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Knowledge, Attitude and Practices Amongst Subjects with Diabetes on Insulin Therapy: A Need to Bridge the Gap

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Abstract- Objectives: To assess the knowledge, attitude and practices of subjects with diabetes on insulin therapy. **Materials and Methods:** A questionnaire based cross-sectional study was done at Karnataka Institute of Endocrinology and Research, Bangalore in 448 subjects with diabetes on insulin therapy. **Results:** 61.38% subjects were men and 44.9% subjects were in the age group of > 60 years. Premixed insulin was the most commonly used insulin regimen (81.47%). Most of the subjects were on conventional insulin (86.8%). Insulin syringe was the most commonly used delivery device (64.7%). 13.1% of subjects were using non corresponding syringes with insulin vials. 94.9% subjects were regular with insulin therapy. 70.5% subjects were self-injecting insulin and 85.4% subjects were rotating the injection sites. Only 20.1% self adjusted the insulin dose. Only 50.7% subjects used the pinch up technique.

Keywords: diabetes mellitus; insulin injection technique; knowledge; attitude; practices.

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Knowledge, Attitude and Practices Amongst Subjects with Diabetes on Insulin Therapy: A Need to Bridge the Gap

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Abstract- Objectives: To assess the knowledge, attitude and practices of subjects with diabetes on insulin therapy. **Materials and Methods:** A questionnaire based cross-sectional study was done at Karnataka Institute of Endocrinology and Research, Bangalore in 448 subjects with diabetes on insulin therapy. **Results:** 61.38% subjects were men and 44.9% subjects were in the age group of > 60 years. Premixed insulin was the most commonly used insulin regimen (81.47%). Most of the subjects were on conventional insulin (86.8%). Insulin syringe was the most commonly used delivery device (64.7%). 13.1% of subjects were using non corresponding syringes with insulin vials. 94.9% subjects were regular with insulin therapy. 70.5% subjects were self-injecting insulin and 85.4% subjects were rotating the injection sites. Only 20.1% self adjusted the insulin dose. Only 50.7% subjects used the pinch up technique. 45.91% subjects used 90-degree angulation for insulin injection. 49.4% subjects found insulin therapy to be painful. Local site reactions were noted in 32.1% subjects. **Conclusions:** Our study has found several errors in insulin injection technique that needs to be circumvented by pre-injection counselling and periodic reassessment by the clinicians.

Keywords: diabetes mellitus; insulin injection technique; knowledge; attitude; practices.

I. INTRODUCTION

Type 2 diabetes mellitus is a multi-systemic disease with multi-factorial etiology and needs multi-disciplinary approach. Due to the slowly progressive beta-cell failure, up to 50% of the beta cells are not functioning adequately at diagnosis itself ⁽¹⁾. The beta-cell failure continues further, at a rate of about 4% each year ⁽²⁾. Therefore, most patients with type 2 diabetes will require stepwise intensification of anti-diabetic therapy to achieve good glycemic control. According to the UKPDS data, each therapeutic agent increases the proportion of patients attaining HbA1c

below 7%, (53 mmol/ mol) by 2 to 3 fold. But, only 50% of patients can maintain this goal after 3 years, and by 9 years only 25% can maintain glycemic control with the same drugs. Hence, it has been suggested that over a period of time, majority of patients will need addition of insulin therapy to attain an HbA1c level below 7% (53 mmol/ mol) ⁽³⁾.

Insulin is the oldest of the anti-diabetic medications available and hence has the most clinical experience. It is also the most effective agent in lowering hyperglycemia, since it can decrease any level of elevated HbA1c to the therapeutic goal, when used in appropriate doses. There is no maximum dose of insulin beyond which therapeutic effect will not occur ⁽⁴⁾. Despite of these advantages, there is significant delay in transitioning from oral agents to insulin therapy in most subjects with type 2 diabetes and insulin remains an underutilized tool for achieving glycemic control ⁽⁵⁾.

Amongst patients on insulin therapy, many patients continue to have elevated HbA1c levels and experience years of uncontrolled hyperglycemia. This is attributable to several obstacles in designing and implementing suitable insulin therapy. These obstacles could be physician related, patient related or even health care system related ⁽⁶⁾. Many studies have revealed poor knowledge, attitude and practices among subjects with type 2 diabetes on insulin therapy. It appears that there is a lot of scope for improvement in subjects with diabetes' approach towards insulin therapy. Insulin injection technique is one of the most common areas with likelihood of errors and it is imperative to look at these factors for formulating a strategy of optimising insulin therapy.

a) Objectives

1. To assess the knowledge, attitude and practice (KAP) of subjects with diabetes who were self-administering insulin.
2. To assess the impact of KAP factors on their glycemic control.

II. MATERIALS AND METHODS

A cross-sectional study was conducted in the outpatient department of Karnataka Institute of Endocrinology and Research, Bangalore from 1st January

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to 31st August 2015, through questionnaire based interview of 448 subjects with diabetes who were self administering insulin as a part of their diabetic therapy. The study was approved by the ethical committee of the hospital. The patients consent to participate in the study was taken, after the nature of the study was explained to them.

Subjects with diabetes, of any age and duration of diabetes, on insulin therapy and willing to participate in the study were included in the study. Patients who were not physically or mentally able to respond to the interview were excluded. The interviews with the patients were conducted by the diabetic educators cum nutritionists in our hospital. The questionnaire contained 33 questions, focussing on the type of insulin regimen, drug compliance, insulin storage, timing of insulin injection in relation to meal, insulin injection site rotation, etc. In addition to KAP data, we collected demographic data including gender, age, occupation, educational status, duration of diabetes, duration of insulin use, and level of glycemic control.

III. STATISTICAL ANALYSIS

Data was entered into microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions. Chi-square was used as the test of significance. Independent t test was used as the test of significance for quantitative data. Continuous data was represented as mean and standard deviation. P value <0.05 was considered as statistically significant.

IV. RESULTS

In the study, 95.5% of subjects had type 2 diabetes and 4.5% had type 1 diabetes. Mean age of the subjects in the study was 55 ± 10.78 years. Mean age of type 1 DM subjects was 15.95 ± 10.78 years and Type 2 DM subjects was 56.82 ± 11.66 years. Significant number of subjects (44.9%) were in the age group of above 60 years. 61.38% of the subjects were male and 38.62% of the subjects were females. 36.4% of the subjects had duration of diabetes between 10 to 20 years; followed by duration between 5 to 10 years. 34.8% of the subjects were using insulin for < 1 year, while 33.9% between 1 to 5 years and 31.3% for > 5 years. Regarding the type of insulin used, 8.04% of the subjects were using basal insulin, 8.48% were using bolus insulin, 81.47% were using premixed insulin and 6.03% were using basal-bolus insulin. 82.6% of the subjects were using conventional insulin, 13.2% were using analogue insulin and 4.2% were using combination of conventional and analogue insulin. With respect to the insulin device used, 64.7% of the subjects were using insulin syringe, 33.5% were using insulin pen and 1.8% were using both. Mean HbA1c of subjects in the study was 9.91 ± 1.97 . Among type 1 diabetics, mean HbA1c was $10.85 \pm$

2.76% and among type 2 diabetic mean HbA1c was $9.86 \pm 1.91\%$. This difference in mean HbA1c between Type 1 and Type 2 DM subjects was statistically significant. 81.4% of the subjects had HbA1c >8% (64 mmol/ mol). Only 5.7% of the subjects had HbA1c <7% (53 mmol/ mol). Regarding education status of the patients, 14.1% had education up to primary school, 27.5% had education up to high school, and 12.7% had studied up to PUC / diploma, 23.7% were graduates and 22.1% were illiterate. 99.8% of subjects in the study were right handed and 17.9% of subjects had abnormal vision (Table 1).

In the study, 86.4% of subjects had obtained knowledge about insulin injection technique from trained professionals. Positive attitude regarding insulin therapy was seen in variable number of patients for different practices associated with insulin use. 91.2% subjects' verified the expiry date of insulin before use. 92.9% of subjects checked the name and type of insulin before use. 78.5% of subjects stopped using the insulin vial/ cartridge after one month of initiation and 21.5% of subjects continued to use the same insulin even after one month of initiation. Of the 297 subjects using syringes for insulin injection, 86.9% were using corresponding syringe with insulin, while 13.1% were using wrong syringes. 96.6% of the subjects were injecting insulin directly on the skin while rest were injecting often through clothing. 40.2% of the subjects reported that they were avoiding insulin injections at social gatherings and outings. Almost 49.4% of subjects felt that insulin injections are painful. Local reactions like lumps/dyscoloration/abscess at the injection site were noted by 32.1% of subjects (Figure 1).

With respect to the practices, 94.9% of the subjects were taking insulin regularly. 70.5% of the subjects were self injecting insulin and 85.4% were rotating the sites of injections regularly. 50.7% of the subjects used the pinch up technique and folded the skin between thumb and index finger while taking insulin injection. Only 32.2% of subjects waited 10 sec before withdrawing the needle. 25.2% of the subjects were taking insulin after meal. Only 20.1% of the subjects adjusted the insulin dose by self. Surprisingly, 1.5% of the subjects shared their insulin vials and pens (Figure 2).

71.4% and 54.8% of the subjects stored insulin in refrigerator when not in use and when in use respectively. 73.4% of the subjects preferred storing insulin in handbag while travelling. 58.9% of the subjects used insulin immediately after taking it out of the refrigerator. Most common sites used for insulin injection were thigh (53.1%), then upper arm (43.3%) and anterior abdomen (40.8%). Atleast 15.4% of the subjects used non-recommended sites for injection including inner thigh, around the umbilicus, hip, groin, calf muscle area, close to the knee, inner arm, forearm and hand. 57.2% of the subjects used clean site for insulin injection while 31.12% used spirit swab to clean the injection site. Only 45.91% of the subjects used 90 degree angulation for insulin injection, while 31.56% used 45 degree angulation

and 17.05% used 30 degree angulation. Among 412 subjects who used conventional insulin, 42.72% of them maintained a injection- meal gap of 11 to 20 minutes and only 8.33% maintained a gap of 20 -30 minutes between injection and meals. Out of 36 subjects who used analogue insulin, 27.78% injected within 10 minutes and 27.78% took injection immediately after meal. 98.2% of the subjects discarded insulin syringes in general waste (Table 2).

V. DISCUSSION

Right injection technique is instrumental in making insulin therapy comfortable and acceptable to subjects with diabetes and also in achieving good glycemic control. Hence, it is essential to guide the patients on using insulin therapy with minimal discomfort and maximum benefits. The forum for injection technique, India has developed evidence based recommendations for the right insulin injection technique, to assist healthcare providers in guiding their patients. Apart from compliance with therapy and regular insulin dose titration, the forum has identified injection site selection, depth of injection, angulation of injection, time lapse before withdrawing the needle and time gap between injection and meals as some of the modifiable factors influencing the success of insulin injection therapy ⁽⁷⁾.

Studies from different countries have demonstrated that diabetes knowledge, attitude and practices (KAP) are poor among subjects with diabetes, especially regarding insulin therapy. Different studies have looked at different aspects of KAP and used different scales of measurement of KAP. In a cross-sectional study (n -150) in North Western Ethiopia, 30.7% of the patients reported that they had missed their insulin due to different reasons at different times ⁽⁸⁾. Another study of 575 subjects with diabetes in UAE showed that 57% had HbA1c levels reflecting poor glycemic control, while 10% admitted non-compliance with insulin therapy ⁽⁹⁾. A multinational survey of 1530 insulin-treated patients showed that 33.2% of patients reported insulin omission at least 1 day in a month, with an average of 3.3 days. The most common reasons for insulin omission included being busy, travelling, skipping meals, stress and public embarrassment ⁽¹⁰⁾. However, not many studies have been conducted to evaluate the errors in insulin injection technique.

Our findings show that there is gap in knowledge, attitude and practices amongst subjects with diabetes on insulin therapy. In our study, subjects with duration of diabetes more than atleast 5 years, were on insulin therapy. The study population consisted of subjects on insulin therapy for short and long duration equally. Despite of insulin therapy, the glycemic control was poor in most patients and only 5.7% of the subjects had HbA1c <7%. This can be explained by the fact that most of the respondents were patients visiting our

institute for the first time and the reason for their visit was poor glycemic control.

In our study population, premixed insulin was the most commonly used insulin regimen, conventional insulin was the commonest insulin used and insulin syringe was the commonest device used. It appears that exploring the use of multi dose insulin regimen, insulin analogues, and pen devices more frequently may contribute to better glycemic control.

Despite of injection technique training by professionals, subjects were found to be committing many errors in insulin injection technique. Usage of non corresponding syringes (100 IU syringe with 40 IU insulin and vice versa) was seen in significant number of subjects. This is due to the fact that patients don't have any knowledge of different types of syringes and their appropriate usage. Also, pharmacies dispense syringes without verifying the type of insulin being used by the patient. There have been instances when patients have drawn insulin from insulin penfills using 40 IU syringes. This obviously leads to erroneous dose delivery. Hence, clinicians should spend some time in educating their patients on the usage of corresponding syringes and vials and also verify at regular intervals if patients are following it. Delaying/ skipping insulin in social gatherings and outings, missing insulin often, taking insulin after meals, was noted in significant number of subjects. This can be minimised by counselling about the importance of each dose of insulin and how it can affect their overall glycemic control. Maintenance of time gap between the injection and meal was also not strictly followed both for conventional and analogue insulin. This shows that the knowledge about time for onset of action of each insulin should be provided to the subjects, so that they maintain the time gap everytime they take insulin injection. Rotating the site of insulin injection, use of pinch up technique, waiting for 10 seconds before withdrawing the needle, were not being followed in small number of subjects. Patient training in this aspect can reduce the pain associated with insulin injection and also maximise the insulin absorption. Shockingly, a small percentage of subjects' shared the pen device with spouse, changing only the needle. This emphasises the importance of highlighting about not sharing delivery device/ insulin between individuals on insulin therapy. Last but not least, most of the subjects disposed insulin waste in general waste. This is happening because many people in India do not have access to medical waste disposal system. Our subjects were educated to store the disposables in a container and deliver it to nearest hospital for disposal. Yet, there is urgent need for establishing better medical waste disposal method by the public waste disposal system.

Nearly half of the subjects found insulin to be painful and also reported local site reactions like lumps, discoloration, and abscesses. This provides evidence that measures to reduce the pain associated with insulin

therapy and avoid local injection site reaction must be provided by the health care providers. Self titration of insulin dose was infrequently done in this study population. This highlights the need for patients on insulin therapy to be educated about self titration of insulin dose, so as to achieve rapid glycemic control. Therefore, it appears that initiating insulin therapy is just the beginning of a long journey of continuous monitoring and modification. Paying attention to the above modifiable factors in insulin injection technique will go a long way in achieving maximum benefit from insulin therapy.

VI. CONCLUSIONS

Our study has found several errors in insulin injection technique that makes the insulin injection painful, reduces patient compliance, prevents optimal utilisation of insulin therapy and also adversely effects glycemic control. The study confirms the need for pre-injection counselling, frequent reassessment of injection technique, and correction of errors in the insulin injection technique. Every clinician caring for diabetic patients must acknowledge, address, and alleviate these factors for achieving optimal success with insulin therapy.

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Tables & Figures:

Table 1: Baseline Characteristics of the study population

Characteristic		Frequency			Percent	
Type of DM	Type 1 Diabetes	20			4.5	
	Type 2 Diabetes	428			95.5	
Age	< 39 years	61			13.6	
	40 to 49 years	48			10.7	
	50 to 59 years	138			30.8	
	> 60 years	201			44.9	
Mean Age (Mean ± SD)		55 ± 14.36 years				
Mean Age Type 1 Diabetes (n =20)		15.95 ± 10.78 years				
Mean Age Type 2 Diabetes (n =428)		56.82 ± 11.66 years				
Gender	Male	275			61.38	
	Female	173			38.62	
Duration of Diabetes	< 1 year	47			10.5	
	1 to 5 year	68			15.2	
	5 to 10 year	115			25.7	
	10 to 20 years	163			36.4	
	> 20 years	55			12.3	
Education	Illiterate	99			22.1	
	Primary School	63			14.1	
	High School	123			27.5	
	PUC and Diploma	57			12.7	
	Graduate and Above	106			23.7	
Duration of insulin use	< 1 year	156			34.8	
	1 to 5 years	152			33.9	
	> 5 years	140			31.3	
Insulin regime used	Basal only	36			8.04	
	Bolus only	38			8.48	
	Pre mixed	365			81.47	
	Basal -Bolus	27			6.03	
Type of insulin used	Conventional	370			82.6	
	Analogue	59			13.2	
	Conventional + Analogue	19			4.2	
Insulin device used	Insulin Syringe	298	64.7	40 IU	290	97.3
				100IU	8	2.7
	Insulin pen	150	33.5	Refillable	99	62.6
				Disposable	59	37.4
HbA1c (n- 366)	< 7	21			5.7	
	7 to 8	47			12.8	
	> 8	298			81.4	
Handedness	Left	1			0.2	
	Right	447			99.8	
Vision	Abnormal	80			17.9	
	Normal	368			82.1	

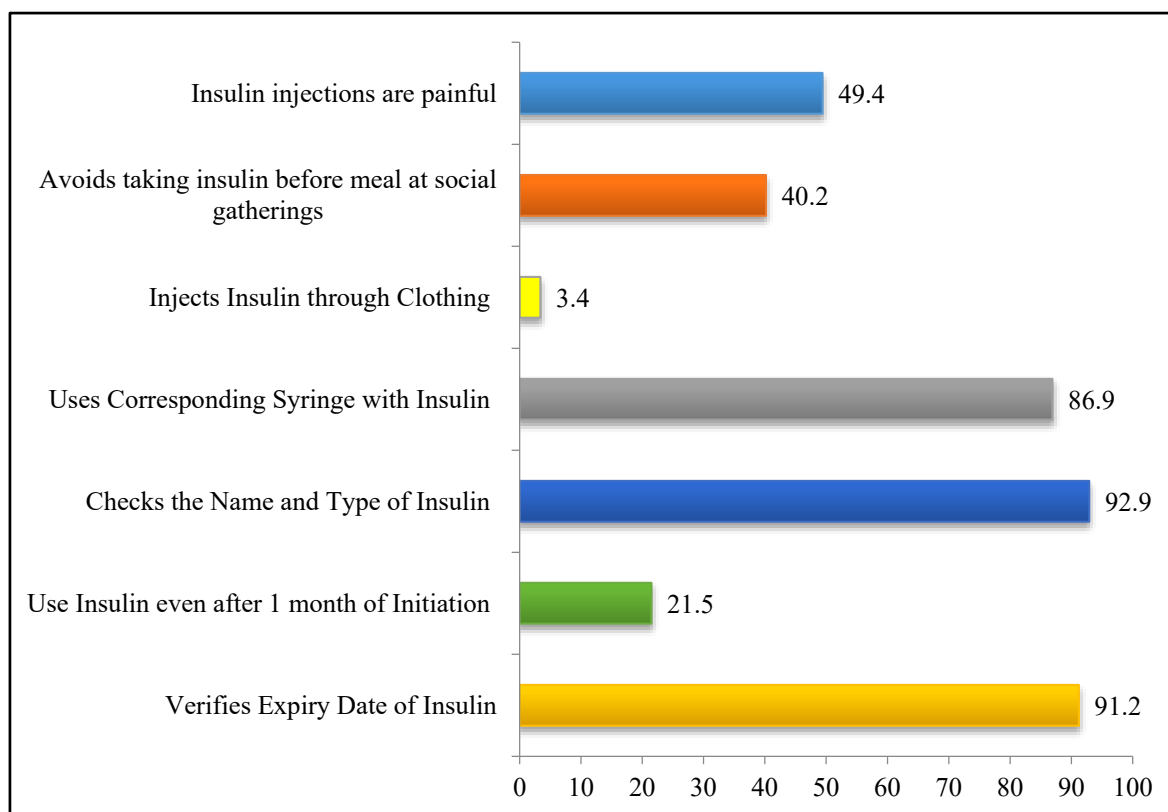


Figure 1: Bar diagram showing attitude of diabetic subjects towards insulin injection technique

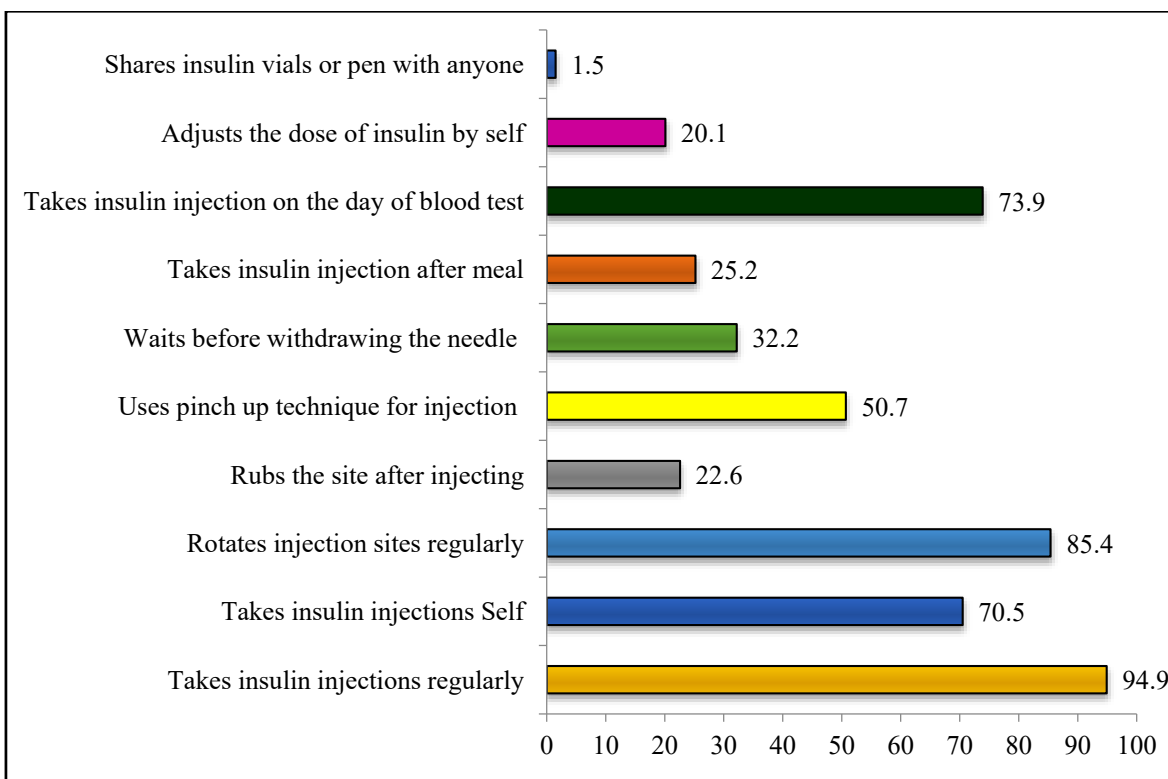


Figure 2: Bar diagram showing practices among diabetic subjects with respect to insulin injection technique

Table 2: Insulin storage, injection procedure and other aspects of injection technique

Parameter	Method	Number (Percentage)
Storage of insulin pens and insulin vials when not in use	Refrigeration	320 (71.4)
	Water Filled Earthen Pitcher	43 (9.6)
	Room Temperature	43 (9.6)
	Freezer	6 (1.3)
	Others	4 (0.9)
	NA	32 (7.1)
Storage of insulin pen in use	Refrigerator	102 (54.8)
	Room Temperature	84 (45.2)
Storage of insulin device while travelling	Hand bag at room Temperature	332 (73.4)
	Inside Water Bottle	33 (7.4)
	Icepack	25 (5.6)
	Others	52 (11.6)
Time for which refrigerated insulin vials are kept at room temperature before injecting. (n- 292)	Use Immediately	172 (58.9)
	< 5 min	40 (13.7)
	10 to 20 min	61 (20.8)
	> 30 min	19 (6.5)
While mixing NPH/ regular insulin, which insulin is drawn in to the syringe first?	NPH	1 (11.2)
	Regular	8 (88.8)
Site of injection	Anterior Abdomen	183 (40.8)
	Upper Arm	194 (43.3)
	Thigh	238 (53.1)
	Others	69 (15.4)
How injection site is cleaned	Don't bother much	28 (6.41)
	Use Spirit Swab	136 (31.12)
	Uses Clean Site	250 (57.21)
	Wash With Water	23 (5.26)
Angulation used while injection	90	202 (45.91)
	45	138 (31.36)
	30	75 (17.05)
	Others	25 (5.68)
Injection and meal time gap (Conventional, n = 412)	≤10 min	42 (10.19)
	11 to 20 min	176 (42.72)
	21 min to 30	104 (25.24)
	>30 min	15 (3.64)
	Immediately after meal	69 (16.75)
	Not known	6 (1.46)
Injection and meal time gap (Analogues, n = 36)	≤10 min	10 (27.78)
	11 to 20 min	2 (5.56)
	21 min to 30	3 (8.33)
	>30 min	0 (0.00)
	Immediately after meal	10 (27.78)
	Not known	11 (30.56)
Disposal of used insulin syringes, needles or pens	General Garbage	440 (98.2)
	Medical Waste	8 (1.2)



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Assessment of Nurses' Knowledge and Attitude Towards Nursing Profession at Public Hospitals in Mekelle Town, Tigray, Ethiopia

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Abstract- Background: In health related areas it is clear that there are different perceptions of nursing. Perception by itself is merely defined as an idea, belief, or an image you have as a result of how you see or understand something. The Perception of nursing may vary depending on age, educational level, social and professional experience.

Objective: To assess Nurses' knowledge and Attitude towards Nurses Profession in public hospitals in Mekelle Town, Tigray, Ethiopia.

Methods: Institution based cross sectional study design was conducted used to assess knowledge and attitude of nurses towards the nursing profession. Sample size was calculated using a formula for estimating a single population proportion. Accordingly, sample size was 135. The dependent variable was attitude of nurses. Simple random sampling techniques were used to select the desired institutions and population proportion to size allocation was done to select the intended study subjects. Data was collected by 10 professional nurses for 1 week using structured self administer questionnaire. Data was entered and analyzed using SPSS version 16.

Keywords: nurse, public hospitals, nursing profession.

GJMR-K Classification: NLMC Code: WY 16



ASSESSMENT OF NURSES KNOWLEDGE AND ATTITUDE TOWARDS NURSING PROFESSION AT PUBLIC HOSPITALS IN MEKELLE TOWN, TIGRAY, ETHIOPIA

Strictly as per the compliance and regulations of:



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Zaid Tadesse Gebrezgabher ^α & Gerezgiher Buruh Abera ^σ

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Result: According to the findings 135 nurses were participated with a response rate of 92%. Accordingly, socio-demographic characteristics, more than half, 75(55.5%) of the respondents were females. About 48(35.6%) of the respondents age lies 36-40. Nearly half, 112(81.7%) of the respondents were married and the majority of the respondents, 117(86.6%) were orthodox followers. About 67(%) of the respondents were diploma graduates in Nursing. Fifty six of them get monthly salary of 774-1644 ETB. The majority, 117 (86.6%) of the respondents primary work place were government hospitals and 86 of them had more than ten years of work experience. Out of 135 nurses, 124 (91.8%) of them had a favorable attitude for nursing profession. Majority of them, 99 (73.3%) have good knowledge towards nursing profession.

Conclusion and recommendation: Majority of the respondents like and had a favorable attitude towards nursing profession. Majority of them also have good knowledge towards nursing profession. Regional health beuro need to provide training for nurses to increase knowledge and change attitude of nurses.

Keywords: nurse, public hospitals, nursing profession.

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1. CHAPTER ONE- INTRODUCTION

a) Background

The definition of Nursing defers from theory to other theory so is not an easy activity to define, but effort has been made by many scholars and health organizations to define it. Among those definitions Virginia Handerson's definition of nursing is more elaborated definition. Virginia Handerson defined Nursing practice as the unique function of the nurse is to assist the individual, sick or well, in the performance of those activities contributing to health or its recovery (or to a peaceful death) that he would perform unaided if he had the necessary strength, will, or knowledge, and to do this in such a way as to help him to gain independence as rapidly as possible (1). The other known definition of nursing is by American Nurses Association (ANA), Nursing is the protection, promotion, and optimization of health and abilities; prevention of illness and injury; alleviation of suffering through the diagnosis and treatment of human responses; and advocacy in health care for individuals, families, communities, and populations (2).

Whatever notion or idea best describes nursing and whatever set of activities it is defined, it is clear that there are different perceptions of nursing. Perception by itself is merely defined as an idea, belief, or an image you have as a result of how you see or understand something (3). More importantly, Perception of nursing may vary depending on age, educational level, social and professional experience and occupational and social factors. My personal and professional experiences have revealed that there are different angles in which people perceive nursing. Some assume nursing as if "it is a vocation and doesn't have its code of ethics" others consider it as "it is only for females" and most assume nursing as "it is only concerned with bed making". The question is how people really perceive nursing particularly the actual perception among professional nurses. The study conducted in UK and Spain by involving nurses, nursing students, patients and non nursing students have revealed that the perception of nursing across all participating groups is largely the same and some changes in the perception of nursing takes place in nursing students. This means, the important

aspects of nursing are perceived more coherently by all the participant groups in the present study as evidenced by the derivation of an internally consistent factor (Factor 1: Important aspects of nursing) from all participant groups.

The second factor (Factor 2: Unimportant aspects of nursing) was not as clearly perceived and was only internally consistent for the diabetic outpatients. This suggests that there may be some difference in the perception of nursing by the diabetic outpatients from the other participant groups. They used the 35-item Nursing Dimensions Inventory (NDI-35) stem questions to gather perception of UK nursing students throughout their education program, qualified UK nurses and Diabetic out patients (4). Generally Nurses are well thought of by the public, and their image is very positive. In a Harris poll taken in July 1999, more than 1,000 people were surveyed about their attitudes toward nursing. The poll showed that 92% of those polled trust information about health care that provided by RNs and 85% would be pleased if their son or daughter became a RN. If we seriously entertain the views of people outside the field of nursing, we can decide collectively on an agenda that will put the best possible public face on nursing. It is important that we do this because nurses are the health care providers involved with the patient throughout the care continuum they manage the journey of patients under their care on a daily basis (5).

By other study it has also been demonstrated that unless public misconceptions of the nursing profession are not corrected nursing schools continue attract some students who do not have the academic and technical aptitudes to meet the nursing education requirement and unless staff nurses and other stakeholders work together to address the critical issue the goal of reducing the nursing shortage through recruitment and retention will remain a distant one (6).

Authors from various fields since Abraham Flexner (1910) have provided different perspectives on what professionalism means, including knowledge based on scientific principles, accountability, autonomy, inquiry, collegiality, collaboration, innovation, ethics and values (7).

Since Florence Nightingale published her 19th-century book "Notes on Nursing," the nursing profession has developed from a low-paying, undesirable career into a highly acclaimed and respected profession. According to the American Nurses Association (ANA), professional nursing excellence centers on prevention of illness, alleviation of suffering, diagnosis, treatment and advocacy in the care of persons, families and communities.

Professional Development

Nursing is a challenging profession that tends to attract self-motivated, lifelong learners. A nurse's education never ends, because of the need to stay in

progress on health care issues and changes in medical theory and practice (8).

b) Statement of the Problem

Since the development of Florence Nightingale, each generation of nurses, in its own way, has fostered the movement to professionalize the image of nurses and nursing. The struggle to change the status of nurses from that of female domestic servants to one of high-level health care providers has been a primary goal of nursing's leaders for many years (9).

Researchers have revealed a number of negative societal perceptions of nursing related to gender stereotyping, subordination to doctors, low academic standards, limited career opportunities and poor pay and conditions, and importantly how these perceptions may affect levels of recruitment into nursing. Focusing specifically on nurses, research has also considered the extent to which these societal perceptions are realities in their workplaces, and the direct experiences that contribute to attrition from both nursing courses and jobs. However, to date, little research has actually bridged the above approaches and considered the perceptions that nurses (6).

In addressing the negative images of nursing, directors of nursing must develop strategies to at a local level before launching any national campaign to improve nurses' image. But the pilots have indicated the need to improve nurses' sense of their own work first (10).

How individuals perceive themselves and how they are perceived by others are an important part of the relationships between maternal health educators, nurses, other health-care providers, and the families they serve (11). A study conducted on the professional self-image, nurses employed in 22 Belgian general hospitals with the goal of identifying problems affecting recruitment and retention. Nurses reported having a positive self-image. Most were proud to be a nurse and considered themselves as competent health professionals and having great responsibility (12).

This area of study, Perception of nursing, has not been researched in developing countries. Thus, it is high time to carry out scientific inquiry to have new insight in Sub Saharan Countries such as Ethiopia where perception is remarkably affected by many social, economical, cultural and spiritual factors. Hopefully the finding of this research will fill the existing knowledge gap and contribute to educators and policy makers for creation of better awareness among the wider community. Though the perception of nursing could have impact on the coordinated work of the health care providers this study will focus only on the knowledge and attitude of nursing nurses towards nursing profession. Assessing knowledge and attitude of nurses to their profession may indirectly assess their motivation and deviation to give a service for the entire beneficiary.

This study have an expected input for any health professionals especially for nurses. Besides In the age of technological advances and economical complexes to health profession it is necessary to assess the perception of nurses to their protection. More ever this study has importance for patients, and the community at large in which they all are service takers in which it may be influenced by nursing professionals. It may also have significant input for policy makers and researchers in which may be used as base line data.

II. CHAPTER TWO - METHODS AND MATERIALS

An institution based cross-sectional study was conducted from May to December 2016. There are four

$$n = \frac{(1.96)^2 \times 0.56(1 - 0.56)}{(0.05)^2} = 378$$

Since the study population was less than 10,000 finite population correction formulas was applied:

$$\begin{aligned} nf &= \frac{n}{1 + (n/N)} \\ nf &= \frac{378}{1 + (378/220)} \\ nf &= 140 \end{aligned}$$

Adding 5% non response rate, the total sample size required for this study appears to be 147 nurses.

Data collection techniques, Instrument

This study was conducted using a structured, quantitative self administered questioner among public hospital in Mekelle town. A structured questionnaire has designed by reviewing previous similar studies in such a way that consists all the variables that can meet the objectives of the study. It includes all questions related to knowledge and attitude. The questionnaire was translated into Amharic language. The data was collected by 10 professional nurses with good data collection experience; two supervisors were selected from the group members. The data collectors were not staff members of the participants to ensure confidentiality. The supervisors was strictly followed the overall activities on daily base to ensure the completeness of the questionnaire, to give further clarification and support for data collectors. Training was given to data collectors for three days. In the training session, the data collectors were oriented on the objectives of the study, how to collect data and confidentiality of information was obtained. All the collected data were checked for completeness, accuracy and consistency by the principal investigators and supervisors. Five percent of the questionnaires were pre-tested at Wukro hospital for individual nurses with the same criteria and necessary corrections was done accordingly.

governmental hospitals in Mekelle. Two of them are under RHB (Quiha and Mekelle hospital), one under the ministry of defense (North command referral hospital), one referral hospital (Ayder referral hospital). There are also four other private hospitals in the town. In addition there are eight health centers and 38 private clinics in Mekelle (35).

The source of population was all nurses who are working under Public hospitals in Mekelle town and a sampled eligible nurse with six months and above work experience in their respective public hospitals. The sample size has determined using a formula of single population proportion. Prevalence was taken as 56 % $n = \frac{(Z_{\alpha/2})^2 p (1-p)}{d^2}$

Study variables

Dependent variables: Attitude of nurses

Independent variables

- ✓ Socio demographic factor: Sex, Age, Marital status, Religion, Profession
- ✓ Individual Factor : Knowledge , previous experience, training, work experience

Data processing and analysis

The data was checked in the field to ensure that all the information if properly collected and recorded. Before and during data processing the information was checked for its completeness. Data was analyzed using scientific calculator. All data was coded in terms of numbers. The collected data was summarized and presented using measure tables and charts, all of which are instruments for interpretation of the collected data.

To assess attitude of nurses towards nursing profession was developed by presenting respondents with a series of negative and positive statements that reflect different aspects of the underlying attitude in a variety of ways. Attitude statements have five possible responses. The responses was labeled as "favorable" or "unfavorable" as follows; "favorable" responses were responses including strongly agreeing and agree for positive statements and strongly disagree, disagree for negative statements. "Unfavorable" responses' are responses including "strongly agree", "Agree" and uncertain for negative statements, and disagree, strongly disagree and uncertain for positive statements. Marking the total attitude score out of hundred, those

with scores of greater than 50% was rated to have favorable attitude and those with a score below 50% as unfavorable attitude.

Knowledge of the respondents towards safe abortion was measured by marking the correct answers of subjects out of a hundred. Knowledge scores 50% or less was labeled as "poor knowledge", knowledge scores between 50% and 70% was labeled as moderate knowledge" and knowledge score above 70% was labeled as "good knowledge" (37).

Ethical Considerations

The study proposal was approved by the ethical clearance committee of Sheba University College. Written permission of these hospitals was secured for their employees to participate in the study and; each nurse within these hospitals was given a written consent to participate in the study after a thorough explanation of the objectives and the procedures of the study. Specifically, respondents was informed about the objectives of the study and that their participation be purely voluntary and they can be free to decline or withdraw at any time during the course of the study. So only those willing to participate were included in the study. Confidentiality was insured by making the questionnaires anonymous. Personal identification of the

respondents was not asked. They were also assured that the information provided in writing would be used only for research purpose and would therefore be strictly anonymous.

III. CHAPTER THREE: RESULT

a) *Socio-Demographic Characteristics*

About 147 self administered questionnaire were prepared to be distributed into respondents of all public hospitals in Mekelle town. About 135 of nurses were participated with a total response of 92%.

According to the findings of socio-demographic characteristics, more than half, 75(55.5%) of the respondents were females. About 48(35.6%) of the respondents age lies 36-40. Nearly half, 112(81.7%) of the respondents were married and the majority of the respondents, 117(86.6%) were orthodox followers. About 67(%) of the respondents were diploma graduates in Nursing. Fifty six of them they get monthly salary about 774-1644 ETB. The majority, 117 (%) of the respondents primary work place were government hospitals and 86 (%) of the respondents had more than ten years of work experience (Table 1).

Table-1: Socio-demographic characteristics of nurses on knowledge and attitude of nursing profession at public hospitals in Mekelle town from May to July 2016 (n=135)

Variable	Frequency	Percent
Sex of the respondent		
Female	75	55.5
Male	60	44.5
Age category		
20-25	6	4.4
26-30	10	7.4
31-35	15	11.1
36-40	48	35.6
41-45	37	27.5
46-50	15	11.1
>50	4	2.9
Marital status of the respondent		
Married	112	81.7
Divorced	4	2.9
Cohabiting	1	0.7
Widowed	4	2.9
Single	16	11.8
Religion of the respondent		
Orthodox	117	86.6
Muslim	15	11.1
Protestant	3	2.2
Work experience of the respondent (in years)		
6 month -1year	7	5.18
1-3	18	13.3
3-5	11	8.1
5-10	11	8.1
>10	86	65

Primary work place of the respondents

1. Governmental Hospital	117	86.6
2. Private hospital	1	.7
3. Governmental health center	13	9.6
4. Private higher clinic	1	.7

Current work place

1. Mekelle hospital	54	40
2. Queha hospital	38	28.1
3. North command referral hospital	43	31.8

b) Nurses attitude towards nursing profession

As shown below, out of the 135 nurses, 124 (91.8%) of them had a favorable attitude for nursing profession [Fig. 3].

c) Knowledge and feeling for nursing profession

Majority of the respondents, 99 (73.3%) have good knowledge towards nursing profession Majority of

the respondents, 95 (70.3%) like nursing profession. About 40 (29.6%) of the respondents didn't like their profession due to low payment compare to their efforts, bad administrative system in the environment they work with, due to it has not grantee and work over load 19(14%),5(3.7%),3(2.2%),2(1.5%) respectively (table 3).

Table-3: Knowledge and feeling to like nursing profession of nurses on nursing profession at public hospitals in Mekelle town from May to July 2016 (n=135)

Do you like your nursing profession	frequency	Percent
Yes	106	78.5
No due to low payment	19	14.1
No due to work overload	2	1.5
No due to bad administrative system	5	3.7
No due to it has not guarantee	3	2.2
Total	135	100
Knowledge		
Poor knowledge	13	9.7
Moderate knowledge	23	17
Good knowledge	99	73.3
Total	135	100

IV. CHAPTER FOUR: DISCUSSTION

In this study about 135 of nurses were participated with main purpose assessing nurse's attitude towards nursing profession at public hospitals, in Mekelle town.

According to the results that were trying to assess the attitude of nurses towards nursing profession, majority of the respondents 91.8% had a favorable attitude. This result is high when we compare to a study done at Addis ababa in which about 56% of the respondents have positive perception for nursing profession. This gap may be due to although respondents on both studies have same salary but there is a big gap on their daily personal expenses that is high expense for living in Addis compare to Mekelle. So it is difficult to live with this professions salary in which this

resone may indirectly affect their attitude towards their profession.

Majority of the respondents 106 (78.5%) like nursing profession. About 40 (29.6%) of the respondents didn't like their profession due to low payment compare to their efforts, bad administrative system in the environment they work with, due to it has not grantee and work over load 19(14.1%), 5(3.7%), 3(2.2%), 2(1.5%) respectively. Majority of the respondents, 99 (73.3%) have good knowledge towards nursing profession.

V. CHAPTER FIVE CONCLUSION AND RECOMMENDATION

- Majority of the respondents had a favorable attitude towards nursing profession

- Majority of the respondents like nursing profession
- Majority of the respondents have good knowledge towards nursing profession
- Of those didn't like their profession due to low payment compare to their efforts and bad administrative system in the environment they work with, due to it has not grantee and work over load were the main reasons they hate their work

Recommendation

According to the conclusions the following recommendations are drawn Regional government need to provide training for nurses to have consistent good knowledge for their profession.

ABBREVIATION AND ACRONYMS

ANA American nursing association

CI confidence interval

P Prevalence

PI Principal investigator

UK United kingdom

WHO World health organization

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An Analytical Study of Chest Girth, Vital Capacity and Respiratory Rate of Inter Collegiate Players of Selected Ball Games

By Miss. Shivani & Dr. Arvind Kumar Tripathi

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Introduction- The lungs, heart and blood vessels perform a vital function as the body's supply system. They supply the muscles with the necessary fuels and oxygen, and carry away waste products such as carbon-die-oxide (co2) and lactic acid. Consequently, the cardio-respiratory system in the athlete needs to be developed to match the muscles which it supplies and cleanses. It is believed that bigger the lungs and heart size greater will be the cardio-respiratory efficiency. Hence the Research Scholar undertook the present study to determine the relationship among the selected variables as well to find out the difference among the Football, Volleyball and Handball.

Keywords: chest girth, vital capacity, respiratory rate, physical education.

GJMR-K Classification: NLMC Code: WF 102



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An Analytical Study of Chest Girth, Vital Capacity and Respiratory Rate of Inter Collegiate Players of Selected Ball Games

Miss. Shivani ^α & Dr. Arvind Kumar Tripathi ^σ

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I. INTRODUCTION

The lungs, heart and blood vessels perform a vital function as the body's supply system. They supply the muscles with the necessary fuels and oxygen, and carry away waste products such as carbon-dioxide (co₂) and lactic acid. Consequently, the cardio-respiratory system in the athlete needs to be developed to match the muscles which it supplies and cleanses. It is believed that bigger the lungs and heart size greater will be the cardio-respiratory efficiency. Hence the Research Scholar undertook the present study to determine the relationship among the selected variables as well to find out the difference among the Football, Volleyball and Handball.

a) Statement of the problem

The research scholar was interested to undertake the study stated as "An Analytical Study of Chest Girth, Vital Capacity and Respiratory Rate of Intercollegiate Players of Selected Ball Games".

b) Purpose of the study

1. The main purpose of the study was to find out the relationship among selected variables i.e. the Chest girth, Vital capacity and Respiratory rate of intercollegiate players of selected ball games.
2. The other purpose of the study was to determine the difference in Chest girth, Vital capacity and Respiratory rate among the players of three selected ball games.

c) Significance of the study

1. The findings of the study would be helpful to the physical education teachers, coaches and players to know the relationship among the chest girth, vital capacity and respiratory rate.
2. The result of the study would help for diagnostic purpose.

3. The findings might help to know which sportsmen possess greater vital capacity and strong respiratory rate hence suitable training programme may be advised accordingly.

d) Hypothesis

1. On the basis of literature, discussion with the experts and scholar's own understanding it was hypothesized that there will be positive co-relation among the selected variables.
2. It was further hypothesized that there will be significance differences in chest girth, vital capacity and respiratory rate among the intercollegiate players of selected ball games.

e) Delimitations

The present study was restricted to the following aspects:-

1. 30 male inter collegiate players were selected from Pt. R.S. University, Raipur.
2. The age of the subjects was ranging from 18 to 28 years.
3. The study was further delimited to the following selected variables: Chest girth, vital Capacity and respiratory rate.
4. The study also delimited to Football, Handball and Volleyball players only.

f) Limitations

1. Coaching and physical education background of the subjects were unknown to the research scholar.
2. The social and economical statuses of the subjects were not known.
3. Diet of the subjects was unknown.
4. Daily routine activities of the subjects were also unknown to the scholar.

II. OPERATIONAL DEFINITION OF THE TERMINOLOGIES

a) Chest girth

Chest girth is the circumference of chest at the level of the nipples in front sub scapular region at the back and is measured at the end of a normal expiration.

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b) *Vital capacity*

It can be defined as the total volume of air that can be forcibly expire after a complete inspiration.

c) *Respiratory rate*

Number of breaths taken in a minute or number of inspiration/expiration in a minute.

III. DESIGN OF THE STUDY

In this chapter selection of subjects, sources of data, selection of tests and criterion measures, administration of test and collection of data are described.

a) *Sources of Data*

For the present study intercollegiate male players of Physical Education were the sources of data.

b) *Selection of Subjects*

30 male intercollegiate players of Pt. R.S. University, Raipur, 10 from each selected sports were selected as subjects for the purpose of the study. The age of the subjects was ranging from 18 to 28 years.

c) *Sampling Procedure*

Simple random sampling method was adopted for the present study.

d) *Criterion Measures*

The criterion measures chosen for the present study were as under -

1. Chest girth was measured by using non stretchable steel tape, and the score was recorded in cm.
2. Vital capacity was measured by using wet spirometer, and the score was recorded in litre.
3. The respiratory rate was counted by using stop watch, and the score was recorded in numbers of exhalation or inhalation in one minute.

e) *Collection of Data*

The data pertaining to the study were collected by applying the selected above mentioned tests following the under described procedures.

f) *Administration of Tests*i. *Chest girth*

Purpose:- to measure the chest circumference of the subjects.

Equipment:- non stretchable steel tape.

Scoring:- the average of the three measurements was recorded in cm.

ii. *Vital capacity*

Purpose:- to measure the volume of air in the lungs at the end of maximal inspiration.

Equipment:- Wet spirometer

Scoring:- the tester observed the indicator closely to note when it had reached the highest point. The score was recorded in litres.

iii. *Respiratory rate*

Purpose:- To measure the inhalation and exhalation of the subjects.

Equipment:- stop watch and mat.

Scoring:- The total number of exhalation or inhalation per minute was recorded for each subject.

IV. ANALYSIS AND INTERPRETATION

a) *Finding*

The data collected on chest girth, vital capacity and respiratory rate of football, volleyball and handball players were computed by using Pearson's Product Moment co-efficient correlation and one way analysis of variance (F- ratio) statistical techniques. The result pertaining to these have been presented in the following tables.

Table 1: Relationship of Chest Girth, Vital Capacity and Respiratory Rate of Intercollegiate Players of Selected Ball Games

GAME	VARIABLES CORRELATED	CO – EFFICIENT OF CORRELATION
Football	Chest Girth and Vital capacity	0.655*
	Chest Girth and Respiratory rare	- 0.772*
	Vital capacity and Respiratory rate	- 0.419
Volleyball	Chest Girth and Vital capacity	0.86*
	Chest Girth and Respiratory rate	- 0.88*
	Vital capacity and Respiratory rate	- 0.08
Handball	Chest Girth and Vital capacity	0.86*
	Chest Girth and Respiratory rate	- 0.71*
	Vital capacity and Respiratory rate	- 0.73*

An analysis of data of football players in Table- 1 reveals that there is significant positive correlation in

between chest girth and vital capacity as the calculated r – value of 0.655 is higher than the tabulated r –value of

0.632 at 0.05 level for 8 degrees of freedom, there is also significant negative correlation in between chest girth and respiratory rate as the calculated r -value of 0.772 is higher than the tabulated r -value of 0.632 but there is no significant correlation between vital capacity and respiratory rate as the calculated r -value of 0.419 is lesser than the tabulated r -value of 0.632 at 0.05 level for 8 degrees of freedom.

For analysis of data of volleyball players, there is significant positive correlation in between chest girth and vital capacity as the calculated r -value of 0.86 is higher than the tabulated r -value 0.632, there is also significant negative correlation in between chest girth and respiratory rate as the calculated r -value of 0.88 is higher than the tabulated r -value 0.632, but there is no

significant correlation between vital capacity and respiratory rate as r -value of 0.08 is lesser than the tabulated r -value of 0.632 at 0.05 level for 8 degrees of freedom.

For analysis of data of handball players, there is significant positive correlation in between chest girth and vital capacity as the calculated r -value of 0.86 is higher than the tabulated r -value of 0.632, there is also significant negative correlation in between chest girth and respiratory rate as the calculated r -value of 0.71 is higher than tabulated r -value of 0.632, and also significant negative correlation in between vital capacity and respiratory rate as the calculated r -value of 0.73 is higher than the tabulated r -value of 0.632 at 0.05 level for 8 degrees of freedom.

Table 2: Comparison of chest girth, vital capacity and respiratory rate among the Intercollegiate male players of Football, Volleyball and Handball

VARIABLE	SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM SQUARE	MEAN SUM OF SQUARE	F-- RATIO
Chest girth	Between the groups	$k-1 = 3-1 = 2$	34.4	$34.4/2 = 17.2$	$17.2/38.8 = 0.44$
	Within the groups	$N-K = 30-3 = 27$	1047.6	$1047.6/27 = 38.8$	
Vital capacity	Between the groups	$k-1 = 3-1 = 2$	2.74	$2.74/2 = 1.37$	$1.37/0.40 = 3.42^*$
	Within the groups	$N-K = 30-3 = 27$	10.83	$10.83/27 = 0.40$	
Respiratory rate	Between the groups	$k-1 = 3-1 = 2$	6.07	$6.07/2 = 3.04$	$3.04/3.92 = 0.78$
	Within the groups	$N-K = 30-3 = 27$	105.8	$105.8/27 = 3.92$	

Table-2 reveals that there are significant difference of vital capacity among the intercollegiate players of selected three ball games as the calculated 'F' value of 3.42 is higher than the tabulated 'F' value of 3.35 at 0.05 level for (2,27) degree of freedom. But there are no significant difference of chest girth and respiratory rate among the intercollegiate players of selected three ball

games as the calculated 'F' values, respectively 0.44 and 0.78 are lesser than the tabulated 'F' value of 3.35 at 0.05 level for (2,27) degree of freedom.

Since the obtained F- ratio was found to be significant, the Least Significant Difference Post Hoc Test was applied to determine the paired mean difference among the selected groups has been shown in Table-3.

Table 3: Paired mean difference of vital capacity among football, volleyball and handball players

MEAN OF			MEAN DIFFERENCE	CRITICAL DIFFERENCE
FOOT BALL	VOLLEY BALL	HAND BALL		
4.07	3.49		0.58*	0.57
4.07		4.18	0.11	0.57
	3.49	4.18	0.69*	0.57

The findings of table-3 reveals that there is significant difference of vital capacity in between the football and volleyball players and also volleyball and handball players as the mean difference of 0.58 and 0.69 respectively are higher than the critical difference of 0.57

at 0.05 level. But there is no significant difference of vital capacity in between the football and handball games players at 0.05 level as means difference of 0.11 is lesser than the critical value of 0.57.

The difference of mean values has been picturesquely depicted in Fig -1

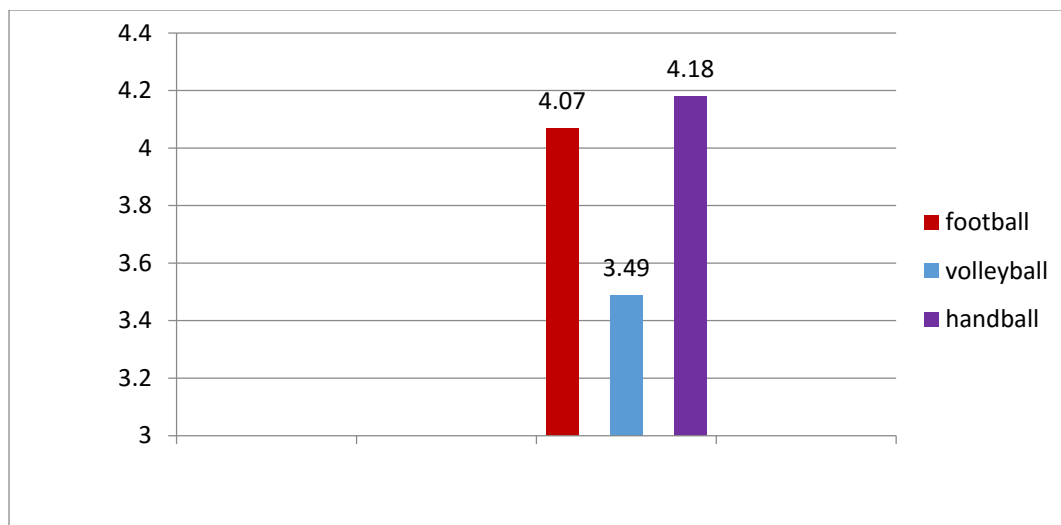


Fig. 1

• Discussion on Findings

It is learnt from the findings of Table -1 that there are significant positive correlation in between chest girth and vital capacity ($r=0.655$, 0.86 and 0.86) of Football, Volleyball and Handball players respectively. The significant positive correlation might have occurred may be attributed to the fact that greater vital capacity depends upon the size of lungs and efficiency of the intercostals muscles which are attached to the ribs of the chest cavity, hence such results occurred in this study.

The findings of Table-1 reveals that there are negatively significant correlation in between chest girth and respiratory rate ($r= - 0.772$, $- 0.88$ and $- 0.71$) of Football, Volleyball and Handball players it may be because less respiratory rate is the product of bigger chest cavity and efficient lungs function, hence this results occur.

Significant relationship also shown in between respiratory rate and vital capacity ($r= - 0.73$) of Handball players it may probably be due to optimal improvement of lungs efficiency.

Findings of Table-3 showed that there are significant mean difference in vital capacity between the Football and Volleyball players ($MD= 0.69$), the significant mean difference occur may be one of the fastest game in the world and completely combination of Aerobic and Anaerobic nature of activity hence they need to improve the vital capacity, according larger vital capacity was shown by the handball players in comparison to volleyball and football players.

V. CONCLUSION

Under the limitation of the study and on the basis of statistical findings it concluded that there are significant positive correlations in between chest girth

and vital capacity and negatively significant correlations in between suggested that to improve vital capacity and develop respiratory rate need to pay due attention for improvement of the chest girth. It is also concluded that handball players showed higher vital capacity than the football and volleyball players, hence due importance to be given while construct a training schedule for the handball players.

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Equine erythrocyte lysed exposed to t-butyl hydroperoxide as a model to study the oxidative stress caused by exercise using a chemiluminescence assay

By Savignone C & Palacios A

Abstract- The present investigation was carried out to determine the presence of oxidative alterations in the horses erythrocyte membrane during a high intensity exercise test. The degree of peroxidation was estimated by chemiluminescence using a suspension of lysed erythrocytes incubated with t-butyl hydroperoxide (t-BHP). Differences were observed in the total values of chemiluminescence throughout the exercise routine, with higher values of light emission obtained with the animal at rest in relation to those observed during and after exercise. The conclusions of this study are the existence of changes in the erythrocyte membranes of the horses exposed to physical exertion, probably associated with the release of ROS caused by the exercise and that the determination of chemiluminescence in suspension of lysates erythrocyte is a sensitive assay applied to detect the existence of oxidative stress associated to physical exercise.

Keywords: oxidative stress; exercise; chemiluminescence; erythrocyte; tert-butyl hydroperoxide.

GJMR-K Classification: NLMC Code: WH 150



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Equine Erythrocyte Lysed Exposed to T-Butyl Hydroperoxide as a Model to Study the Oxidative Stress Caused by Exercise Using a Chemiluminescence Assay

Savignone C ^α & Palacios A ^σ

Abstract- The present investigation was carried out to determine the presence of oxidative alterations in the horses erythrocyte membrane during a high intensity exercise test. The degree of peroxidation was estimated by chemiluminescence using a suspension of lysed erythrocytes incubated with t-butyl hydroperoxide (t-BHP). Differences were observed in the total values of chemiluminescence throughout the exercise routine, with higher values of light emission obtained with the animal at rest in relation to those observed during and after exercise. The conclusions of this study are the existence of changes in the erythrocyte membranes of the horses exposed to physical exertion, probably associated with the release of ROS caused by the exercise and that the determination of chemiluminescence in suspension of lysates erythrocyte is a sensitive assay applied to detect the existence of oxidative stress associated to physical exercise.

Keywords: oxidative stress; exercise; chemiluminescence; erythrocyte; tert-butyl hydroperoxide.

1. INTRODUCTION

During the exercise, there are several potential sources to produce reactive oxygen species, which can produce oxidative stress. Exercise generates different types of physiological responses in an individual that depend on the type and duration of the same, since it supposes a stress for the organism that tests its capacity of adaptation (Art and Lekeux 2005; Vollaard et al. 2005; Posada Arias et al. 2013). During exercise, oxygen consumption (VO_2) is increased, which is used to produce energy in the mitochondria of muscle fibers, generating intermediate species called reactive oxygen species (ROS) (Inayama et al. 2000; Fernandez et al. 2009). In blood, the oxidation of oxyhemoglobin to methaemoglobin generates a large amount of ROS, the value of which is directly related to the type of exercise performed and the need for oxygen in the tissues (Clemens and Waller 1987; Svistunenko 2005). The ROS production during exercise depends on the intensity, frequency, duration and type of exercise (Williams et al. 2005; Kirschvink et al. 2008). Therefore, the exercise is considered as a condition of excessive generation of

ROS, which also results in compensatory compensations by the antioxidant systems (Vollaard et al. 2005), however, ROS generation can become overwhelming for the antioxidant defense system and pose potential problems, inducing the loss of membrane integrity and cellular dysfunctions, affecting cellular lipids, proteins and DNA (Clarkson and Thompson 2000). In relation to blood cells, circulating erythrocytes are regularly exposed to stress conditions and are especially vulnerable as they have no membrane repair mechanism or regenerative capacity. Due to the high tension of O_2 in arterial blood and the content of Fe, within erythrocyte continuously occur ROS such as O_2^- , H_2O_2 and HO (Bakker et al. 2000; Cimen 2008; Herlax et al. 2011). It is known that ROS readily attack polyunsaturated fatty acids (PUFAs), present in cell membranes, such as the erythrocyte, a process known as lipid peroxidation (oxidative destruction of PUFAs) (Dillard et al. 1978). Oxidative lipid damage can lead to disorganization, dysfunction and destruction of membranes (Halliwell and Gutteridge 1990). This may be due to a decrease in their fluidity, inactivation of receptors and enzymes, increased ion permeability and eventually membrane rupture (Gutteridge and Halliwell 1990; Gutteridge 1995). The presence of oxidative stress does not automatically imply oxidative damage. Oxidative stress has been defined as the exposure of cells to various sources that produce a break in the balance between the pro-oxidant factors and the antioxidant mechanisms responsible for eliminating these chemical species, either by a deficit of these defenses or by an exaggerated increase of the production of ROS. All this results in alterations of the structure-function relationship in any specialized organ, system or cell group (Venereo Gutierrez 2002). Oxidative damage can only be verified by direct measurement of different markers of this process. Peroxidation is the biomarker of oxidative damage most extensively studied after exercise (Deaton and Marlin 2003). Various studies in human and veterinary medicine have been developed for the analysis of peroxidation in red blood cells, with the exposure to a large number of prooxidants agents such as: cumenehydroperoxide (Akoev et al. 1998; Tesoriere et al. 2001), t-butyl hydroperoxide (t-BHP) (Mawatari and

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Murakami 2001; Zou et al. 2001; Iglesias and Catalá 2005) and hydroperoxides of fatty acids (Mawatari and Murakami 1998; Udilova et al. 2003). They have been made from suspensions of erythrocyte ghosts (Mawatari and Murakami 1998, 2001; Tesoriere et al. 2001, Zou et al. 2001, Udilova et al. 2003, Iglesias and Catalá 2005 and Muriel 2016), or from lysed cells (Van der Zee 1996; Domanski et al. 2004; Svistunenko 2005; Sajewicz 2010; Sajewicz et al. 2015; Savignone et al. 2016). The aim of the present study was to determine the presence of oxidative alterations in the erythrocyte membrane in horses submitted to a high intensity exercise test by estimating the degree of peroxidation by chemiluminescence.

II. MATERIALS AND METHODS

a) Materials

The tert-BHP was obtained from Sigma Chemical Co. (St. Louis, MO, USA). All other reagents and chemicals were of analytical grade.

b) Animals

Eight adult horses, weighing between 450 and 470 kg and belonging to University farm, were used in the assay. Horses were maintained on alfalfa bale and tap water ad libitum.

The horses were accustomed to continuous training on a treadmill (Kagra, Mustang 2200) which is in the Laboratory of Physiology and Pathophysiology of Equine Sport, Faculty of Veterinary Sciences, National University of La Plata. The animals were given the following standardized exercise protocol: preheating 1 min at 1.5 m/s and 4 min at 4 m/s; then, with a 3% slope, 1 minute steps were performed with increasing intensities (5; 6; 7; 8; 9; 10; 11; 12; 13 m/sec, etc.) until reaching the fatigue point. Finally, the recovery phase was performed without slope at 4 and 1.5 m/s for 4 and 1 min respectively (Muriel 2016). Peripheral blood samples were obtained from the right jugular vein (previous channeling) in heparinized tubes. Samples were taken with the animal at rest prior to exercise (T0 or rest), at the fatigue point (T1 or exercise) and at the end of recovery (T2 or recovery) (Muriel 2016). All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

c) Preparation of erythrocytes

Samples were quantified based on hemoglobin concentration, determined by photometry on a Sysmex KX21-N hematology analyzer (Sysmex corporation, Kobe, Japan). The erythrocytes were isolated from whole blood by centrifugation (1000g for 10 min at 4°C). The buffy coat and plasma were discarded and erythrocytes were washed three times in isotonic phosphate buffer (PBS 5 mM pH 7.4, 150 mM NaCl). The erythrocytes pellet was suspended in isotonic phosphate buffer. Preparation of suspension of lysates erythrocyte was carried out

according to the method of Dodge et al. (1963). Briefly, packed, washed erythrocytes were lysed by adding 10 vol of 5 mM phosphate buffer pH 7.4 (at 4°C) while mixing and after leaving on ice for 30 min. Finally homogenizing the suspension.

d) Peroxidation of erythrocyte analyzed by chemiluminescence

Suspensions of lysates erythrocyte were incubated at a final concentration of 0.25 mg/ml total hemoglobin with 2 mM t-BHP for 40 min at 37°C. Identical aliquots of the preparation were incubated for 40 min at 37°C without addition of t-BHP as the control experiment for endogenous peroxidation products in the erythrocyte lysates preparation.

Peroxidation was initiated by adding a small amount of stock solution of t-BHP (80 mM) to each vial that was maintained at 37°C and was measured by monitoring light emission (Wright et al. 1979) with a liquid scintillation analyzer Packard 1900 TR. Chemiluminescence was determined over a 40 min period and recorded as count per minute (cpm) every 10 min.

e) Statistical analysis

Analysis of variance and student's t-test was performed to test the significance of difference ($P < 0.05$) between the mean values among groups.

f) Results

The addition of t-BHP to equine suspension of lysates erythrocyte resulted in the peroxidation as evidenced by the emission of light. All results are shown in Table 1.

Table 1: Total light emission (cpm x 1000) of lysates erythrocyte

Blood sample time	Equine	1	2	3	4	5	6	7	8	mean \pm SE
T0	with t-BHP	260,1	370,8	271,2	401,1	246,1	400,5	425,0	277,9	331.62 \pm 26 ^a
	without t-BHP	90,4	139,2	174,9	149,3	89,5	115,1	187,2	91,9	129.74 \pm 14 ^b
T1	with t-BHP	250,4	262,9	184,2	256,1	174,8	250,7	315,5	251,4	243.29 \pm 16 ^c
	without t-BHP	98,1	99,4	122,9	150,1	93,9	78,1	145,1	190,7	122.33 \pm 13 ^b
T2	with t-BHP	234,8	275,4	210,1	243,1	224,1	234,3	278,6	240,2	242.63 \pm 8 ^c
	without t-BHP	107,9	185,9	114,8	156,3	103,3	93,9	234,6	200,9	149.73 \pm 19 ^b

abc: means with different superscripts differ significantly at $p < 0.05$

Differences were observed in the total values of chemiluminescence throughout the exercise routine, with observed values of 331.620cpm (\pm 26.324), 243.290cpm (\pm 15.875) and 242.630cpm(\pm 8.351) for T0, T1 and T2 respectively. The values obtained were different between T0 and T1 and between T0 and T2 ($p = 0.0413$ and 0.0131 respectively). There were no differences between T1 and T2.

Figure 1 shows the total chemiluminescence during incubation of equine suspension of lysates erythrocyte with or without the addition of t-BHP.

The higher value of chemiluminescence reached with addition of t-BHP was a 425.002 cpm (equine 7, T0) while the minimum value was 174.860cpm(equine 5, T1).The data are given in Fig. 2.

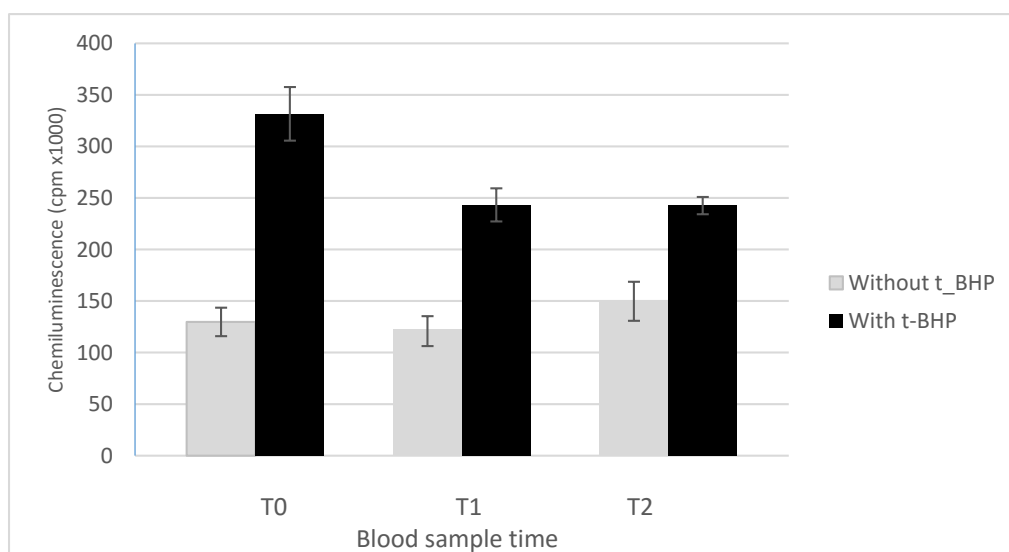


Fig. 1: Total chemiluminescence during incubation with or without t-BHP

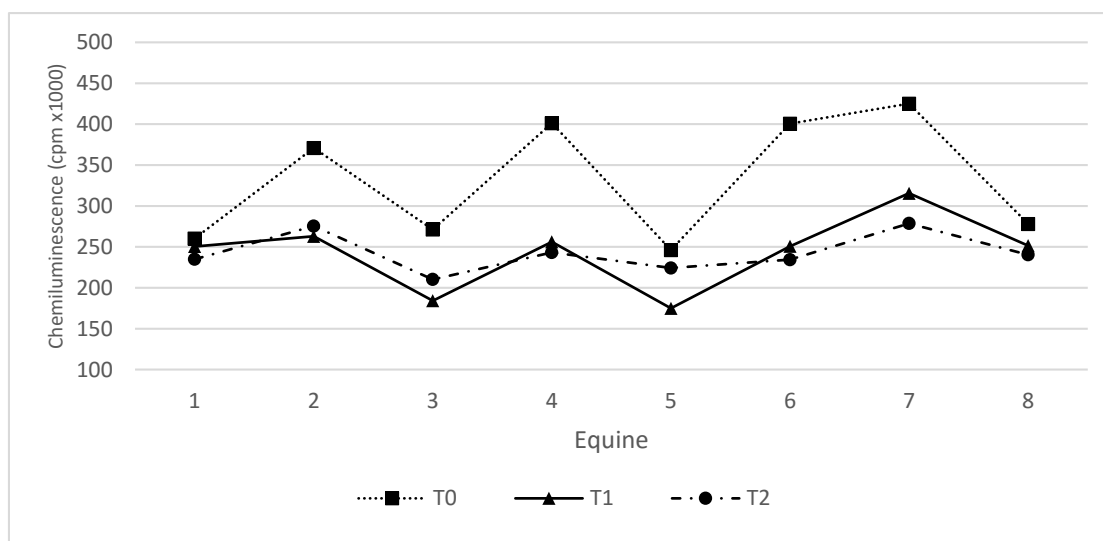


Fig. 2: Individual values of chemiluminescence reached with addition of t-BHP in each equine

III. DISCUSSION

It is known that horses are exposed to exercise-induced changes in oxidative/antioxidant balance, depending on the type of exercise, intensity and duration, training level, environmental conditions, and the presence of diseases (Williams et al. 2005, 2012). In this specie, the occurrence of oxidative stress induced by exercise has been well demonstrated (Hargreaves et al. 2002; Kirschvink et al. 2002). Both training and exercise induce the production of ROS which cause cell and tissue damage (Clarkson and Thompson 2000). The mechanics of ROS generation are not completely clear, although its sources include the oxidation of hemoglobin in the same blood and the processes of ischemia-reperfusion in various tissues (Van der Zee 1996; Domanski et al. 2004; Svistunenko 2005; Muriel 2016). These mechanisms may act synergistically and their magnitude is related to the type of exercise performed and its intensity (Finaud et al. 2006). Respect to the ischemia-reperfusion mechanism, during exercise the flow of blood is restricted in some areas (kidneys and splanchnic region) to be diverted to the active muscles. This produces a hypoxia state in restricted areas, directly related to the magnitude of the exercise (Adams and Best 2002). Also, muscles undergo relative hypoxia during exercise performed at intensities above maximal oxygen consumption, since the supply cannot meet the energy needs (Powers and Jackson 2008). Finally, reoxygenation of these tissues, known as payment of oxygen debt, occurs after cessation of exercise, which leads to an increase in ROS generation (Ji 1999).

In the present study, suspension of lysates erythrocyte from equine submitted to a high intensity exercise, were exposed to a prooxidant (t-BHP). Erythrocytes have many scavenger systems, and can be used to examine the balance between pro-oxidants and antioxidants since they are representative cells where

superoxide radicals are being continuously generated by auto oxidation of hemoglobin. We used lysed red cells because we believe it is a relatively simple model, since in these cells the presence of redox-active hemoglobin residues, with peroxidative activity, potentially catalyzes the oxidation of membrane components including polyunsaturated lipids (Everse et al. 1994; Alayash et al. 2001; Silaghi-Dumitrescu et al. 2007; Lu et al. 2014; Ansari et al. 2015).

Lipid peroxidation is by far the most extensively studied marker of oxidative damage following exercise (Deaton and Marlin 2003). Although it is possible to have chemiluminescence without lipid peroxidation in cell-free systems, it is established that an increase in lipid peroxidation rate in organs and isolated cells produces a parallel increase in photoemission.

We observed the existence of changes in the erythrocyte membranes of the horses subjected to physical exertion, these findings clearly suggest the pro-oxidant environment prevailing in the blood during high-intensity exercise, probably associated with the release of ROS caused by the exercise.

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Towards Automated Epileptic Seizure Detection for Lightweight Devices through EEG Signal Processing

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Abstract- Epileptic seizure is considered as one of the severe disorder of the nervous system. The quality of life hampered those have this disorder. An appropriate system which can detect the epilepsy will leverage the quality of life for the affected person. This paper mainly focuses on the development of a novel method to detect real-time epileptic seizure based on lightweight device such as 'Emotiv Epoc'. Weighted Permutation Entropy (WPE) value was computed to segment and extract the features. A threshold based algorithm which optimizes the battery consumption of the epoc device has also been proposed.

Keywords: epileptic seizure, k-means clustering, discrete wavelet transform, power optimization.

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Towards Automated Epileptic Seizure Detection for Lightweight Devices through EEG Signal Processing

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Abstract- Epileptic seizure is considered as one of the severe disorder of the nervous system. The quality of life hampered those have this disorder. An appropriate system which can detect the epilepsy will leverage the quality of life for the affected person. This paper mainly focuses on the development of a novel method to detect real-time epileptic seizure based on lightweight device such as 'Emotiv Epoc'. Weighted Permutation Entropy (WPE) value was computed to segment and extract the features. A threshold based algorithm which optimizes the battery consumption of the epoc device has also been proposed.

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I. INTRODUCTION

Epilepsy is one of the most common disorders of the nervous system and affects people of all ages, races and ethnic backgrounds. Epileptic seizures are characterized by an unpredictable occurrence pattern and transient dysfunctions of the central nervous system, due to excessive and synchronous abnormal neuronal activity in the cortex [1]. This activity could include several neurons of different locations and sizes. The clinical symptoms of epileptic seizures might affect the motor, sensory, and automatic functions of the body along with the consciousness, cognition, and memory of the patient [2]. To diagnosis of epilepsy, EEG signal interpretation is considered as the most prominent testing tools due to painless, at a reasonable cost, and efficient temporal resolution of long-term monitoring [3]. However for long EEG recording the visual interpretation becomes an expensive, intensive and tedious error-prone exercise and also result can be vary from different neurophysiologists in same recording [4].

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In a conventional system, EEG recording used to be conducted in well equipped hospitals which required equipments are at least bulky, expensive, and require professional setup and configuration. The development of several sophisticated, lightweight and accurate EEG recording devices with wireless transmission like 'Emotiv Epoc' [15] becomes more practical for epileptic patients, offer movement freedom and lowering the infection risks due to percutaneous plugs. The availability of such kind of devices open the door for smartphone based epilepsy care. Today the smartphone has the strong processing capability with high speed wireless connectivity and being extensively used even in low and middle income countries and possible to capture the seizure event and it may serve like a physician having witnessed the event. Now there arises some question such as whether it will satisfy the physician expectation or not, how faster it will give the result against the physician.

In this paper we mainly focus on real-time EEG signal processing for epilepsy monitoring. Here we have designed and developed a novel method for preprocessing and classification step which is suitable for real-time epilepsy detection. Our classification algorithm is based on unsupervised learning and it needs to calibrate the system before running the detection. We also propose a method to optimize the power consumption of the portable device using motion detection algorithm.

The rest of this paper is organized as follows. Section 2 discusses the review of prior work related to the use of smartphone. Section 3 details the EEG processing pipeline for our approach and its components. Section 4 presents the experimental discussion and the power optimization algorithm, followed by the conclusion in Section 5.

II. RELATED WORK

Many researches were done by using offline data form laboratory to improve the feature extraction and classification module. However, a very few real-time work was done with the live EEG data using lightweight devices. In [4], they have evaluated the presently available applications of mobile phones in the day to day care of epileptic patients as a diagnostic,

prognostic and therapeutic tool. Currently a variety of apps like the 'epilepsy society app' or 'my epilepsy diary' or 'epilepsy vault' are available in the market which can be used as seizure diaries allowing the patient or the caregiver to record the basic information regarding epilepsy and its management thus increasing awareness regarding the illness. Some sensor based devices such as 'Epdetect' or 'Smartmonitor's Smartwatch' which can be used to detect a seizure in progress by using inbuilt gyroscopic sensors, accelerometers and GPS modules for detecting a seizure and locale of seizure.

César et al. [5] showed the multi-centre quasi-prospective assessment and evaluation of seizure prediction performance on a long-term EEG recording of 278 patients suffering from pharmaco-resistant partial epilepsy, also known as refractory epilepsy. They explained that computational intelligence techniques showed a high potential for seizure prediction.

Sang-Hong Lee et al. [6] proposed new combined methods to classify normal and epileptic seizure EEG signals using wavelet transform (WT), phase-space reconstruction (PSR), and Euclidean distance (ED) based on a neural network with weighted fuzzy membership functions (NEWFM). From 24 initial extracted features, 4 minimum features with the highest accuracy were selected using a non-overlap area distribution measurement method supported by the NEWFM and this resulted in performance sensitivity, specificity, and accuracy of 96.33%, 100%, and 98.17%, respectively.

An efficient feature extraction method was proposed by computing the spectral power of Hjorth's mobility components, which were effectively estimated by differentiating EEG signals in real-time [7]. They used five epileptic patients EEG data and resulted in a detection rate of 99.46% between interictal and epileptic EEG signals and 99.78% between normal and epileptic EEG signals. Their results suggest that the spectral features of Hjorth's mobility components in EEG signals can represent seizure activity and may pave the way for developing a fast and reliable epileptic seizure detection method.

Noha S. Tawfik et al. [8] introduced a new automated seizure detection model that integrates Weighted Permutation Entropy (WPE) and a Support Vector Machine (SVM) classifier model to enhance the sensitivity and precision of the detection process. The WPE algorithm relies on the ordinal pattern of the time series along with the amplitudes of its sample points. They implemented and tested on hundreds real EEG signals and the performance is compared based on sensitivity, specificity and accuracy. They did various experiments in different scenarios including healthy with eyes open, healthy with eyes closed, epileptic patients during no-seizure state from two different location of the brain. Their results claimed outstanding performance

and revealed promising results in terms of discrimination of seizure and seizure free segments with manifests high robustness against noise sources.

In [9], the authors proposed the new features based on the phase space representation (PSR) for classification of epileptic seizure and seizure-free EEG signals. First of all EEG signals were decomposed using empirical mode decomposition (EMD) and then phase space reconstructed for obtained intrinsic mode functions (IMFs). They proposed new features based on the 2D and 3D PSRs of IMFs for classification of epileptic seizure and seizure-free EEG signals. Least squares support vector machine (LS-SVM) employed for classification of epileptic seizure and seizure-free EEG signals, and evaluated its classification performance using different kernels namely, radial basis function (RBF), Mexican hat wavelet and Morlet wavelet kernels.

In this work we designed and developed a real-time EEG signal processing using Weighted Permutation Entropy based segmentation and select optimum features from time domain and frequency domain and applied the unsupervised machine learning technique to detect the epileptic seizure. We also proposed a threshold based algorithm to optimize the power consumption of the light weight weight device as Emotiv epoc.

III. MATERIALS AND METHODS

In our study we used CHB-MIT scalp EEG dataset which is publicly available in online [14]. This database was collected at the Children's Hospital Boston, consists of EEG recordings from pediatric subjects with intractable seizures. Subjects were monitored for up to several days following withdrawal of anti-seizure medication in order to characterize their seizures and assess their candidacy for surgical intervention. The EEG data were recorded with respect to the international standard 10–20 system. Such recordings were collected from 24 patient subjects where 5 males-aged 3 to 22, 17 females-aged 1.5 to 19 and 1 unknown. All EEG recordings were sampled at 256 Hz with 16-bit resolution. Most files contain 23 EEG signals (24 or 26 in a few cases). In general, the dataset consisted of 916 h of continuously recorded EEG and 198 seizures. All recordings of every patient were divided into 1 h length. According to the annotation files accompanying the dataset, the duration of a seizure was at least 9 s in every EEG recording while the longest seizure was about 190 s long. In this study, we took total 8 minutes where 240 s before the seizure onset for the pre-ictal state and 240 s after the seizure onset for the ictal and post-ictal states from every EEG recording including 23 channels (figure 2(a)). The whole procedure is shown in figure 1.

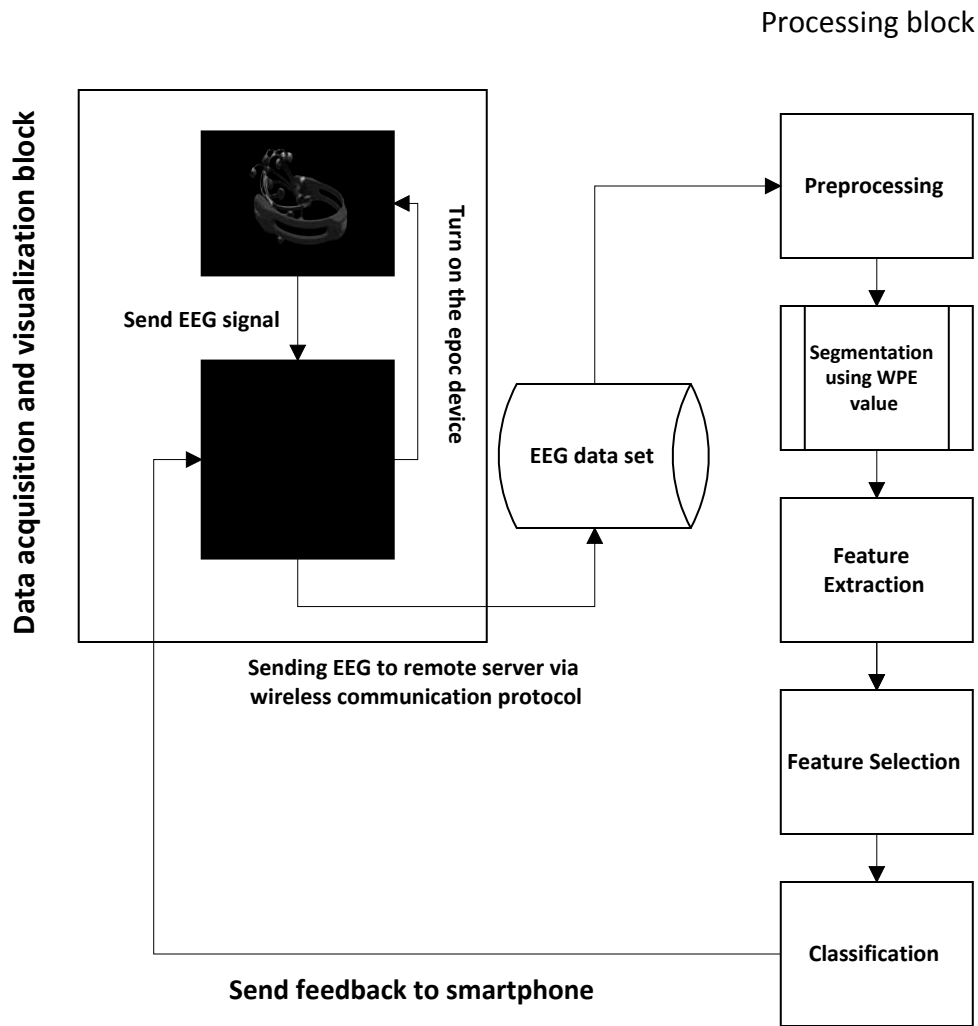


Figure 1: Flow diagram of this work.

a) Preprocessing

To reduce the computational cost and optimize the memory, firstly we resample the EEG raw data from higher frequency to a smaller frequency 128Hz. Band pass filter and notch filter has been applied to remove the artifacts. First of all we applied low pass filter with 0.1Hz and then followed by high pass filter with 60 Hz frequency. The power line interference has been eliminated by using 50Hz notch filter. This filter has been designed according to [10], the quality factor Q is calculated by

$$Q = \frac{f_0}{(f_2 - f_1)} \quad (1)$$

Here frequency f_0 at 50 Hz while the cutoff frequencies f_1 and f_2 at 49 Hz and 51 Hz, respectively. As the filtered signal still nonstationary so we segment the signal using Weighted Permutation Entropy (WPE) value which has been calculated according to [8, 11]. The probability distribution of each pattern with weight ω can be represented as:

$$P\omega(\pi i) = \frac{\sum_{j < N} 1_{u: \text{type}(u) = \pi i(X_j)} \cdot \omega_j}{\sum_{j < N} 1_{u: \text{type}(u) = \pi(X_j)} \cdot \omega_j} \quad (2)$$

here X_j is the arithmetic mean of sequence j given by:

$$\bar{X}_j = \frac{1}{m} \sum_{t=1}^m x_j + (t+1)\tau \quad (3)$$

where m and l denote respectively the embedding dimension and time delay. Each weight values are calculated by,

$$\omega_j = \frac{1}{m} \sum_{t=1}^m x_j + (t+1)\tau - \bar{X}_j \quad (4)$$

WPE is then computed as:

$$H\omega(m, \tau) = -\frac{1}{\ln(m!)} \sum P\omega(\pi i) \ln P\omega(\pi i) \quad (5)$$

We then obtain individual epochs by extracting the EEG signals in a time window $[V, V-]$ around each event marker and this WPE value is calculated for each window; any change in the dynamics of the system will be reflected in the variation of WPE with respect to moving window. The window length VW should be greater than $N!$ for a reliable estimation of WPE (Figure 2(b)).

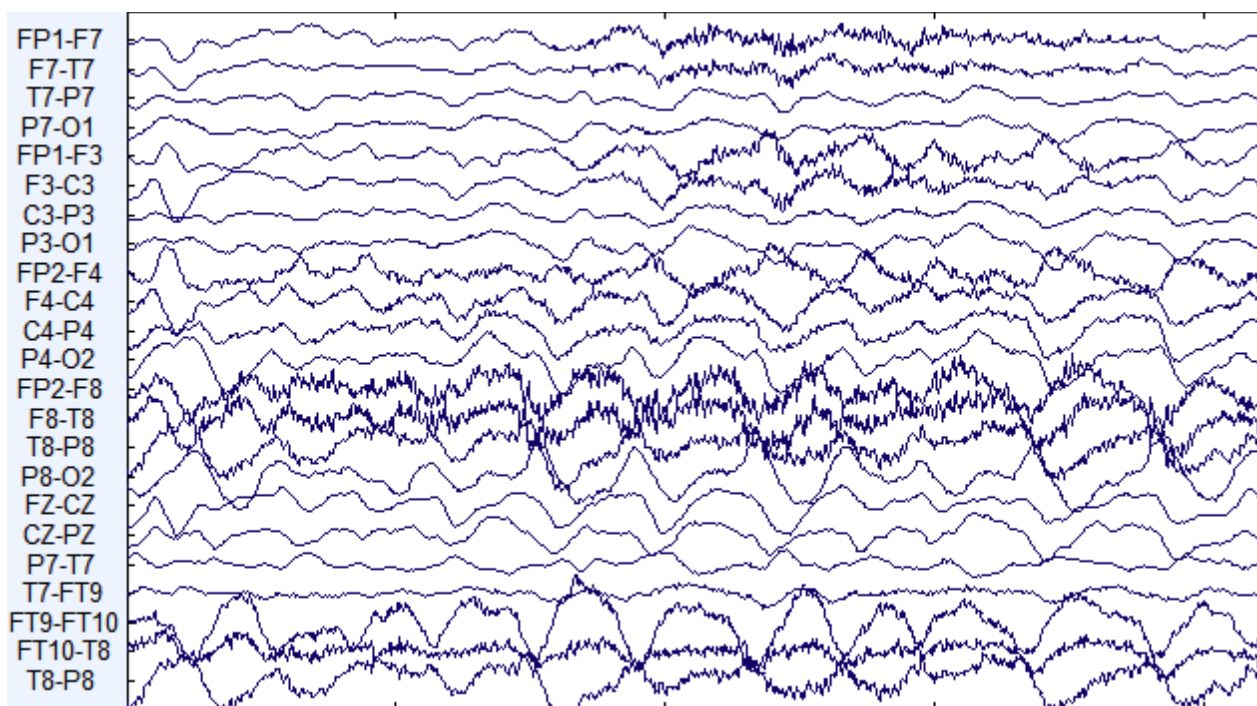


Figure 2(a): Raw EEG data before preprocessing

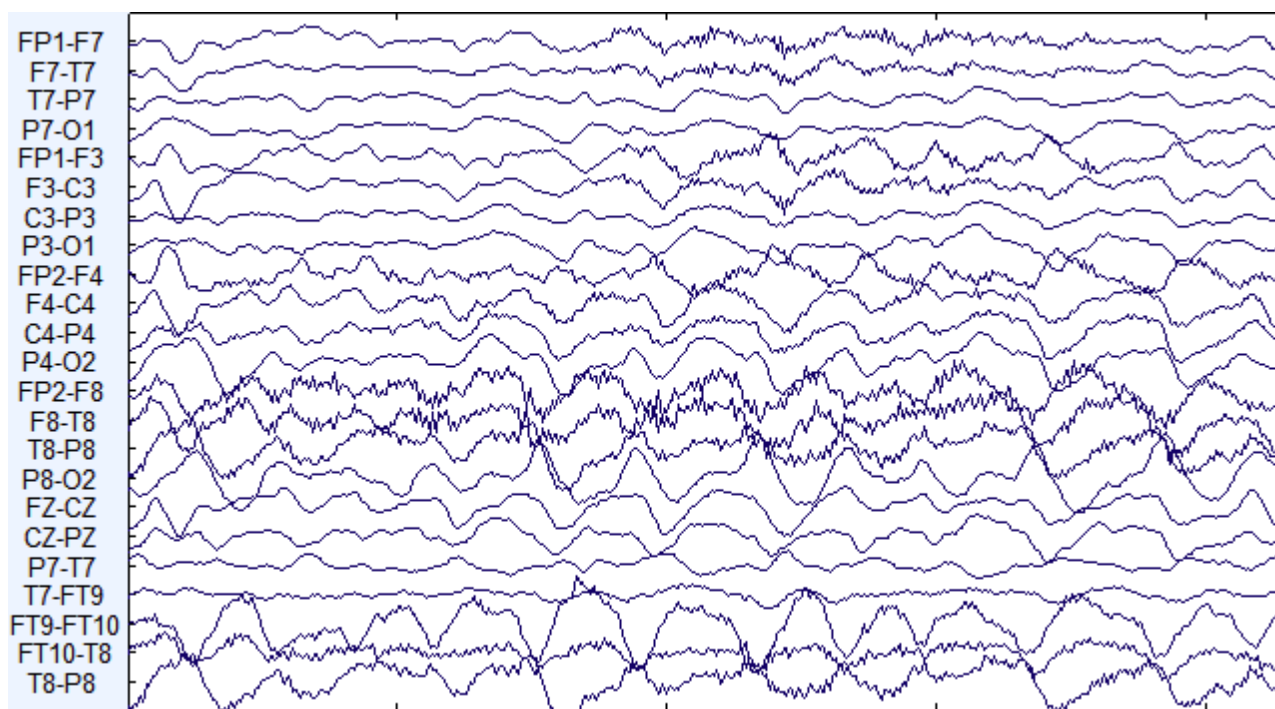


Figure 2(b): Clean EEG data after preprocessing

b) Feature Extraction

The approach to epileptic feature extraction was based on mobility, Fourier transform and wavelet transform. Twenty-five time-domain features were computed for all the selected electrodes, using consecutive 5 s windows without overlap.

For generating time-varying spectral features of the differentiated EEG signals, we applied Short-time Fourier transform (STFT). In the STFT analysis, the

parameters of the sliding window were optimized, including the window size and the step size. Then we extracted the averaged powers ranging from 2 to 55 Hz with 2-Hz frequency resolution. For each frequency-bin, we calculated the ratio of the averaged power of differentiated signals to that of the original signals. Those calculated ratios of all frequency-bins were constructed as a feature vector into classifiers.

A discrete wavelet transform (DWT) was utilized to facilitate efficient time-frequency analysis. The segmented signal is decomposed into a set of coefficients describing the frequency content at given times. According to [12], the DWT can be defined as:

$$S_{2^i}x(n) = h_k S_{2^{i-1}}x(n - 2^{i-1}k) \quad (6)$$

$$W_{2^i}x(n) = \sum_{k \in \mathbb{Z}} g_k S_{2^{i-1}}x(n - 2^{i-1}k) \quad (7)$$

where S_{2^i} is a smoothing operator, W_{2^i} is the digital signal $x(n)$, $k \in \mathbb{Z}$ is the integral set, and h_k and g_k are coefficients for the corresponding low-pass and high-pass filters. As the filtered signal at level i is down-sampled, so we reduce the length of the signal at level $i - 1$ by a factor of two and generating the detail (d_i) and approximation coefficients (a_i) at level i . In our work, using Daubechies 4 (DB4) we produced wavelet coefficients, including detail and approximation coefficients at levels 1–4.

c) Classification

For real time scenario, there is no way to first label or train the data while analyzing live EEG. So we adopted unsupervised classification techniques. That is, these techniques only depend on the information contained in the EEG data. Considering the flexibility of the computation we used K-means clustering technique which partitions the objects into K mutually exclusive clusters, such that objects within each cluster are as close to each other as possible, and as far from objects in other clusters as possible [10,16]. Grouping similar components of a signal enables physicians to localize seizure states quickly. The K-means algorithm minimizes the within-cluster sum of squares by Lloyd iteration to make the data to the same cluster more compact and dependent:

$$\Phi = \sum_{i=1}^k \sum_{j=1}^{|c_j|} d(x_i, c_j) \quad (8)$$

The Euclidean distance between the i th data point and the j th centroid is defined as follows:

$$d(x_i, c_j) = \sqrt{\sum_{j=1}^k (x_i - c_j)^2} \quad (9)$$

The central point of a cluster is recomputed as:

$$c_j = \frac{1}{|c_j|} \sum_{x \in c_j} x \quad (10)$$

The overall k-means algorithm summarized as:

1. Initialization
 - a. Define the number of clusters (k)
 - b. Designate a cluster center for each cluster, typically chosen from the available data points
2. Assign each remaining data pint to the closet cluster centre. That data point is now a member of that cluster.
3. Calculate the new cluster centre from equation (10).
4. Calculate the sum of within-cluster sum of squares from equation (8). If this value has not significantly changed over a certain number of iterations, stop the iterations. Otherwise, go back to step 2.

IV. EXPERIMENTAL RESULTS

We have divided the data as healthy (N), interictal (I) and epileptic (E). According to section 3 we have preprocessed and extracted features. These extracted features then fed to the k-means clustering algorithm and we analyzed the results. Our results showed 97.6 % accuracy. Figure 4 showed the different error rate after applying k-means clustering technique. The statistical measurement showed in Table 1.

Table 1: Performance measurement of our proposed method using K-means clustering

Precision	Recall	F-Measure	ROC Area	Class
0.98	0.985	0.983	0.999	N
0.97	0.97	0.97	0.997	I
0.98	0.97	0.975	0.999	E

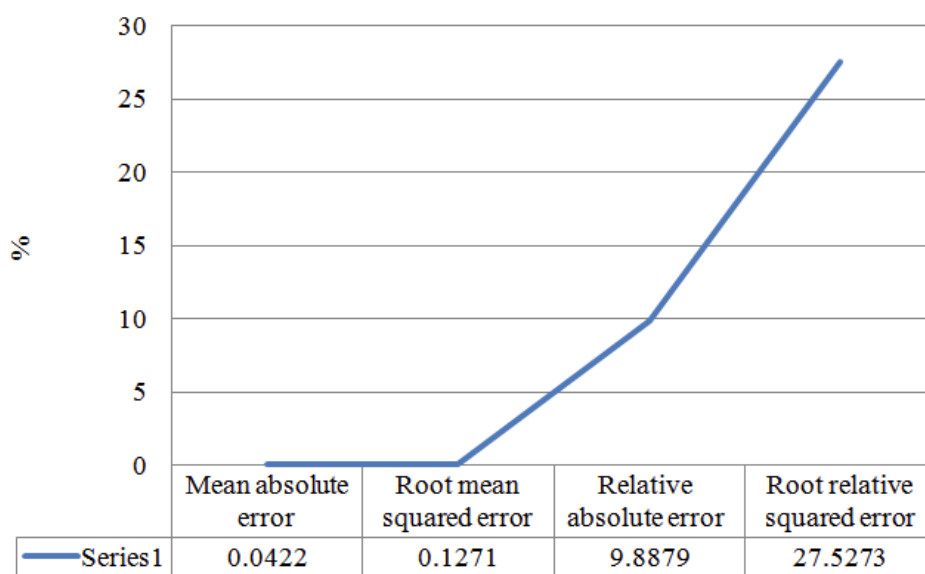


Figure 4: Different error rate for K-means clustering

a) Power optimization

Emotiv Epoc device has limited battery life. We have developed a threshold based algorithm which will optimize the battery life (Figure: 3). In this case, user first needs to place his/her smartphone in arm using an arm band. Then we will use the inbuilt motion sensor to check the frequency of the body movement. If the

frequency movement fall under 2-5 Hz then we consider it as an ongoing seizure and we turn on the epoc device for 10 minutes. After 10 minutes the device will turn to sleep mode and send an acknowledgement to smartphone. So the smartphone is again becoming sensing mode and checking the body movement as described above.

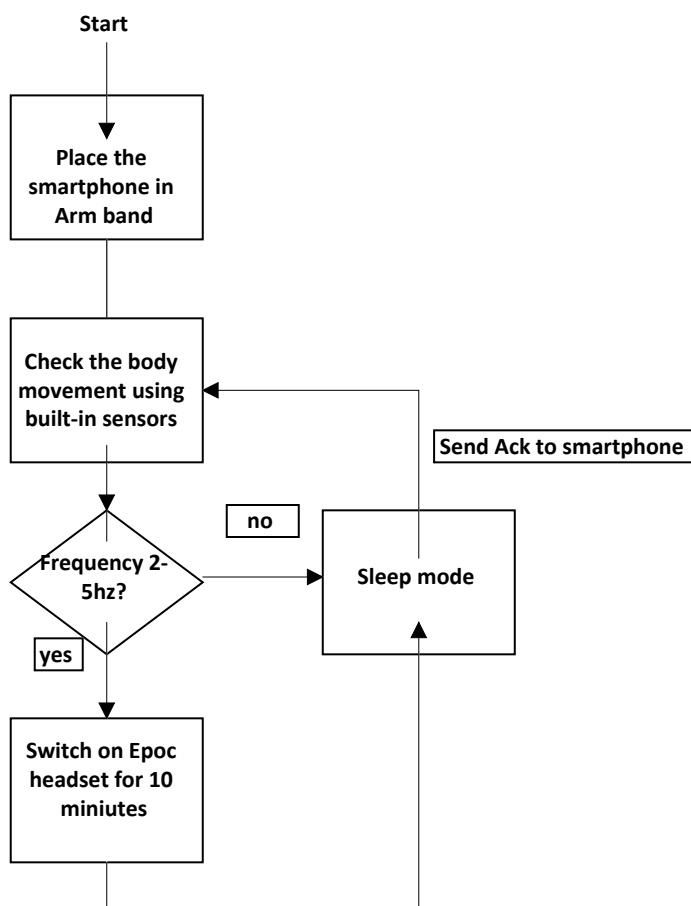


Figure 3: Flow diagram of power optimization

V. CONCLUSION

Monitoring of epilepsy is considered a very challenging activity which requires a set of technical and essential processes including continuous acquisition of EEG signals, pre-processing, feature extraction and selection, seizures detection and classification and continuous visualization of the obtained results. The main contribution of this article lies in developing and implementing an automatic, efficient and scalable approach to monitor the unpredictable occurrence of epileptic seizures in a reasonable time. Our experimental results showed the feasibility to apply our technique in lightweight device such as Emotiv epoc.

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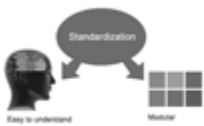
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- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
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- Submit to generally acknowledged facts and main beliefs in present tense.



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<i>References</i>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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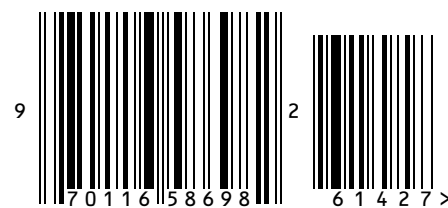
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