasher**	250	141	126	124	70	52.5
5	**HilatAlkhalifa**	250	161	94	156	78	47.0
6	**Alslam**	250	184	132	118	92	62.5
Total		1500	828	694	806	66.7	52.5

Table 3-2: A Result showed control mortality is (5.6%), Highest control mortality observed in day one (10%), in LLINs evaluated

Day	Date	No. exposed	Kdafter 1hr	No. after24 hr	No. alive after24 hr	Kd%	Control mortality %
1	**3.11. 2014**	100	12	14	69	2.4	10
2	**4.11. 2014**	100	2	8	90	2.4	5
3	**11.11 .2014**	100	0	2	98	1.6	2
Total		300	14	24	257	2	5.62

Table 3-3: temperature and humidity during test days from NPHL room test.

Day	Temperature ºC	Humidity%
1	28.25	76.25
2	28.25	70.75
3	27.75	69.00
Total	28.00	72.00

5. Discussion

Similar study conducted in eastern Sudan Among the households, 42% and 46.2% respectively had one and two PermaNet® 2.0 inside their houses [14]. clarified that more than 80% of the households was had LLINs, Since distribution a total of 60.5% the nets had been damaged by having holes [15] This study Evident that,47% of the households was had LLINs damaged with holes. A total of 64.7% of the households have reported that they sleep under nets every night [16] that similar this study where approximately 61% of the households used bed nets after sunset directly.

The majority of households used bed net in autumn season, this correspond stratum of eastern Sudan (Gedarif) season malaria in autumn [16]. also LLINs during rainy season, most of its

hanged during sunset. This result not matched to This was later confirmed by observations of the nets that were hanged inside houses and 50.4% of the households were observed with hanged nets inside houses [17],that approve this study; The majority of bed net be inside of room .All samples of bed net was Permanet 2.0,that confirmed LLINs distributed in2012 (NMCPs).In 25 (21.4%) households bed nets received were totally damaged, that approved to a result More than 59.5% of bed net holed during observation. More than 51% of LLINs dirty, main that dust maybe effect in efficiency of LLINs against mosquito and other insect. Approximately 91% of the households consultation to doctors after infected with malaria, that mean good awareness regarding health care. Sixty-three (44.7%) households reported that at least one member of the household has suffered an attack of malaria (both clinical and/or lab-confirmed) during the past three months. (14). in this study approved; approximately 40% of the households received LLINs infected with malaria. Approximately 74% of the household's exposure your bed nets to sunlight directly for drying after washing, that agree It was suspected that exposure from sunlight could degrade the insecticide in the fibres of the bed nets [18].

A total mortality rate of susceptible colony of An. *Arabiensis* exposed to LLINs from study area is 52.5%and control mortality is (5.6%). The Highest control mortality observe in day one (10%), that contradicted this study LLINs are still effective after three years of distribution in the study area (70%) [19].

Conclusion;

The study was concluded that:

- Approximately 61% of house hold used LLINs and efficacy of LLINs was 52.5%.

-Repeated washing of LLINs had increase the efficacy.

-Poor practicing towards LLINs by households.

-Good practicing towards consultation of medical doctor after appear of malaria symptoms**.**

Recommendations; The state and the national control program should monitor the efficacy of LLINs regularly. Intensive Health education to change the practice of washing LLINs at least three time in year, saving it in shade to dry and utilize in all season for protect against mosquito or other insects.

Ethical Consideration: Institutional clearance was obtained from the Blue Nile National Institute for Communicable Diseases (BNNICD) committee and the Ministry of Health in Gedarif State before the project was able to get started. The study utilized the informed

agreement of responders and community leaders obtained the respondents had the option of participating in the study or rejecting it.

References:

1. World Malaria Report (WMR) (2013). Fact Sheet. Global Malaria Programme, World Health Organization.

2. Gilles, H.M. and Warrell, D.A. (1993) Bruce-Chwatt's Essential Malariology, 3rd edition, Edward Arnold, London.

3. Jaap J. van Hellemond and others(2009),Human Plasmodium knowlesi Infection Detected by Rapid Diagnostic Tests for Malaria, Emerging Infectious Diseases, Centeral disease control(CDC),pages1478-1480.

4.WHO (2012). WHO Global Malaria Programme: Position Statement on ITNs.

5.WHO,(2013).Malaria control in humanitarian emergencies: an inter-agency field .

6.National Rural Health Mission (2009). Action Plan for Scaling-up Long Lasting 7.Insecticidal Nets for malaria control in India. Directorate General of Health Services.

WHO, UNITAID(2014) Malaria Vector Control Commodities Landscape 2nd Edition. handbook – 2nd ed.

8. NMCP (2012) .Five years Strategic Plan for the National Malaria Control Programme Sudan (2011 – 2015). Khartoum

9. National Malaria Control Prgramme, Sudan (2010). National Strategic Plan for RBM (2007-2012): 12-13.

10.Federal Ministry of Health ,Sudan ,National Malaria CONTROL Program ,Malaria indicator survey report , (2012).

11. Gedarif state malaria control programme,(2015).

12.WHO (2012). WHO Global Malaria Programme: Position Statement on ITNs.

13. WHO, (2013), guideline for laboratory and field testing on long lasting insecticidal nets

14. Hassan. S. H, Malik. E. M, Okoued. S. I. and Eltayeb. E. M . (2008)Retention and efficacy of long-lasting insecticide-treated nets distributed in eastern Sudan: a two-step community-based study.Malaria Journal2008, 7:85.

15. M Fettene, Meshesha B and Ciara G.(2009).Utilization, retention and bio-efficacy studies of PermaNet® in selected villages in Buie and Fentalie districts of Ethiopia. Malaria Journal 2009, 8:114..

16 .John, B B (2010). A research Dissertation submitted to the postgraduate school in partial fulfilment of the requirement for the award of the degree of Masters of Arts Sociology of Makerere ,University, Kampala.

17. M.H. Kayedia,b,, J.D. Lines, A.A. Haghdoosta,c, M.H. Vatandoostd,Y. Rassid, K. Khamisabadye,(2008) , Evaluation of the effects of repeated hand washing,sunlight, smoke and dirt on the persistenceofdeltamethrin on insecticide-treated nets Tropical Medicine & Hygiene

18. GobirZainab, Tukur Zainab,(2013,0 Post-intervention assessment of long-lasting insecticide nets (LLINs) distributed in the Kano metropolis, Kano State, Nigeria , zamah09@gmail.com).

19 . M Jones, Antoine Sanou, Wamdaogo M Guelbeogo‹ N'Fale Sagnon

‹Paul CD Johnson and Hilary Ranson (2012) Aging partially restores the efficacy of malaria vector control in insecticide-resistant populations of Anopheles gambiae s.l. from Burkina Faso, Joneset al. Malaria Journal2012,11:24