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I am glad that the **Volume 11, No. 1, 2015 issue** of **Journal of Exercise Science and Physiotherapy** ***(JESP)*** is ready for circulation. An important milestone has been achieved during the year 2014 with the indexing of the JESP in the Jour Informatics, Global Impact Factor (IF 0.650 for the year 2014), J-Gate, Informit, Electronic Journals Library, University Library of Regensburg, International Scientific Indexing (ISI), SIS, International Impact Factor Service, MIAR, DRJI, Advanced Sciences Inerdex (ASI) Germany (2014 Impact factor 0.8), Jifactor (Medicine Impact Factor 0.5), Open Academic Journals Index, Sjournals Index, Index Copnicus (IC value 4.19), http://www.sherpa.ac.uk/romeo/ as Romeo blue journal. Another achievement is the finalization of digital archiving with Portico where the digital preservation of all the issues of the JESP have been started. More and more commonly used rating is the criteria of citation which has also a great impact on gaining the Impact Factor rating. Building citation rating is long-lasting processes which require strict strategy which is consistently inculcated.All the contributors, reviewers and editorial board members deserve congratulations for their efforts in maintaining the quality of there publications and rigorous review processes and dealing with all this efficiently and in a timebound manner for maintaining the timely release of the journal. The improvement in the SJIF impact factor will help to gain better scores in different kind of evaluations and especially in gaining better citation results. The editorial committee members are busy with their effort to get the journal indexed in more and more databases to further improve the citation of the research published in the JESP.

This issue of JESP contains nine original research articles. One of the very important area of research especially pertaining to India relates to the increasing incidences of diabetes and its associated consequences due to the peripheralneuropathy problem. Over 30 million have now been diagnosed with diabetes in India. The CPR (Crude prevalence rate) in the urban areas of India is thought to be 9 per cent. In rural areas, the prevalence is approximately 3 per cent of the total population. The population of India is now more than 1000 million: this helps to give an idea of the scale of the problem. The estimate of the actual number of diabetics in India is around 40 million. This means that India actually has the highest number of diabetics of any one country in the entire world. IGT (Impaired Glucose Tolerance) is also a mounting problem in India. The prevalence of IGT is thought to be around 8.7 per cent in urban areas and 7.9 per cent in rural areas, although this estimate may be too high. It is thought that around 35 per cent of IGT sufferers go on to develop type 2 diabetes, so India is genuinely facing a healthcare crisis. In India, the type of diabetes differs considerably from that in the Western world. Patients with diabetes often develop peripheral neuropathy, a microvascular complication that may lead to substantial pain to the patient and in advance cases may sometime times cause non healing wounds and even diabetic foot leading to amputations. Because of the increased risk of complication of diabetic peripheral neuropathy an early diagonosis is important for such patients. The studies reported by Kumar et al al from Patiala, Punjab & Chenamgere et al from Manipal, India based on the measurement of reaction times and dynamic foot scanner can serve as useful tools to assess the effects of poor management of diabetes in patients.

I am sure you will enjoy the same and strengthen our hands to futher improve the position of the journal in the international market by contributing your research to JESP.

S.K. Verma

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Prevalence and Determinants of Hypertension among University Employees

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Abstract

Objective: Aim of the present study was to determine the prevalence of hypertension and identify factors (sex, age, BMI, smoking, alcohol consumption, diet (veg vs non-veg), sweet use, ghee use, family history of hypertension, type of work (teaching vs non-teaching)) that determine hypertension among university employees. *Methodology***:** The present study was a cross sectional survey done on a random sample of 100 out of 671 employees (male 71, females 29) aged 18 or above. Determinants data was collected on a standard performa by a trained physiotherapist who also recorded the bp on each subject through recommended procedure. Set point bp for hypertension was 130/85 mmhg for sbp and dbp respectively. Data was analysed by ibm spss (21.0 version) software. *Results:* Males had higher prevalence than females. Prevalence ofhypertension increased with age and bmi. Smoking, alcohol consumption, family history of hypertension, type of work, qualification significantly influenced the occurrence of hypertension among employees. Multiple regression analysis identified qualification, smoking, bmi factors along with constant predicts 79% variability in SBP hypertension. Sex, smoking, bmi factors along with constant predicts 72% variability in DBP hypertension. *Conclusion:* Prevalence of hypertension among university employees was 37%, 41% for sbp, dbp cut-off respectively.higher prevalence is associated with advancing age, higher bmi and lower education. Analysis also showed smoking, alcohol consumption, family history and type of work are risk factors for hypertension in university employees. Finally smoking, BMI along with either qualification or sex explains more than 70% variability in both sbp and dbp hypertension.

Introduction:

Hypertension, defined as elevated blood pressure, is rapidly increasing world wide. It is reported to be a leading cause for mortality, accounting 13% of global death (*Lawes et al., 2008*) and 17% of death in middle income countries, in which India is a part (*WHO, 2009*). It is second only to alcohol use in the middle income countries that causes greater loss of disability adjusted life years (DALYs), accounting 5.4% of total DALYs (*WHO, 2009*). Once considered as disease of developed and industrialized nations, hypertension is rapidly increasing in developing countries now (*Pereira et al., 2009*) and is one of the leading causes of death and disability in developing countries (*Deepa et al., 2003*). Most recent review of hypertension prevalence rates in India (*Gupta, 2004*) reports a significant rise in the prevalence of hypertension. The current prevalence rate of hypertension in India is now equal to that of USA (*WHO, 2011*).

Previous studies indicate that the prevalence of hypertension varies considerably from one region of India to another. This fact emphasis the need of prevalence studies in different parts of India as our country is multi cultural, multi lingual, multi ethnic society. However, there are only very few studies available from Haryana state- that is too using old WHO classification of 160/90 mm of Hg as hypertension reference value (*Gupta et al., 1978*).

India is the third largest country in higher education only after China and America. Since the Indian government considers higher education as one of main source for future economic growth, it allocated considerable percentage of its budget into higher education in11thfive year plan. Its objective is to improve the student gross enrollment index from current 15% to 22% at end of 12thfive year plan which is equal to world's average. To achieve this objective, number of universities has increased to 431 with 5.05 lakh total number of teachers apart from non-teaching academic and administrative supporting staffs (*Gupta, 2010*). The people working in these universities are coming from diverse socioeconomic backgrounds.Their working style also differs both physically and psychologically. This may lead to the development of hypertension among the university population.

Age, sex, smoking, family history of hypertension, obesity (increased BMI or waist circumference), physical inactivity are considered as some of the risk factors for primary hypertension. Thus, primary objective of the present study was to see the prevalence of hypertension among university employees in Haryana according to their qualifications, type of work, age, sex, BMI and other personal traits such as smoking, alcohol use, and type of food intake. The preview of the aim is thus to see whether these factors along with fast food intake, weekly salad, fruit, ghee and sweet use ingestion, self-reported hypertension (self HTN) determine the hypertension presence or not in the university employees.

Materials & Methods:

Present study was a cross sectional study that was carried out at a university in Haryana with a total eligible population of 671 (both teaching and non-teaching staffs). Sample size was determined using online sample size calculator, confidence interval 95% with 10% margin of error for 671 subjects yielded 101 as sample size, for practical reason study was carried out on 100 subjects. The subjects were selected using systematic random sampling method from university employees list- every sixth employee from any one of first 71 serial numbers. There was 0% refusal rate as the study was a part of university health programme. There were a total of 100 (71 males and 29 females) subjects with mean ± SD age, height, weight of 34.33 ± 8.80 yrs, 171.24 ± 8.20 cm, 67.12 ± 12.24 kg respectively.

Prior to BP measurement, subjects were asked to sit and following details were recorded from each subject for risk stratification and subsequent analysis: age, sex, height, weight, work profile (teaching, non-teaching), educational qualification, food preference (vegetarian, non-vegetarian), usage of salad, fruit, sweets and ghee (per week), consumption of fast foods, smoking history, alcohol usage, self HTN.

The Physiotherapist measured height with a stadiometer. Patients stood on a firm surface in their bare feet to have their height measured. Body mass was measured at the end of examination with a calibrated bathroom-type digital scale, on a firm surface. Patients were weighed in the standing position, wearing light indoor clothes, but no shoes, jewellery or heavy clothing. Body mass index was calculated by weight (in kg) divided by height (in m^2), and all subjects were divided into low weight (BMI ≤18.5), normal weight (BMI 18.5-22.9), overweight (BMI 23.0-24.9), mild obese (BMI 25.0-26.9), moderate obese (BMI 27.0-29.9) and morbid obese (≥30.0) groups based on recent Indian Health Ministry Guidelines based on *Singh et al., (2008) and Misra etal., (2009).*

Blood pressure Measurement: Bloodpressure was measured through standard procedure using mercury sphygmomanometer and stethoscope (*Frese et al., 2011*).In simple, subjects were seated quietly in a chair with back support, with both feet flat on the floor and arms at heart level, for at least 5 minutes prior to obtaining a measurement.They were instructed to relax as much as possible and to not talk during the measurement procedure. The blood pressure cuff placed on the patient's bare arm and inflated 30 mmHg above disappearance of brachial pulse. Then cuff was deflated at recommended rate of 2 mm Hg per second. Systolic blood pressure was recorded at the point in which auscultatory pulsations (Korotkoff phase I) appeared and the disappearance of the auscultatory pulsations (Korotkoff phase V) was recorded as diastolic pressure. The whole procedure was repeated again. If the difference between the two readings is more than 5 mm Hg, one more readings was obtained, and the average of the three readings was used for analysis.The cut-off point for hypertension was ≥130 and ≥85 mmHg for SBP hypertension and DBP hypertension respectively.

Hypertension Classification: Hypertension was classified based on ESH (European society of hypertension)/ESC (European society of cardiology) criteria (*Mancia et al., 2007*). This states < 120/<80 mmHg of SBP/DBP as optimal, 120-129/80-84 mmHg as normal, 130-139/85-89 mmHg as high normal, 140-159/90-99 mmHg as grade I hypertension, 160-179/100-109 mmHg as grade II hypertension and ≥180/≥110 mmHg as grade III hypertension. In the present investigation, high normal was included into hypertension risk classification for two reasons. First, ATP (adult treatment panel) for metabolic syndrome include ≥130/≥85 mmHg as hypertension. Secondly, risk for cardiovascular disease double by every 20/10 mmHg rise that starts from 115/75 mmHg. This means even high normal group faces danger of cardiovascular disease (*Lewington et al., 2002; IOM, 2010*). *Statistics:* The Chi-square test (multinominal) was carried out to detect factors that may determine the hypertension. Only factors that were significant in chi-square test were entered into binary logistic regression analysis. All three types (enter, forward and backward) with two modes (with or without constant) was used for regression analysis and the best prediction model was used for presentation. Above said analysis were carried out for both SBP and DBP separately. All statistical analyses were performed using the 'IBM SPSS (21.0 version)' software. A p-value less than 0.05 were used to define statistical significance.

Results:

The overall prevalence of SBP and DBP hypertension based on educational qualifications, age, sex, BMI, smoking, alcohol use, work type and different stages of hypertension was found out and presented in Table 1. In general hypertension prevalence was observed to increase with increase in age and BMI and decrease as the education level increased. Smoking and alcohol use was observed to increase the hypertension prevalence. Male and non-teaching staffs were more commonly affected by hypertension than their counterparts. High normal hypertension was most prevalent and subsequently hypertension rate decreased.

Table 2 shows the significant factors decided by multinominal chi-square test with odds ratio (OR) for dichotomous variables using binary chi-square test. BMI and self HTN are the most significant factors followed by smoking for SBP hypertension. BMI followed by sex are observed to be the most significant factors for DBP hypertension. Binary chi-square test showed smoking and self HTN as highest two OR values for both SBP and DBP hypertension amongst five variables.

Table 1: Prevalence of SBP and DBP hypertension based on qualification, age, BMI, sex, smoking, alcohol use, work type and ESH classification

Factor	Sub factor (n)	Prevalence (%) SBP (37%)	DBP (41%)
Educational Qualifications	Doctrate (n=17)	29.40	29.40
	Post Graduates (n=42)	21.40	33.30
	Post Matric & Graduates (n=33)	57.60	51.50
	Matric & Below (n=8)	50.00	62.50
Age, yrs	<30(n=39)	30.80	33.30
	30-39(n=34)	35.30	44.10
	40-49(n=21)	42.90	47.60
	>49(n=6)	66.70	50.00
BMI (Kg.m^{-2})	Low weight (n=8)	12.50	12.50
	Normal weight (n=45)	37.80	40.00
	Over weight (n=22)	22.70	36.40
	Mild obese (n=10)	30.00	30.00
	Moderate obese (n=13)	69.20	69.20
	Morbid obese (n=2)	100.00	100.00
Sex	Males (n=71)	43.70	50.70
	Females (n=29)	20.70	17.20
Smoking	Yes (n=15)	80.00	73.30
	No (n=85)	29.40	35.30
Alcohol Use	Yes (n=15)	58.30	58.30
	No (n=76)	30.30	35.50
Work Type	Teaching (n=45)	24.40	26.70
	Non Teaching (n=55)	47.30	52.70
ESH Category	High Normal	23.00	16.00
	Grade 1	13.00	08.00
	Grade II	01.00	11.00
	Grade III	00.00	06.00

Table 2: significant factors along with OR (95% CI) for hypertension in University employees (n=100).

Variable (DF)	X^2 SBP	X^2 DBP	OR (95% CI) SBP	OR (95% CI) DBP
Sex (n=4)	08.188*	13.285**	2.97 (1.08-8.19)	4.94 (1.69-14.39)
Work Profile (n=4)	10.198*	09.746*	2.77 (1.17-6.56)	3.07 (1.32-7.15)
Qualification (n=12)	18.565*	17.574^{NS}		
Smoking (n=4)	14.951**	09.361*	9.60 (2.49-36.97)	5.04 (1.48-17.21)
Alcohol use (n=4)	09.468*	07.649^{NS}	3.23 (1.25-8.32)	
Self HTN (n=4)	16.237***	11.379*	7.08 (2.08-24.09)	5.69 (1.68-19.23)
BMI (n=20)	39.983***	56.719***		

*, **, *** are p less than 0.05, 0.01, 0.001 respectively. NS means non-significant value. OR values represents males in sex, non-teaching in work profile, yes in smoking, alcohol use, and self HTN.

Table 3: Determinants of SBP in university employees (n=100)
Model: Backward (conditional) method (4 steps)- x^2= 35.482-0.045-0.282-0.705= 34.450

VARIABLE	β	SE	OR	95% CI OF OR	P
Qualification	-0.757	0.316	0.469	0.252-0.871	0.017
Smoking	2.564	0.818	12.989	2.615-64.523	0.002
Self HTN	1.227	0.735	3.411	0.808-14.400	0.095
BMI	0.644	0.237	1.904	1.198-3.027	0.006
Constant	-4.764	1.483	0.009		0.001

Table 3 shows determinants for SBP after entering all the seven variables in Table 2 into a binary logistic regression analysis. Backward step conditional logistic regression with constant was the best model that could explain the SBP in our population. Qualification, smoking, self HTN and BMI were collectively able to explain 79% of variability in SBP in our population.

Table 4 shows determinants for DBP after entering all the five variables in Table 2 into a binary logistic regression analysis. Enter method logistic regression with constant was the best model that could explain the DBP in our population. Sex, smoking and BMI were collectively able to explain 74% of variability in DBP in our population.

Table 4: Determinants of DBP in university employees (n=100)

Model: Enter method with constant- x^2= 27.217

SNo	Variable	β	SE	OR	95% CI of OR	p
1.	Sex	1.385	0.668	3.993	1.079-14.778	0.038
2.	Smoking	1.490	0.806	4.436	0.914-21.533	0.065
3.	BMI	0.448	0.217	1.565		0.039
	Constant	-7.518	1.736	0.001	1.023-2.394	0.000

OR (95% CI) values represents males in sex, morbid obese in BMI, yes in smoking.

Discussion:

The overall prevalence of hypertension of 48%, observed in the present study is in agreement with recent study reported on larger sample size in India (*Gupta et al 2004*) and *WHO report (2011).* There was 37% SBP hypertension and 41% DBP hypertension in university employees.Hypertension is a major public health problem in India and the world. Various studies conducted across the country have estimated the prevalence of hypertension ranging from 0.76% in 1994 to 79.8% in 2011. However, the study results were not consistent, due to variations in the cut off values and also differing age groups constituting the study.

Epidemiologicalstudies to assess the prevalence of hypertension are essential as these can be used as baseline value for future research to see the risk factor trends. These studies also help to implement preventive strategies in high risk areas or population. Currently available hypertension preventive strategies include promoting health through reducing weight, increasing physical activity, decreasing salt intake amongst target population. These efforts have the potential to reduce the emergence or minimize the prevalence of pre-hypertension and hypertension in different regions of India.

To our knowledge this is the first of this kind and there is no study that is related to the prevalence of hypertension in university employees either within India or outside. This limits the discussion so we tried to compare our results with latest Indian hypertension epidemiological studies that are similar to our objectives.

Recently published article by *Gupta et al. (2013)* on middle class urban subjects reported that hypertension prevalence increase as the age, educational qualification and BMI increase which supports our findings. However, their study results indicate low socio-economic status linkage with less prevalence of hypertension. They also reported fat intake, fruits and salad usage as other risk factors for hypertension.

Hypertension prevalence has been reported to decrease with an icrease in the education level in the present investigation; this observation is in agreement with the similar findings reported by *Kumar et al. (2011) &; Meshram et al. (2012)*. Further the results of the present study demonstrate a gradual increase in the prevalence rate with increase in the age of the subjects. The previous studies have also shown an overall increase in prevalence of hypertension with age (*Hajjar et al. 2006; Agrawal et al. 2008; Kannan and Satyamoorthy, 2009; Todkar et al, 2009; Jonas et al., 2010; Srinivasan et al, 2010; Kumar et al., 2011; Parikh et al., 2011; Bharati et al., 2012; Meshram et al., 2012; Rajasekar et al., 2012*). Thus the prevalence is least in the >29 years age group and highest 50 years and above age groups.The finding of increase in the prevalence of hypertension with increase in the body mass index of the subjects agrees with similar results of association of BMI/obesity with hypertension reported by many researchers(*Deshmukh et al, 2006; Hajjar et al. 2006; Gupta et al, 2007; Mohan et al, 2007; Radhika et al, 2007; Agrawal et al. 2008; Yadav et al, 2008; Tiwari et al, 2009; Todkarei al, 2009; Jonas et al., 2010; Bharati et al., 2012; Meshram et al., 2012; Rajasekar et al., 2012). Landsberg et al., (2013)* in their study proposed various patho mechanisms for higher incidence of hypertension in obese population.

The present study results show that prevalence of hypertension is significantly higher in men compared to women. *Hajjar et al. (2006)* reported steeper increase in blood pressure among men with the advancement in age than women before menopause. *Bhat et al. (2010)* observed double the number of hypertension cases among men which is similar to our findings. Similar findingshave been observed by *Tiwari et al., (2009); Bharati et al.(2012); Rajasekar et al. (2012)***.**Hypertension was more prevalent in subjects who take smoking and alcohol. The findings of present study were observed to be similar to other authors (*Hajjar et al. 2006; Mohan et al, 2007; Agrawal et al. 2008; Yadav et al, 2008; Kannan and Satyamoorthy, 2009; Todkar et al, 2009; Parikh et al., 2011; Bharati et al., 2012; Meshram et al., 2012; Rajasekar et al., 2012***)**. In fact recent meta-analysis done by *Briasoulis et al., (2012)* showed increased alcohol consumption has progressively increased the incidence of hypertension.

The prevalence of hypertension was more among non-teaching staff than the teaching staff. The relation was highly significant. The most probable reason assigned to this high prevalence may be related to their day to day engagements, sedentary habits, lower education (*Kumar et al., 2011; Meshram et al., 2012*), lower socioeconomic status (*Kumar et al., 2011; Meshram et al., 2012; Rajasekar et al., 2012*), lower occupational class (*Lynch et al., 1998*), no exercise and stress and strain of office work (*Markovitz et al., 2004*) and present day society including indulgence in alcohol and smoking.

The sample size of the present study was small and localized to one university in a small state of India. Generalization of these results into a larger section need warranted. This is the main limitation of the present study. However, main purpose of this study was to identify the problem in the said population so that future extra mural projects could be implemented in the high risk population (i.e) based on the results we could say male non-teaching staffs with smoking and or alcohol habits need intervention.

Conclusion: The prevalence of hypertension in university employees was similar to that of national average. So this population should be considered as high risk population and preventive measure should be taken to control them. Male sex, non-teaching staffs (lower qualification), obesity (high BMI), smoking are factors that could determine the blood pressure in this population

References:

Agrawal, V.K., Bhalwar, R., Basannar, D.R. 2008. Prevalence and determinants of hypertension in a rural community. *Med. J. Armed Forces India.*, **64(1):** 21-5.

Bharati, D.R., Nandi, P., Yamuna, T.V., Lokeshmaran, A., Agarwal, L., Singh, J.B., Basu, M., Das, P., Pal, R. 2012. Prevalence and covariates of undiagnosed hypertension in the adult population of Puducherry, south India. *Nepal Journal of Epidemiology.*, **2(2):**191-9.

Bhat, R.A., Laway, B.A., Zargar, A.H. 2010. Prevalence of metabolic syndrome in Kashmir valley of Indian subcontinent. *Indian J. Med. Sci.*, **64:** 259-64.

Briasoulis, A., Agarwal, V., Messerli, F.H. 2012. Alcohol consumption and the risk of hypertension in men and women: A systematic review and meta-analysis. *J. Clin. Hypertens. (Greenwich).*, **14:**792-8.

Deepa, R., Shanthirani, C.S., Pradeepa, R., Mohan, V. 2003. Is the 'rule of halves' in hypertension still valid?--Evidence from the Chennai Urban Population Study. *J. Assoc. Physicians India.*, **51:**153-7.

Deshmukh, P.R., Gupta, S.S., Dongre, A.R., Bharambe, A.S., Maliye, C., Kaur, S., et al. 2006. Relationship of anthropometric indicators with blood pressure levels in rural Wardha. *Indian J. Med. Res.*, **123(5):** 657-64.

Frese, E.M., Fick, A., Sadowsky, H.S. 2011. Blood pressure measurement guidelines for physical therapists. *Cardiopulm. Phys. Ther. J.*, **20(2):** 5-12.

Gupta, P.C., Gupta, R., Pednekar, M.S. 2004. Hypertension prevalence and blood pressure trends in 88,653 subjects in Mumbai, India. *J. Hum. Hypertens..*, **18:** 907–10.

Gupta, R. 2004. Trends in hypertension epidemiology in India. *J. Hum. Hypertens.*, **18:**73-8.

Gupta, R., Rastogi, P., Sarna, M., Gupta, V.P., Sharma, S.K., Kothari, K. 2007. Bodymass index, waist-size, waist-hip ratio and cardiovascular risk factors in urban subjects. *J. Assoc. Physicians. India.*, **55(9):** 621-7.

Gupta, S.P., Siwach, S.B., Moda, V.K. 1978. Epidemiology of hypertension. Based on total community survey in the urban population of Haryana. *Indian Heart J.*, **30:** 315-22.

Gupta, B.M. 2010. Ranking and performance of Indian Universities, based on publication and citation data. *Indian J. Sci. Technol.*, **3(7):** 837-43.

Gupta, R., Deedwania, P.C., Achari, V., Bhansali, A., Gupta, B.K., Gupta, A., Mahanta, T.G., Asirvatham, A.J., Gupta, S., Maheshwari, A., Saboo, B., Jali, M.V., Singh, J., Guptha, S., Sharma, K.K. 2013. Normotension, prehypertension and hypertension in urban middle-class subjects in India: Prevalence, awareness, treatment and control. *Am. J. Hypertens.*, **26(1):** 83-94.

Hajjar, I., Kotchen, J.M., Kotchen, T.A. 2006. Hypertension: Trends in prevalence, incidence and control. *Annu. Rev. Public Health.,* **27:** 465-90.

IOM (Institute of Medicine). 2010. *A Population-Based Policy and Systems Change Approach to Prevent and Control Hypertension.* Washington, DC: The National Academies Press.

Jonas, J.B., Nangia, V., Matin, A., Joshi, P.P., Ughade, S.N. 2010. Prevalence, awareness, control and associations of arterial hypertension in a rural central India population: The central India eye and medical study. *Am. J. Hypertens.,* **23:** 347-50.

Kannan, L., Satyamoorthy, T.S. 2009. An epidemiological study of hypertension in rural household community. *Sri Ramachandra Journal of Medicine.,* **2(2):** 9-13.

Kumar, N.P., Shankaregowda, H.S., Revathy, R. 2011. An assessment of preventable risk factors for chronic non-communicable diseases in an adult population. *Asian Journal of Epidemiology.,* **4(1):** 9-16.

Landsberg, L., Aronne, L.J., Beilin, L.J., Burke, V., Igel, L.I., Lloyd-Jones, D., Sowers, J.. 2013. Obesity-related hypertension: Pathogenesis, cardiovascular risk and treatment. *J. Clin. Hypertens (Greenwich).,* **15:**14-33.

Lawes, C.M.M., Vander Hoorn, S., Rodgers, A.; International Society of Hypertension. 2008. Global burden of blood-pressure-related disease, 2001. *Lancet.,* **371(9623):** 1513-8.

Lewington, S., Clarke, R., Qizilbash, N., Peto, R., Collins, R.,. 2002. Age-specific relevance of usual blood pressure to vascular mortality: A meta-analysis of individual data for one million adults in 61 prospective studies. *Lancet.,* **360:** 1903-13.

Lynch, J.W., Everson, S.A., Kaplan, G.A., Salonen, R., Salonen, J.T. 1998. Does low socioeconomic status potentiate the effects of heightened cardiovascular responses to stress on the progression of carotid atherosclerosis? *Am.J. Public Health.,* **88:** 389–94.

Mancia, G., De Backer, G., Dominiczak, A., Cifkova, R., Fagard, R., Germano, G., Grassi, G., Heagerty, A.M., Kjeldsen, S.E., Laurent, S., Narkiewicz, K., Ruilope, L., Rynkiewicz, A., Schmieder, R.E., Boudier, H.A.J.S., Zanchetti, A., Vanhanian, A., Camm, J., De Caterina, R., Dean, V., Dickstein, K., Filippatos, G., Funck-Brentano, C., Hellemans, I., Kristensen, S.D., McGregor, K., Sechtem, U., Siber, S., Tendera, M., Widimsky, P., Zamorano, J.L., Kjeldsen, S.E., Erdine, S., Narkiewicz, K., Kiowski, W., Rosei, E.A., Ambrosioni, E., Cifkova, R., Dominiczak, A., Fagard, R., Heagerty, A.M., Laurent, S., Lindholm, L.H., Mancia, G., Manolis, A., Nilsson, P.M., Redon, J., Schmieder, R.E., Struijker-Boudier, H.A.J., Viigimaa, M., Filippatos, G., Adamopoulos, S., Agabiti-Rosei, E., Ambrosioni, E., Bertomeu, V., Clement, D., Erdine, S., Farsang, C., Gaita, D., Kiowski, W., Lip, G., Mallion, J.M., Manolis, A.J., Nilsson, P.M., O'Brien, E., Ponikowski, P., Redon, J., Ruschitzka, F., Tamargo, J., Zwieten, P., Viigimaa, M., Waeber, B., Williams, B., Zamorano, J.L. 2007. Guidelines for the management of arterial hypertension: The task force for the management of arterial hypertension of the European society of hypertension (ESH) and of the European society of cardiology (ESC). *Eur. Heart J.,* **28(12):**1462-536.

Markovitz, J.H., Matthews, K.A., Whooley, M., Lewis, C.E., Greenlund, K.J. 2004. Increases in job strain are associated with incident hypertension in the CARDIA Study. *Ann. Behav. Med.,* **28:**–9.

Meshram, I.I., Arlappa, N., Balkrishna, N., Rao, K.M., Laxmaiah, A., Brahmam, G. 2012. Prevalence of hypertension, its correlates and awareness among adult tribal population of Kerala state, India. *J. Postgrad. Med..,* **58:** 255-61.

Misra, A., Chowbey, P., Makkar, B.M., Vikram, N.K., Wasir, J.S., Chadha, D., Joshi, S.R., Sadikot, S., Gupta, R., Gulati, S., Munjal, Y.P.. 2009. Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for asian Indians and recommendations for physical activity, medical and surgical management. *J Assoc Physicians India.,* **57(2):** 163-70.

Mohan, V., Deepa, M., Farooq, S., Datta, M., Deepa, R. 2007. Prevalence, awareness and control of hypertension in Chennai - the Chennai urban rural epidemiology study (CURES – 52). *J. Assoc. Physicians India.,* **55(5):** 326-32.

Parikh, S., Choksi, J., Bala, D.V. 2011. The study of epidemiology & determinants of hypertension in urban health training center (UHTC). *Gujarat Medical Journal.,* **66(1):** 22-7.

Pereira, M., Lunet, N., Azevedo, A., Barros, H. 2009. Differences in prevalence, awareness, treatment and control of hypertension between developing and developed countries. *J. Hypertens.,* **27(5):** 963-75.

Rajasekar, V.D., Krishnagopal, L., Mittal, A., Singh, Z., Purty, A.J., Binu, V.S., Iillayabharathi, V. 2012. Prevalence and risk factors for hypertension in rural area of Tamil Nadu, South India. *Indian Journal of Medical Specialities.,* **3(1):** 12-7.

Singh, S.P., Sikri, G., Garg, M.K. 2008. Body mass index and obesity: Tailoring "cut-off" for an Asian Indian male population. *Med. J. Armed Forces India.,* **64(4):** 350-3.

Tiwari, R., Srivastava, V., Gour, N. 2009. A cross-sectional study to determine prevalence of obesity in high income group colonies of Gwalior city. *Indian journal of Community Medicine.,* **34(7.3):** 218-22.

Todkar, S.S., Gujarathi, V.V., Tapare, V.S. 2009. Period prevalence and sociodemographic factors of hypertension in rural Maharashtra: a cross-sectional study. *Indian Journal of Community Medicine.,* **34(7.3):** 183-7.

WHO. 2009. *Global Health Risks: Mortality and burden of disease attributable to selected major risks.* Geneva: World Health Organization.

WHO. 2011. *Non communicable Diseases: Country Profiles 2011.* Geneva: World Health Organization.

Yadav, S., Boddula, R., Genitta, G., Bhatia, V., Bansal, B., Kongara, S., et al. 2008. Prevalence & risk factors of prehypertension & hypertension in an affluent north Indian population. *Indian J. Med. Res.,* **128(12):** 712-20.

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Relationship among Speed, Power & Fatigue Index of Cricket Players

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Relationship among Speed, Power & Fatigue Index of Cricket Players

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Abstract

Objective: The purpose of this study was to observe speed, power and fatigue index of under 19 year cricket players. The design of this study required participants to perform six sprints each of 35 meter. Thirty one (N=31) trained male cricketers between the ages of 15 and 19 years volunteered for this study. The mean age, height and weight of cricketers were 16.81±1.13years, 172.23±6.85cm and 61.33±8.93Kg. The mean sprint time of -1st, 2nd, 3rd, 4th, 5th and 6th of cricketers were 5.39±0.34 seconds, 5.53±0.31 seconds, 5.61±0.36 seconds, 5.85±0.26 seconds, 5.94±0.25seconds and 6.07±0.17 seconds respectively. The mean power of -1st, 2nd, 3rd, 4th, 5th and 6th sprints of cricketers was 491.00±105.90 watts, 454.90±94.81watts, 435.23±90.49 watts, 382.84±78.54watts, 364.68±78.62watts and 339.94±58.96watts respectively. The maximum power, minimum power and average power of cricketers was 511.55±94.97watts, 333.71±65.83watts, and 411.42±73.59 watts respectively. It was concluded from the results of this study that sprint time and power decline in cricketers may be due to the reduced energy production via anaerobic glycolysis and muscle acidosis.

Introduction

Due to the nature of cricket that nesessitates intermittent activities such as batting, bowling, fielding in cricket, anaerobic power and capacity is of great interest to those involved with them, as most rely heavily on players' ability to move quickly and powerfully. *Noakes & Durandt (2000)* estimated that during a one-day game, a hypothetical player scoring 100 runs, made up of 50 singles, 20 twos, 10 threes and 20 fours, would cover a distance of 3.2 km in an activity time of 8 minutes. Average running speed would be 24 $km.h^{-1}$ with at least 110 deccelerations required *(Noakes & Durandt, 2000).* From this, it can be deduced that the physiological demands of batting in a one-day game are substantial. *Noakes & Durandt (2000)* speculate that the main cause of stress for cricket players is the stop-start nature of both sprinting between the wickets and fast bowling (during the 'run up' and delivery of the ball), contributes to early-onset fatigue indicators which, over time, results in a specific type of fatigue which negatively impacts performance and increases the risk of injury *(Christie et al., 2011b).* Sprint running times have been shown to be well correlated to peak and mean power output *(Tharp et al., 1985; Patton & Duggan, 1987).* The purpose of this study was to observe a relationship among speed, power and fatigue index of under 19 year cricket players.

Materials & Methods

Thirty one (N=31) trained male cricketers between the ages of 15 and 19 years of Punjab Cricket Academy volunteered for this study. The design of this study required participants to perform six sprints each of 35 meter. A rest of 10 second was given to the participants between each sprint. The power and fatigue index was calculated using the equations of *Draper and Whyte (1997).*

Statistical Analysis: Statistical analysis was performed with SPSS version 16.0 (free trial, SPSS Inc, Chicago). Mean, Standard Deviation and Linear correlation (Pearson's) was run between speed, power and fatigue index. The alpha level for the data analysis was determined at 0.05 levels.

Results & Discussion

Table 1. Descriptive Statistics of male cricketers

Variables	Mean	Std. Deviation
Age, year	**16.81**	**1.13**
Height, cm	**172.23**	**6.85**
Weight, kg	**61.38**	**8.93**
Sprint time-1,seconds	**5.39**	**0.34**
Sprint time-2,seconds	**5.53**	**0.31**
Sprint time-3,seconds	**5.61**	**0.36**
Sprint time-4,seconds	**5.85**	**0.26**
Sprint time-5,seconds	**5.94**	**0.25**
Sprint time-6,seconds	**6.07**	**0.17**
Power-1,watts	**491.00**	**105.90**
Power-2,watts	**454.90**	**94.81**
Power-3,watts	**435.23**	**90.49**
Power-4,watts	**382.84**	**78.54**
Power-5,watts	**364.68**	**78.62**
Power-6,watts	**339.94**	**58.96**
Maximum power, watts	**511.55**	**94.97**
Minimum power, watts	**333.71**	**65.83**
Average power, watts	**411.42**	**73.59**
Fatigue index	**5.20**	**1.92**

The mean age, height and weight of the cricketers were 16.81±1.13year, 172.23±6.85 cm and 61.33±8.93Kg respectively. The mean sprint time of 1st, 2nd, 3rd, 4th, 5th and 6th of cricketers was 5.39±0.34 seconds, 5.53±0.31 seconds, 5.61±0.36 seconds, 5.85±0.26 seconds, 5.94±0.25seconds and 6.07±0.17 seconds respectively (Table 1). The mean power of 1st, 2nd, 3rd, 4th, 5th and 6th sprints of cricketers was 491.00±105.90 watts, 454.90±94.81watts, 435.23±90.49 watts, 382.84±78.54watts, 364.68±78.62watts and 339.94±58.96watts respectively. In addition, the maximum power, minimum power and average power of cricketer were 511.55±94.97 watts, 333.71±65.83 watts, and 411.42±73.59 watts respectively. The mean fatigue index of cricketer was 5.20 ± 1.92 (Table 1).

Table 2 shows the relationship among sprint times, powers & fatigue index. There was a significant negative correlation observed between different sprint times and power. There was a significant negative correlation between fatigue index and sprint time-1st & 2nd (r = -0.75 p<.01), sprint time-1st (r = -0.75 p<.01) and sprint time-3rd (r = -0.57 p<.01). A similar trend of significant negative correlation was found between average power and sprinttime-1st (r = -0.47 p<.01), sprinttime-2nd (r = -0.50 p<.01), sprinttime-3rd (r = -0.48 p<.01), sprinttime-4th (r = -0.58 p<.01), sprinttime-5th (r = -.054 p<.01), and sprinttime-6th (r = -0.45 p<.01). A significant negative correlation was also found between maximum power and sprinttime-1st (r = -0.64 p<.01), sprinttime-2nd (r = -0.63 p<.01), sprinttime-3rd (r = -0.57 p<.01), sprinttime-4th (r = -0.44 p<.01) and sprinttime-5th (r = -0.38 p<.05).

Table 2. Correlations among sprint time, power & fatigue index

Variable(s)	Power-1	Power-2	Power-3	Power-4	Power-5	Power-6	Maximum power	Minimum power	Average power	Fatigue index
Sprint time-1	-.79**	-.49**	-.41*	-.28	-.11	-.13	-.64**	-.23	-.47**	-.75**
Sprint time-2	-.57**	-.77**	-.56**	-.31	-.11	-.10	-.63**	-.21	-.50**	-.75**
Sprint time-3	-.46**	-.49**	-.78**	-.36*	-.17	-.11	-.57**	-.32	-.48**	-.57**
Sprint time-4	-.45*	-.38*	-.51**	-.75**	-.53**	-.45*	-.44*	-.53**	-.58**	-.17
Sprint time-5	-.34	-.25	-.39*	-.65**	-.75**	-.53**	-.38*	-.55**	-.54**	-.06
Sprint time-6	-.34	-.18	-.25	-.57**	-.51**	-.62**	-.33	-.53**	-.45**	.01

** significant at p<0.01, * significant at p<0.05

Table 3 shows the relationship among power & fatigue index. A significant positive correlation was found between fatigue index and power-1st (r = 0.67; p<.01), power-2nd (r = 0.63; p<.01) and power-3rd (r = 0.52; p<.01). A significant positive correlation was also found between maximum power and power-1st (r = 0.91 p<.01), power-2nd (r = 0.87; p<.01), power-3rd (r = 0.84; p<.01), power-4th (r = 0.71; p<.01), power-5th (r = 0.65; p<.01) and power-6th (r = 0.69; p<.01). A similar trend of significant positive correlation was also found between minimum power and power-1st (r = 0.69; p<.01), power-2nd (r = 0.67; p<.01), power-3rd (r = 0.74; p<.01), power-4th (r = 0.92; p<.01), power-5th (r = 0.88; p<.01) and power-6th (r = 0.95p<.01). A significant positive correlation was also found between average power and power-1st (r = 0.86; p<.01), power-2nd (r = 0.87; p<.01), power-3rd (r = 0.85; p<.01), power-4th (r = 0.91; p<.01), power-5th (r = 0.84; p<.01) and power-6th (r = 0.86;p<.01).

Table 3. Correlations among power & fatigue index

Variable(s)	Maximum power	Minimum power	Average power	Fatigue index
Power-1	.91**	.69**	.86**	.67**
Power-2	.87**	.67**	.87**	.63**
Power-3	.84**	.74**	.85**	.52**
Power-4	.71**	.92**	.91**	.16
Power-5	.65**	.88**	.84**	.08
Power-6	.69**	.95**	.86**	.07

** significant at p<0.01, * significant at p<0.05

Table 4 shows the relationship among the various powers during different sprint run. A significant positive correlation was found between power-6th and power-1st (r = 0.64; p<.01), power-2 (r = 0.62; p<.01), power-3 (r = 0.62; p<.01), power-4(r = .88 p<.01) and power-5(r = .89; p<.01). A similar trend of significant positive correlation was also found between power-1 and power-2 (r = .72; p<.01), power-3 (r = 0.68; p<.01), power-4(r = 0.968; p<.01) and power-5(r = 0.58; p<.01) (Table 4).

Table 4. Correlations among various powers during different sprint run

Variable(s)	Power-2	Power-3	Power-4	Power-5	Power-6
Power-1	.78**	.68**	.68**	.58**	.64**
Power-2	-	.77**	.69**	.57**	.62**
Power-3		-	.72**	.61**	.62**
Power-4			-	.88**	.88**
Power-5				-	.89**

** significant at p<0.01, * significant at p<0.05

Results of this study show a trend of increase in time of sprint from sprint-1st to sprint-6th. However, there was a trend of decrease in power during the different sprints from power -1st to power-6th and this may be due to the production and subsequent accumulation of lactic acid during the six sprints. It was also observed that higher sprint time (sprinttime-1st vs. sprinttime-6th) is associated with lower power (power-1st vs. power-6th) response as sprint time showed mean relative increase as compared to mean relative decrease of power. It can be seen that there is a significant difference in relative sprint time increase between sprint-1 to sprint-6.There was a significant positive correlation between fatigue index and various powers. However, there was a significant negative correlation between various sprint times and different powers. Similarly, there was a significant negative correlation between fatigue index and various sprint times.

Discussion: The principal findings of the present study were, first, the best 35 m sprint time was related to the maximum power (r = -0.64,p<.01) and power during the first sprint test (r = -0.79,p<.01) involving 6x35 m sprints. Second, the best 35 m sprint time was related to the fatigue index that occurs during the 6x35 m test. *Dawson et al., (1993)* also found sprinting time to be significantly correlated with three measures of anaerobic power. A strong correlation was also found between the best 35 m sprint time and maximum power (r = -0.64, p<.01), average power (r = -0.47, p<.01) and fatigue index (r = -0.45,p<.01), indicating that subjects with better sprint times had higher levels of fatigue. *Hirvonenet al. (1987)* found runners of higher sprinting ability were able to deplete a greater proportion of CP stores when compared with runners of lower sprinting ability. *Kumar & Kathayat (2014)* reported that a repeated sprint protocol of crickter playersproducing the highest peak power output during repeated sprinting efforts had the greatest decreases in mean power output. A similar result was also reported on football players *(Kumar & Singh, 2014).Holmyard et al. (1988)* found individuals producing the highest peak power output during repeated 6s sprinting efforts on a non-motorised treadmill had the greatest decreases in mean power output. Therefore, subjects who can produce higher peak power outputs and better sprint times are probably able to do so due to their ability to utilise a greater proportion of their CP stores. With short recovery periods, these subjects would have lower CP stores prior to the next sprint and are therefore likely to fatigue more over a series of repeated sprints. The present study also involves shorter recovery periods which are less than the half life of CP resynthesis *(Harris et al., 1976)*. The CP stores will not be adequately replenished during the RSA test and a progressive decline in CP stores and a slowing of the 35 m sprint times will ensue. Even though anaerobic glycolysis provides a significant contribution to the initial stages of the sprint test, its contribution appears to diminish over the latter stages of a repeated sprint test. *Gaitanos et al. (1993)* measured the change in muscle CP, ATP, lactate and pyruvate during 10×6 s maximal sprints on a cycle ergometer. They estimated that during the first sprint, anaerobic glycolysis was contributing approximatel 50% to anaerobic ATP However, by the last sprint, anaerobic glycolysis was only contributing approximately 20 % to anaerobic ATP production. Based on these findings, *Gaitanos et al. (1993)* also suggested that it was likely aerobic metabolism increased its contribution during these last sprints. These studies suggest that the phosphagen system is the major anaerobic energy system during 3 - 5s of maximal sprinting and its importance appears to increase over the latter stages of a series of repeated sprinting efforts.

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Conclusion: A significant negative correlation was found between different sprint times (speed) and power and fatigue index. Results, of this study suggested that the phosphagen (CP) system may be the major anaerobic energy system during the first sprint of repeated sprint test and in the last sprints aerobic metabolism may likely increased its contribution. Thus, it was concluded that cricketer had run a good sprint (i.e. taken less sprint time)as they had generated more power during the sprint running and this may be due to their training programme.Further, the sprint time (i.e. speed) and power decline in repeated sprint tests of cricketer may be due to reduced energy production via anaerobic glycolysis and muscle acidosis.

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References

Kumar,Ashokand Kathayat, Lokendra Bahadur.2014. A Study of Speed, Power & Fatigue Index of Cricket Players.*Journal of Exercise Science and Physiotherapy*,**10(1):** pp. 21- 24.

Kumar,Ashok and Singh, Gurwinder.2014.A Study of Anaerobic Power and Capacity of Football Players. *Journal of Exercise Science and Physiotherapy*,**10(2):** pp.97-103.

Christie, CJ. Barford, G. & Sheppard, B. 2011b. Concentric and eccentric strength changes in the lower limb musculature following repeated sprints between the wickets. *Proceedings of the 4th World Congress on Science and Medicine in Cricket*, pp. 82, Chandigarh, India, 31 March–01 April, 2011.

Dawson, B., Fitzsimons, M. & Ward, D. 1993. The relationship of repeated sprint ability to aerobic power and performance measures of anaerobic work capacity and power. *Australian Journal of Science and Medicine in Sport*,25(4):88-93.

Draper, N. and Whyte, G. 1997. Here's a new running based test of anaerobic performance for which you need only a stopwatch and a calculator. *Peak Performance*, **96:** p. 3-5.

Gaitanos, G., Williams, C., Boobis, L. & Brooks, S. 1993. Human muscle metabolism during intermittent maximal exercise. *Journal of Applied Physiology*,**75(2):** 712-719.

Harris, R., Edwards, R., Hultman, E., Nordesjo, L. & Sahlin, K. 1976. The time course of phosphorylcreatine resynthesis during recovery of the quadriceps muscle in man. *Pflugers Archives*,**367:**137-142.

Hirvonen, J., Rehunen, S., Rusko, H. & Harkonen, M. 1987. Breakdown of high – energy phosphate compounds and lactate accumulation during short supramaximal exercise. *European Journal of Applied Physiology and Occupational Physiology*, **56:**253-259.

Holmyard, D., Cheetham, M., Lakomy, H. & Williams, C. 1988. Effect of recovery duration on performance during multiple treadmill sprints.In: T. ReiUy, A. Lees, K. Davids, and W.J, Murphy (eds.). Science and Football, London/New York: E. & F.N. Spon, 134-142.

Noakes TD and Durandt J.J. 2000. Physiological requirements of cricket. *Journal of Sports Sciences*, **18:** 919-929.

Patton J.F. and Duggan A. 1987. Anevaluation of tests of anaerobic power. *Aviat. Space Envir. Med.*, **58:** 237-42.

Tharp G.D., Newhouse R.K., Uffelman L., Thorland W.G.and Johnson G.O. 1985. Comparison of sprint and run times with performance on the Wingate Anaerobic Test. *Res. Q. Exercise Sport*, **56(1):** 73-6.

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Correlation between Anxiety and Mental Skill in University Volleyball Male Players

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Abstract

Introduction: Many athletes who perform well during training or practice can suffer from performance anxiety on game day. *Purpose of the Study:* The purpose of the study was to find out the correlation between Anxiety and Mental skill among University male volleyball players.
Methodology: A total of 15 university Volleyball male players were selected as subjects from different colleges affiliated to Karnatak University, Dharwad St: Karnataka, The ages of players were between 20 to 25 years. All the subjects completed Ottawa and SCAT questionnaire for measuring their mental skill and competitive anxiety. *Results:*'t' -test was employed to evaluate the SCAT questionnaire and Pearson correlations method was used to assess the correlation between anxiety and mental skill. The results showed that there was a significant correlation between mental skill and competitive anxiety in university volleyball male players ($p<0.05$). *Conclusion:* The present study findings shows that it is important that sportsmen are classified according to the type of sport & type of event in order to judge the differences between different games and to identify methods by which they can achieve high levels of performance in their sports. The psychological training needs to be provided by the coaches along with the physical training and under psychological training, it is imperative that players are trained how to face stressful situations occurring during the competitions.

Introduction

Many athletes who perform well during training or practice can suffer from performance anxiety on game day. If feelings of nervousness, anxiety or fear interfere with the sports performance, learning to use a few tips from sports psychology may help them get their anxiety under control and reduce game day nerves. Competition in games put extremely high expectations on the competing athletes regardless of competitors' capacities, reasons for participation and skill levels. An inherent aspect of athletics is the need for players to meet the demands of the competition and to perform well under pressure *(Craft et al, 2003).* Some of the researchers have explored the roles that situational factors play in mediating the state anxiety of athletes prior to competitions. *(Jones, et al, 1991;Matheson and Mathes, 1991).*

Anxiety is defined as feelings of nervousness and tension caused by the environment or surrounding expectation that is related to 'arousal'. Those demands are usually stressful and thus may cause an imbalance between the demands and the athlete's ability to fulfill the expectations. These sorts of conditions place high stress loads on the individuals who are competing. The stress presented in competition usually elicits anxiety in athletes, supplying an additional element for them to manage. When anxiety is not directed or construed correctly, athletes lose control and performance levels *(Aufenanger, 2005; Bridgesand Knight, 2005).* All these years, an increase in performance has been the foundation need of what dreamed by all athletes to stand out in their respective sports. Athletes train hard to help their skills and faculty's regardless of the time they take to fulfill this *(Parnabaset al, 2009).* When anxiety is not managed or explained correctly, athletes lose control and their performance levels decrease *(Weinberg & Gould, 2010).* It is not possible that fatigue and anxiety are synonym with sport across different cultures with the kind of stress present in each society. Although there is a lot of information on subjects of fatigue and anxiety, it is only recently that the researchers have initiated performing studies on the correlation between fatigue and perception on anxiety. Anxiety has been one of the most thoroughly inspected topics in sport psychology literature *(Khodayari et al, 2011).* Among the popular coping strategies used by athletes to deal with anxiety are goal-setting, breath control, imagery, positive self-talk, focus on the present, progressive relaxation, biofeedback, autogenic training, meditation and thought stopping *(Parnabas, et al 2009).* Therefore, there need to be a positive thinking and better mental skills to solve the problems that may arise because of anxiety. If it is not handled well or misinterpreted, athletes will lose control and their performance will decrease *(Gualberto, and Wiggins, 2008).*

Materials & Methods

Subjects: A total of 15 university male volleyball players were selected as subjects from different colleges affiliated to Karnatak University, Dharwad St: Karnataka, The ages of players were between 20 to 25 years.

Administration of Questionnaire & Procedures: All the subjects completed questionnaires of Ottawa (OMSAT3) and

Rainer and Martin's Sports Competition Anxiety Test (SCAT) for measuring their anxiety a day and 30 minutes before competition.

Sports Competition Anxiety Test-(SCAT): This test measures the anxiety of athletes *(Marten et al, 1990)*. This test was used to evaluate the anxiety level of university male volleyball players. The test includes fifteen items which involve 5 spurious items, 8 positive items and 2 negative items. Trait anxiety was measured by Martens' 9 Sport Competition Anxiety Test (SCAT). The SCAT is a 15-item inventory with scores ranging from 10 (low) to 30 (high).

Ottawa Mental Skill Assessment Tool-3 (OMSAT-3): OMSAT-3 is used to measure a wander of mental skills. The OMSAT-3 involves 48 items and 12 mental skill groups, which are grouped under three main general idea components. They are 1) Goal Setting 2) Self Confidence 3) Commitment 4) Stress Reactions 5) Fear Control 6) Activation 7) Relaxation 8) Imagery 9) Mental Practice 10) Focusing 11) Refocusing and 12) Competition planning. A 7-point Likert scale is used, ranging from strongly agree to strongly disagree with a neutral option available.

Statistical Analysis: Values are presented as mean values and SD. T-test was employed to evaluate the SCAT questionnaire and Pearson correlations method were used to assess the correlation between anxiety and mental skill. The significance level was determined as $p<0.05$. Data was analyzed using SPSS Version 16.0 (Statistical Package for the Social Sciences, version 16.0, SSPS Inc, Chicago, IL, USA).

Table 1: Results from descriptive statistic and correlation between mental skills and anxiety

Mental skills and their subscale	Mean	± SD
Activation	0.57	±6.25
Cognitive Skills	0.39	±3.55
Commitment	0.89	±4.62
Competition Planning	1.09	±7.52
Fear Control	1.02	±3.82
Focusing	1.07	±3.63
Foundation Skills	0.65	±7.10
Goal Setting	0.62	±5.08
Imagery	1.21	±6.86
Mental Practice	0.78	±6.11
Mental Skills	0.34	±3.67
Psychosomatic Skills	0.48	±3.25
Refocusing	0.88	±4.81
Relaxation	0.79	±6.71
Self Confidence	0.61	±6.96
Stress Reactions	0.92	±3.26

Results

The results show that there is a significant correlation between mental skills and anxiety ($p<0.05$). There were significant correlation between anxiety and subscales of mental skills, mental practice, refocusing, fear control, goal setting, focusing, self confidence, psychosomatic skill, cognitive skills and mental skill ($p<0.05$). There was no significant correlation between anxiety and subscales of mental skills, stress reactions, Commitment, relaxation, activation, imagery, competition planning, foundation skills ($p>0.05$). High level correlation was found between self-confidence and anxiety ($r=0.519$) and low correlation was found between commitment and anxiety ($r=0.121$). Higher level of correlation, among psychosomatic skills subscales was found between stress control and anxiety ($r=0.529$) and low correlation was found between activation and anxiety ($r=0.179$). Higher level of correlation of cognitive skills subscales was found between focusing and anxiety ($r=0.673$) and a low level correlation was found between image and anxiety ($r=0.316$). Higher level of correlation mental skills subscales (psychosomatic skill, cognitive skills and foundation skills) was between cognitive skills and mental skills ($r=0.612$) and a low level correlation was found between foundation skills and mental skills ($r=0.289$).This cross sectional study examined the correlation between mental skills and anxiety in university male volleyball players. As a corollary analysis, the correlation between mental skills and the intensity of anxiety was measured by the SCAT and OMSAT-3. As a major finding in this study, there were correlations between the mental skills and anxiety of female athletes. Because all athletes were examined together in this phase to see how different mental skills might affect the ways in which athletes interpret their feelings of anxiety. Because of the small sample size, the three types of mental skills that measured by the OMSAT were examined partly in relation to the SCAT subscales representing anxiety *[Filino et al, 2009]*. It is found that a significant correlation exists between mental skills and anxiety ($p<0.05$). The main finding of this study was consistent to research results from *Filino et al. (2009). Aufenanger (2005),* in their study showed that a correlation exists between mental skills and anxiety were predictive athletes' interpretation of anxiety and self-confidence as facilitator to their performance

Conclusion and Suggestions: It is confirmed that there is a correlation between mental skills and anxiety of university male volleyball players. Further studies in this respective field & other games should be performed in deeper and wider contexts that will consider athletes from other organizations. It is important that researchers categorize athletes based on the type of sport, in order to determine differences between different sports and to identify methods by which they can achieve high levels of performance. The psychological training has to be provided by the coaches along with the physical training and under psychological training, it is imperative that players are trained how to face stressful situations occurring during the competitions.

References:

Aufenanger, S.J., 2005. Relationships between mental skills and competitive anxiety interpretation in open skill and Close Skill Athletes, Degree of Master of Science Department of Physical Education, Health, and Sport Studie Miami University Oxford, Ohio 2005.

Bridges, A. and B. Knight, 2005. The role of cognitive and somatic anxiety in athletic

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performance. Hanover,Germany: Hanover College

Chan Siu Mei Amy. 2005. Relationship between pre competition anxieties and situational factors of university badminton players. Bachelor of arts in physical education and recreation management (honours) Hong Kong Baptist University March 2005. Cited from :http://libproject.hkbu.edu.hk/trsimage/hp/020 13487.pdf

Craft, L.L., Magyar, M.T., Becker,B.J., and Feltz, D.L. 2003. The relationship between the Competitive State Anxiety Inventory-2 and sport performance: A meta-analysis. *Journal of Sport and Exercise Psychology*.**25(1):** 44-65.

Filino, D., Fauzee, O. Sofian, M., Abdullah, M.C. Meesin, C. and Choosakul, C. 2009. Relationship between mental skill and anxiety interpretation in secondary school hockey athletes. *European Journal of Social Sciences*. **9(4):** 651-658.

Gualberto, C.J. and M.S. Wiggins, 2008. Direction and intensity of trait anxiety as predictors of burn out among collegiate athletes. *Journal of Sport Psychology*. Murray State University.

Jones, G., A. Swain and A. Cale, 1991. Gender differences in precompetition temporal patterning and antecedents of anxiety and self-confidence. *Journal of Sport & Exercise Psychology*,13(1): 1-15.

Khodayari, B., A. Saiiari and Y. Dehghani, 2011 Comparison Relation between Mental Skills with Sport Anxiety in Sprint and Endurance Runners. *Procedia-Social and Behavioral Sciences*. **30:** 2280-4.

Krane, V. and J.M. Williams, 1994. Cognitive anxiety somatic anxiety and confidence in track and field athletes: The impact of gender, competitive level and task characteristics. *International Journal of Sport Psychology'*25(2): 203-217.

Martens, R., Burton, D., Vealey, R.S., Bump, L.A., & Smith, D.E. 1990. Developmentandvalidation of the Competitive State Anxiety Inventory-2 (CSAI-2). In R. Martens, R.S. Vealey, & D. Burton (Eds.), Competitive anxiety in sport(pp. 193-208).Champaign, IL: Human Kinetics

Matheson, H. and S. Mathes, 1991. Influence of performance setting, experience and difficulty of routine on precompetition anxiety and self confidence of high school female gymnasts. *Perceptual and Motor Skills*.**72(3c):** 1099-105.

Parnabas, V.A., Y. Mahmood and K. Ampofo Boateng, 2009. Cognitive, Somatic and Negative Coping Strategies Among Malaysian Athletes. *European Journal of Social Sciences*. **9:** 3.

Raglin, J.S. and Y.L. Hanin, 2000. Competitive anxiety. *Emotions in Sport*. pp: 93-111.

Perry, J.D. and J.M. Williams, Others. 1998. Relationship of intensity and direction of competitive trait anxiety to skill level and gender in tennis. *Sport Psychologist,* **12(2):** 169-79.

Weinberg, R.S. and D. Gould, 2010. *Foundations of sport and exercise psychology*. 5th edition. Pp 40-86. Human Champaign, IL: Kinetics Publishers.

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Correlation between Balance and Ankle Range of Motion in Community Dwelling Women Having Fear of Fall Aged 60 to 80 Years

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Correlation between Balance and Ankle Range of Motion in Community Dwelling Women Having Fear of Fall Aged 60 to 80 Years

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Abstract

Objective: To study the relationship between balance impairments and changes in ankle range of motion (ROM) in older women who have fear of fall. *Method:* Correlation study was carried out with 100 female subjects aged 60 to 80 years. Fear of fall was measured using short falls efficacy scale (FES), balance using Tinetti Performance Oriented Mobility Assessment (POMA) (balance and gait) test and functional reach test (FRT). Goniometry was used to determine active and passive ROM of ankle joint. *Result:* High significant correlation value was observed for balance measure (FRT & POMA gait subtest) with ankle range of motion (ROM). Significant correlation value was recorded for sagital plane motion rather than frontal plane motion for FRT (r: 0.55). Correlation value for frontal plane motion was however observed to be significant for POMA gait subtest (r: 0.49). *Conclusion:* Balance impairments can be predicted using ankle ROM impairments in community dwelling women.

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Introduction

Aging is a result of slow and progressive decline in multiple body systems. Impairment in any component of postural control system can lead to instability and falls in older people. 25-35% of elderly people from community fall each year and these rates are rising with age *(Soo-Kyung et al, 2013).* It is one of the major health problems in aging adults. Falls and fall-related injuries are a major cause of morbidity and mortality in the elderly. Fall related mortality rate increases spectacularly with advancing age, especially in populations older than age 70 years *(Laurence & Karen, 2006).*

Fear of fall is one of the major negative consequences of balance impairment. One survey has reported that between 30% and 73% of older persons who have fallen admit fear of falling *(King &Tinetti, 1995, Vellas et al, 1997).* Fear of falling can limit physical and social activities; automatically, lowering quality of life *(Soo-Kyung et al, 2013).* Most falls in elderly people are associated with multiple risk factors, including both extrinsic (environmental hazards, housing characteristics, poor footwear) and intrinsic factors (weakness of muscles, reducing balance control, gait disorder, limited vision, cognitive impairment, advance age, medical illness, dizziness) *(Shehab & El-Kader, 2004, Laurence & Karen, 2006).*

The maintenance of balance is also one of the major factors that lead to fall in elderly people. Maintaining balance is the ability to maintain an upright position during quiet standing, and it is necessary for successful performance of daily life tasks *(Lord et al, 1996).* Balance maintenance is a complex phenomenon that is influenced by multiple neural and musculoskeletal factors. Balance is maintained through a complex process which involves sensory detection of body motions, integration of sensorimotor information within the central nervous system, and execution of appropriate musculoskeletal responses *(Soo-Kyung et al, 2013).* The postural control ability is decline according to aging. Adequate postural control depends on the integration of vestibular, visual, and somatosensory information of the body motion. As the age advance, generalized reduction of the vision and vestibular function take place. Impairment in any component of postural control system can lead to instability and falls in older people *(Soo-Kyung et al, 2013). Lord et al. (1996)* reported that deterioration of postural stability related to aging is associated with reduced sensation in the lower limbs as measured by joint position, tactile, and vibration sensitivities. It not only affects sensorimotor functions, but also affects the muscle strength and joint movement which decline with increasing age *(Grimston et al, 1993).*

Bennell and Goldie (1994) demonstrated that range of motion (ROM) of the ankle is an important risk factor of reducing postural stability. Thereby, decreased ankle range may alter the movement patterns and these altered movement patterns may compromise balance, and ultimately limit the functional activities *(Mecagni & O'Sullivan, 2000). Vandervoort et al. (1992)* reported that an average decrement of ankle joint ROM was greater in females than males with aging.

Tinetti Performance Oriented Mobility Assessment (POMA) measures subject's gait and balance. It has two subtests. Scores on this assessment categorize individuals as having a "low risk for falling," "greater chance of falling," or "high risk for falling.

The Functional Reach Test is a single item test developed as a quick screen for balance problems in older adults *(Duncan et al, 1990).* The FRT evaluates the maximal distance that a person can reach forward while maintaining a fixed base of support *(Mecagni & O'Sullivan,* 2000). A score of 15 cm or less indicates a significant increased risk for falls. A score between 15-25 cm inches indicates a moderate risk for falls *(Duncan et al, 1990).* The Short FES-I is a good and feasible measure to assess fear of falling in older persons. It is either self-administered or administered through interview, which asks respondents to rate their level of concerns in performing common activities. Short fall efficacy scale is comprised of 7 components with 1 indicating "not at all concerned" and 4 indicating "very concerned".

The purpose of this study was to examine the relationship between balance and ankle ROM in community-dwelling, elderly women. These results may serve in clarifying specific components to incorporate into future intervention studies for reducing falls in elderly people.

Materials &Methods

Subjects: Subjects were recruited from the dwelling community through personal contact. It consisted of 100 women with mean age 65.43 years (range= 60-80year). About 81% women were highly concerned of fall and 19% women were moderately concerned about fall.

Instrumentation: The function reach test (FRT) and Tinetti performance-oriented Mobility assessment (POMA) were used to measure balance. Measurement of ankle ROM was done by 360º goniometer. *Reliability:* A pilot study was done to find out intrarater reliability for FRT, POMA and goniometric measurements on 2 consecutive days in 15 subjects. The following ICC value POMA (r: 0.98), FRT (r: 0.98), FES (r: 0.98), goniometry (Dorsiflexion-r: 0.98, Planterflexion-r: 0.86) indicative high intrarater reliability. *Procedure:* Subjects were recruited from the community through personal contact. Prior to testing the purpose and procedure of the study were explained to the subjects. After analyzing the inclusion and exclusion criteria, each subject was asked to sign an informed consent form. After taking informed consent short fall efficacy scale measurement was administered. Next functional reach test was performed for three trials, and average of second and third trials were taken as a final reading.

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After that POMA balance and gait score were administered by reading instructions from a script. Bilateral ankle range of motion was performed in two positions (1) knee in flexion (2) knee in extension as per *Norkin and White(1995)* with the subjects barefoot to exclude the influence of footwear.

Data collection tools:

- Tinetti Performance Oriented Mobility Assessment (POMA)
- Functional Reach Test (FRT) (Measuring tape)
- Goniometry (360º goniometer)
- Short Falls efficacy scale

Data analysis: Descriptive statistics for each ankle ROM was done using excel 2007. The Spearman's correlation coefficient was used to calculate correlations. Three levels were taken in consideration.

1. Unilateral sagital plane motion (DF, PF) and frontal motion (EV, INV) with FRT
2. Unilateral sagital plane motion (DF, PF) and frontal motion (EV, INV) & POMA balance test
3. Unilateral sagital plane motion (DF, PF) and frontal motion (EV, INV) & POMA gait test

Results & Discussion

The means and standard deviation for each motion are summarized in table 1.

Table1: Means and Standard deviation for each motion

Ankle range	With Knee flexion				With Knee extension			
	Active		Passive		Active		Passive	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dorsiflexion	17.16	3.59	21.10	1.96	12.13	3.33	20.05	1.89
Planterflexion	26.59	5.82	37.86	5.23	32.35	4.72	39.96	3.82
Eversion	5.50	0.92	7.32	0.89	4.83	0.83	7.16	0.85
Inversion	8.51	1.03	11.30	1.21	7.77	1.25	11.32	1.26

Since there were no differences between the right and left side ankle range of motion, therefore only left side ranges were taken into consideration for data analysis.

Short fall efficacy scale: The mean short FES score was 16.17(SD 3.028). Nineteen subjects had score from 9 to 13, which indicate moderate concern for fall. Eighty one subjects had scored more than 14, which is considered to be indicative of high concern for fall.

Functional Reach: The mean FRT score for our sample was 25.2 cm (SD 5.58). Three subjects had an FRT score below

15.2 cm (6 inches), which is considered to be indicative of a greater fall risk.

Tinetti Performance Oriented Mobility Assessment: The mean scores of POMA were 14.15 (SD 3.16). Ninety four subjects had total scores below 19, indicating that they were at "high risk of falls", six had scores between 19-24 indicating that they were at "moderate risk of falls" and no one had scores above 24 indicating "low risk of falls".

Correlation between balance measurements and goniometry are summarized in figs 1 to 3.

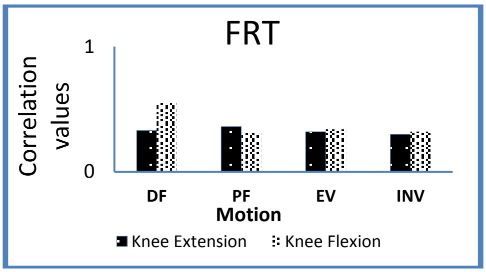

Fig. 1: Correlation between ROM and FRT in Knee Extended & knee flexion (DF-dorsiflexion; PF-Plantarflexion; EV-Eversion; INV-Inversion)

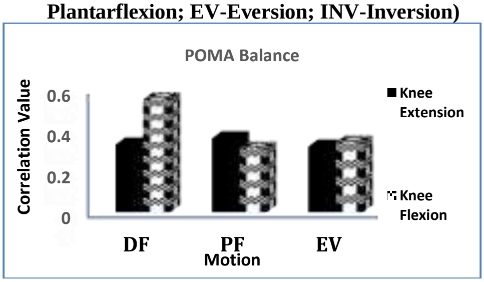

Fig. 2: Correlation between ROM and POMA balance

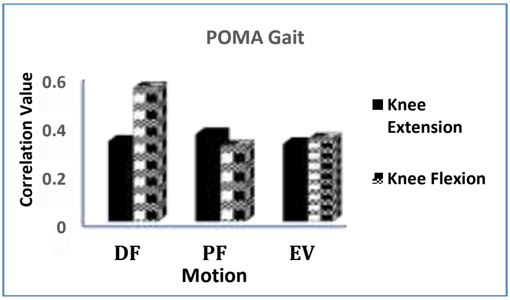

Fig 3: Correlation between ROM and POMA Gait with knee extended and knee flexed [(DF: Dorsiflexion, PF: Planterflexion, EV: eversion, INV: inversion)]

Discussion

As there are no normative data for ROM measurements for women in this age group, we cannot make comparisons. This may show the fact that our measurements were active and not active assisted which represents maximal possible range. Where active motion is dependent on subjects force generating capacity, lifestyle and footwear difference between populations studied may also have contribute to differences *(Mecagni & O'Sullivan,* 2000).

In the present study, the ROM of subjects was assessed in both knee flexed and extended positions in order to remove the influence of gastrocnemius muscle length. It has been proved in the study by *Mecagni & O'Sullivan, (2000)* that restricted ankle ROM in knee extended position is due to non contractile tissue such as capsule, ligament and bone rather than gastrocnemius muscle.

This study shows a greater correlation of ankle ROM with functional reach test (FRT) and POMA gait subtest

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than the POMA balance subtest which indicate that ankle ROM may be more associated with balance during ambulation and forward reaching task of everyday life.

POMA gait subtest has moderate correlation with inversion (knee extension, r:0.49 & knee flexion, r:0.45) and mild correlation with dorsiflexion (knee extension, r:0.39 & knee flexion, r: 0.47), Planterflexion (knee extension, r: 0.35) & knee flexion, r: 0.46), Eversion (knee extension, r: 0.33 & knee flexion, r: 0.46). This indicate that all ankle motions contribute to maintain balance during gait.

There is a greater degree of correlation between FRT and Dorsiflexion (r: 0.55), which is indicative of ankle strategy. Higher correlation between POMA gait subtest and inversion (r: 0.44) is suggestive of importance of frontal motion in gait. A study by *Hylton et al (2005)* stated that ankle flexibility and strength of toe planter flexiors were associated with leaning tests and functional measure.

In this study a negative correlation between FES and FRT (r:-0.18) has been observed. A high score of FES indicate the high risk of fall while in FRT high values indicate more flexibility of ankle. Thus a negative correlation between them in our study supports that fact.

Conclusion: It was found that a relationship exists between ankle ROM and performance on balance tests in community-dwelling elderly women who have fear of fall. Decline in ankle ROM may result in decline in function and balance control. This is an important finding which can be helpful to improve balance, postural stability and function by training balance strategies which can lower the fall incidence in the elderly population. A frontal plane ROM (inversion, eversion) is considerably important in balance during dynamic activities like walking. And sagital plane ROM (Dorsiflexion, Planterflexion) which may be more important for balance with voluntary control. There is negative correlation of FES with FRT and POMA. Thus our result suggests that ROM can be used as screening tool to determine balance impairments and fall risk in older elders.

References

Mecagni, S., O’ Sullivan, Roberts. 2000. Balance and ankle range of motion in communitydwellingwomen aged 64 to 87 years: A Correlational study. *Phys. Ther.,* **80:**1004-1011.

Hylton, B.; Menz, Meg E. Morris, and Stephen, R. Lord. 2005. Foot and Ankle Characteristics Associated With Impaired Balance and Functional Ability in Older People: *J. Gerontol.,* **60:** 1546-1552.

Shehab, M.; El-Kader, Abd. & Awny, F. Rahmy 2004. Balance Performance and Ankle Dorsiflexors Muscles Force in Elderly,*Bull. Fac. Ph. Th. Cairo Univ.,***Vol. 9(1):** 1-9.

Nitz, J, Low, Choy, N. 2004. The relationship between ankle dorsiflexion range, falls and activity level in women aged 40 to 80 years. *New Zealand Journal of Physiotherapy,* **32(3):**121-125

Soo-Kyung Bok, Tae Heon, Lee, Sang Sook, Lee, 2013. The Effects of Changes of Ankle Strength and Range of Motion According to Aging on Balance. *Ann. Rehabil. Med..,* **37(1):** 10–16.

Lord, S.R., Clark, R.D., Webster, I.W. 1991. Postural stability and associated physiological

JESP Vol. 11, No. 1, 2015: 22-28

Journal of Exercise Science & Physiotherapy
Published by
Exercise Fitness & Health Alliance
Article no. 231; UAIC: 97302312020

factors in a population of aged persons. *J Gerontol,* **46:** M69-76.

Bennell, K.L., Goldie, P.A. 1994. The differential effects of external ankle support on postural control. *J. Orthop. Sports Phys.Ther.,* **20:** 287-95.

Vandervoort, A.A., Chesworth, B.M., Cunningham, D.A., Paterson, D.H., Rechnitzer, P.A., Koval, J.J. 1992. Age and sex effects on mobility of the human ankle. *J. Gerontol,* **47:** M17-21.

Grimston, S.K., Nigg, B.M., Hanley, D.A., Engsberg, J.R 1993. Differences in ankle joint complex range of motion as a function of age. *Foot Ankle*, **14:** 215-22.

King, M.B., Tinetti, M.E. 1995. Falls in community-dwelling older persons. *J. Am. Geriatr. Soc***.,** **43:**1146–54.

Vellas, B.J, Wayne, S.H., Romero, L.J, Baumgartner, R.N., & Garry, P.J. 1997. Fear of falling and restriction of mobility in elderly fallers. *Age Ageing,* **26:** 189–93.

Laurence, Z. Rubenstein, Karen, R. Josephson 2006. Falls and Their Prevention in Elderly People: What Does the Evidence Show? *Med. Clin. N. Am.,* **90:** 807–824

Gertrudis, I.J., Kempen, Lucy Yardley, Jolanda C. M. Van haastregt et al. 2007. The Short FES-I: a shortened version of the falls efficacy scale-international to assess fear of falling. age ageing. *J. Am. Geriat. Soc.,* **53:** 501–510.

Duncan, P.W., Weiner, D.K., Chadler, J., Studenske, S. 1990. Functional reach: A new clinical measure of balance. *J. Gerontol.,***45:** M192-197.

Tinetti, M.E. 1986. Performance-oriented assessment of mobility problems in elderly patients. JAGS, 34: 119-126. Scoring description: PT Bulletin Feb. 10, 1993

Norkin CC, White DJ. 1995. Measurement of Joint Motion: A Guide to Goniometry. 2nd ed. Philadephia, Pa: FA Davis Co, 154–161.

Masanobu Uchiyama, Shinichi Demura, Sohee Shin 2011. Is There a Relationship between the Functional Reach Test and Flexibility? Scientific research, Vol.1, No.2, 11-15.

Suraj Kumar et al. 2008. Relationship Between Fear of Falling, Balance Impairment and Functional Mobility in Community Dwelling Elderly. IJPMR, 19 (2): 48-52.

Anne Shumway-Cook et al. 1997. The Effect of Multidimensional Exercises on Balance, Mobility, and Fall Risk in Community-Dwelling Older Adults. Physical Therapy, 77:46-57.

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Prevalence of Metabolic Syndrome in Rural Premenopausal and Postmenopausal females of Amritsar (Punjab) using threeInternational definitions: ATP-III, IDF and mATP-III

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Abstract

Background: Metabolic Syndrome (MS) is one of the major cause of morbidity and mortality across the globe. Therefore, this study was aimed to assess the prevalence of MS and its components using three international diagnostic criteria in the pre- and postmenopausal rural females of Amritsar (Punjab). *Methods:* This cross-sectional study was conducted among 300 rural females (186 premenopausal and 114 postmenopausal) of Amritsar (Punjab) during the period from June 2013 to June 2014. The age range of females was 25-55 years. WC and blood pressure of each participant was also measured. Fasting blood samples were analysed to estimate TC, TGL, HDL-C and FBG. LDL-C and VLDL-C were also calculated. The prevalence of MS was assessed using three international criteria ATP-III, IDF and mATP-III, respectively. For data analysis mean and standard deviation were calculated. Further Student's t-test, chi-square test and kappa statistic were also applied. *Results:* The postmenopausal women had significantly higher values of WC, SBP and DBP. In context to lipid profile variables, the values were again significantly higher among postmenopausal females except LDL-C. The prevalence of MS was 21.66 %, 24.33% and 25.66 % using ATP-III, IDF and mATP-III criterion, respectively. The postmenopausal females were observed to have significantly higher prevalence of MS. The degree of agreement (kappa statistic) was more (0.87) between mATP-III and IDF criteria as compared to between ATP-III and IDF (0.85) and between mATP-III and ATP-III (0.76) which shows that mATP-III has more concordance with IDF and less with ATP-III . Among 300 rural females, 18.3% (55) females were screened positive for MS by all the three criteria. The most prevalent component of MS was reduced levels of HDL-C whereas the least common was elevated levels of FBG. *Conclusion:* MS is quite prevalent in rural women of Amritsar using all the three criteria.

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Introduction

The Metabolic Syndrome (MS) is a major, widely prevalent and escalating public health challenge in both developed and developing countries *(Ford, 2004; Kraja et al, 2005; Allal-Elasmi et al, 2010; Sidorenkov et al, 2010; Mozumdar & Liguori, 2011; Okafor, 2012; Shen et al, 2012; Kaur, 2014).* The term MS is a web of interconnected physiological, biochemical, clinical and metabolic risk factors like abdominal obesity, insulin resistance, elevated levels of triglycerides (TGL), reduced levels of High Density Lipoproteins-Cholesterol (HDL-C) and hypertension. *Stern et al. (2004); Enas et al.(2010), Sidorenkov et al. (2010)* reported that individuals with MS have two-fold risk of developing Cardiovascular Diseases (CVDs), three-fold risk of heart attack and five-fold risk of developing Type-2 Diabetes Mellitus (T2DM).

MS was first observed and described by the anatomist Morgagniin 1765 *(Enzi et al, 2003).* He manifested the link of abdominal obesity to the metabolic factors like hypertension, atherosclerosis, dyslipidemia, sleep apnea-hyponea and hyperuricemia. Later in 1920, *Kylin (1923),* a Swedish physician described the clustering of hypertension, hyperglycemia and gout. Some decades later, *Vague (1947)* found that abdominal obesity was a determinant factor in predisposing individuals to diabetes, atherosclerosis, gout and uric calculi. Following this, in 1965, an abstract was presented at the European Association for the Study of Diabetes *(Avogaro & Crepaldi, 1965)* which again described this syndrome comprising of hypertension, hyperglycemia and obesity. In 1988, *Reaven (1988)* reintroduced the concept of syndrome 'X' for the clustering of cardiovascular risk factors like hypertension, glucose intolerance, and high TGL and LDL-C concentration. His main contribution was an introduction of the concept of the insulin resistance. Unfortunately, he missed abdominal obesity from the definition which was added later as a crucial abnormality. Later on, *Kaplan (1989)* introduced the term "The Deadly Quartet" to describe the joint presence of upper body obesity, hypertriglyceridemia, glucose intolerance and hypertension. Over the years, the syndrome has been given several names including Insulin Resistance Syndrome X, Reaven Syndrome X, Metabolic Cardiovascular Syndrome and Dysmetabolic Syndrome.

Different diagnostic criteria have been proposed by various agencies for the assessment of MS during the past three decades. For the first time, in the year 1998, World Health Organisation *(Alberti & Zimmet, 1998)* provided a criterion for the assessment of MS. Then European Group for the Study of Insulin Resistance (EGIR) *(Balkau and Charles, 1999)* countered with a modification of the WHO

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criterion in 1999. In 2001, the National Cholesterol Education Program Adult Treatment Panel-III (NCEP-ATP III) introduced an alternative clinical criterion for defining the MS with the aim to identify people at long term risk for ischemic heart disease. The ATP-III criterion did not mandate the requirement of any single risk factor for diagnosis. With the formulation of these guidelines, some uniformity and standardization has occurred in the definition and criterion of MS which has been very useful for epidemiological purposes. Then, later on, International Diabetes Federation *(IDF, 2005)*, proposed a new criterion in April, 2005 suggesting that abdominal obesity assessed with the help of waist circumference (WC) is mandatory for the diagnosis of MS. Once this essential condition was present, at least two additional risk factors out of four were necessary for the diagnosis. Later on, in the year 2005, NCEP ATP-III *(Grundy et al, 2005)* proposed a modified criterion for the assessment of MS with modification in the cut-off values of WC.

Table: Diagnostic criteria for the assessment of Metabolic Syndrome among females

Variables	NCEP ATP-III (2001)	IDF (2005)	mNCEP ATP-III (2005)
WC (cm)	≥ 88	≥ 80	≥ 80
BP (mm Hg)	≥ 130/85	≥ 130/85	≥ 130/85
TGL (mg/dl)	≥ 150	≥ 150	≥ 150
HDL-C (mg/dl)	<50	<50	<50
FBG (mg/dl)	≥ 110	≥ 100	≥ 110

Many studies from developed countries *(Kawamoto et al, 2011; Arthur et al, 2012; Marjani et al, 2012; Liu et al, 2013; Shahbazian et al, 2013; Ali et al, 2014; Xu et al, 2014)* have reported that MS and CVDs are more common in postmenopausal women when compared with premenopausal women, which may be related to hormonal changes during menopausal transition. There is a paucity of studies on MS and menopausal status in the developing countries especially in India using different definitions. Therefore, in the present study, an attempt has been made to assess the prevalence of MS among the rural premenopausal and postmenopausal women of Amritsar (Punjab).

Materials &Methods

The data for the present cross-sectional study was collected from various rural areas of Amritsar during the period from June 2013 to June 2014. The study group included 300 rural females, of which 186 were premenopausal women (those who were regularly menstruating and non-pregnant) and 114 postmenopausal women (those who had reached natural menopause and had their last menstrual bleeding at least 12 months previously) ranging in age between 25 to 55 years. Those women who experienced cessation of menstruation due to hysterectomy or any other surgical cause were excluded from the study. Ethical clearance from the Institutional Ethical Review Committee of Guru Nanak Dev

University was obtained prior to carrying out the study. After fully explaining the nature, procedures, aims and objectives of the study to all the females in a language they understood, verbal as well as written informed consent was obtained. The participation of women was voluntary. First of all, the women were taken into confidence. All the females were interviewed in person at their homes to collect information regarding age, menopausal status, reproductive history as well as family history using a well designed and structured proforma. The WC is the best tool for the assessment of abdominal obesity, it was measured with the help of a non-stretch fibre glass measuring tape at a point midway between the inferior margin of the ribs and the superior border of the iliac crest on each subject single handedly by the investigator herself *(Weiner and Lourie, 1981)*. Blood pressure of each participant was measured using auscultatory method with the mercury sphygmomanometer and a stethoscope after rest of 15 minutes as per recommendation of the American Heart Association *(Ataman et al, 2005)*. Three readings each of Systolic Blood pressure (SBP) and Diastolic Blood Pressure (DBP) were recorded at an interval of 5 minutes at least and the mean values were used in the data for analysis. A certified technician assisted in the withdrawl of 2 ml venous blood from all the subjects in the morning after a twelve hour overnight fast. The blood samples were centrifuged for 10 minutes at 3000 rpm. Lipid levels were determined using commercially available Erba kits and levels of Total Serum Cholesterol (TC), Triglycerides (TGL), High Density Lipoproteins-Cholesterol (HDL-C) and Fasting Blood Glucose (FBG) were estimated from the absorbance values obtained on semi-automated biochemical analyser. Very Low Density Lipoproteins-Cholesterol (VLDL-C) was calculated by indirect method as VLDL-C is one fifth of TGL. Low Density Lipoproteins-Cholesterol (LDL-C) was calculated by subtracting VLDL-C and HDL-C from TC. Following three diagnostic criteria were utilized for the assessment of MS.

Data was analysed using the Statistical Package for Social Sciences (SPSS inc, Chicago, IL, USA; version 15). The mean and standard deviation were calculated for continuous variables and percentage for categorical variables. The baseline characteristics were compared between premenopausal and postmenopausal women by Student's t-test. The chi- square (χ^2) test was applied to compare differences between proportions. All analyses were two-tailed and a p-value <0.05 was considered statistically significant. The prevalence of MS was assessed among premenopausal and postmenopausal females. For estimation of agreement between different definitions kappa statistic was also used.

Results

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The baseline characteristics of the studied females stratified with respect to the menopausal status are presented in Table 1. Out of the 300 rural females, 186 were premenopausal and 114 were postmenopausal. The mean age of postmenopausal (52.66±7.45 years) women was significantly higher ($p<0.01$) than the mean age of premenopausal (32.68±5.86 years) women. In the pooled sample, the mean values of WC, SBP and DBP were significantly ($p<0.05$) higher among postmenopausal women than premenopausal women. Similarly, the postmenopausal women had significantly ($p<0.05$) higher values of all the biochemical parameters as compared to their premenopausal counterparts except LDL-C.

Table 1. Baseline Characteristics of Premenopausal and Postmenopausal Women

VARIABLES	Premenopausal Women (N=186)		Postmenopausal Women (N=114)		Total Number Of Women (N=300)		't' value
	MEAN	SD	MEAN	SD	MEAN	SD	
Age (years)	32.68	5.86	55.66	7.45	41.41	12.92	28.038***
WC (cm)	78.64	10.78	81.68	12.02	79.80	11.34	3.667***
SBP (mm Hg)	122.28	13.94	140.64	20.51	129.26	18.94	8.436***
DBP (mm Hg)	81.15	11.05	87.68	12.36	83.63	11.98	4.626***
TC (mg/dl)	143.37	42.69	158.08	60.00	148.96	50.39	2.287*
TGL (mg/dl)	103.49	45.84	160.97	68.05	125.33	61.90	7.978***
HDL-C (mg/dl)	41.70	16.89	47.56	17.36	45.33	17.39	2.888**
LDL-C (mg/dl)	83.93	54.65	75.11	41.59	78.46	47.10	1.524
VLDL (mg/dl)	20.70	9.17	32.19	13.61	25.02	12.38	7.978***
FBG (mg/dl)	83.25	7.93	89.45	13.86	85.61	10.98	4.356***

Significant at p<0.05; **Significant at p<0.01, ***Significant at p<0.001

Table 2 shows the prevalence of MS and metabolic risk factors in the premenopausal women, postmenopausal women and pooled sample. The prevalence of MS was 21.66%, 24.33% and 25.66% according to ATP-III, IDF and mATP-III criteria, respectively. The postmenopausal women were found to have significantly ($p<0.05$) higher prevalence of MS as compared to premenopausal women using all the three criteria. The prevalence of metabolic risk factors like high WC, raised blood pressure, reduced levels of HDL-C, elevated levels of TGL and FBG was also significantly ($p<0.05$) higher in postmenopausal women than their premenopausal counterparts. In the pooled sample, according to ATP-III criterion, the most prevalent component was reduced levels of HDL-C followed by raised blood pressure, high WC, elevated levels of TGL and elevated levels of FBG. Based on IDF and mATP-III criteria, the most frequent component was reduced levels of HDL-C

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followed by high WC, raised blood pressure, elevated levels of TGL and elevated levels of FBG. It is apparent from this table that the most prevalent component of MS among both premenopausal and postmenopausal rural females was reduced levels of HDL-C and the least prevalent was elevated levels of FBG.

Table 2. Prevalence of Components of Metabolic Syndrome among Participants

NCEP ATP-III (2001)	*Total(N=300)*	*Premenopausal(N=186)*	*Postmenopausal(N=114)*
WC (cm)	**28.33(85)**	**25.80(48)**	**32.45(37)**
BP (mm Hg)	**34.33(103)**	**21.50(40)**	**55.26(63)**
TGL (mg/dl)	**28.00(84)**	**15.05(28)**	**49.12(56)**
HDL-C (mg/dl)	**59.66(179)**	**56.98(106)**	**64.03(73)**
FBG (mg/dl)	**4.00(12)**	**-----**	**10.52(12)**
Metabolic Syndrome	**21.33(65)**	**6.98 (14)**	**44.73(51)**
IDF (2005)	*Total(N=300)*	*Premenopausal(N=186)*	*Postmenopausal(N=114)*
WC (cm)	**49.00(147)**	**43.54(81)**	**57.89(66)**
BP (mm Hg)	**34.33(103)**	**21.50(40)**	**55.26(63)**
TGL (mg/dl)	**28.00(84)**	**15.05(28)**	**49.12(56)**
HDL-C (mg/dl)	**59.66(179)**	**56.98(106)**	**64.03(73)**
FBG (mg/dl)	**16.33(49)**	**15.05(28)**	**18.42(21)**
Metabolic Syndrome	**24.33(73)**	**11.82(22)**	**44.73(51)**
mNCEP ATP-III (2005)	*Total(N=300)*	*Premenopausal(N=186)*	*Postmenopausal(N=114)*
WC (cm)	**49.00(147)**	**43.54(81)**	**57.89(66)**
BP (mm Hg)	**34.33(103)**	**21.50(40)**	**55.26(63)**
TGL (mg/dl)	**28.00(84)**	**15.05(28)**	**49.12(56)**
HDL-C (mg/dl)	**59.66(179)**	**56.98(106)**	**64.03(73)**
FBG (mg/dl)	**4.00(12)**	**-----**	**10.52(12)**
Metabolic Syndrome	**25.66(77)**	**10.75(20)**	**50.00(57)**

Figures in parenthesis indicate the number of subjects
NCEP ATP-III (National Cholesterol Education Program Adult Treatment Panel- III)
mNCEP ATP-III (modified National Cholesterol Education Program Adult Treatment Panel- III)
IDF (International Diabetes Federation)
Waist Circumference (WC); Blood Pressure (BP);Triglycerides (TGL); High Density Llipoprotein-Cholesterol (HDL-C); Fasting Blood Glucose (FBG)

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Table 3. Clustering Of Components of Metabolic Syndrome among Studied Participants

Components of Metabolic Syndrome	NCEP ATP-III (2001)		
	Premenopausal (N=186)	***Postmenopausal (N=114)***	***Total (N=300)***
0	**21.50(40)**	**13.15(15)**	**18.3(55)**
1	**45.69(85)**	**22.80(26)**	**36.66(110)**
2	**25.80(48)**	**19.29(22)**	**23.33(70)**
3	**6.98(13)**	**26.31(30)**	**14.33(43)**
4	**0.53(1)**	**17.54(20)**	**7.0(21)**
5	**00**	**0.88(1)**	**0.3(1)**
Components of Metabolic Syndrome	**mNCEP ATP-III (2005)**		
	Premenopausal (N=186)	***Postmenopausal (N=114)***	***Total (N=300)***
0	**16.66(31)**	**9.64(11)**	**14(42)**
1	**40.32(75)**	**20.17(23)**	**32.66(98)**
2	**32.25(60)**	**19.29(22)**	**27.33(82)**
3	**9.67(18)**	**24.56(28)**	**15.33(46))**
4	**1.07(2)**	**21.92(25)**	**9.0(27)**
5	**00**	**3.50(4)**	**1.3(4)**
Components of Metabolic Syndrome	**IDF (2005)**		
	Premenopausal (N=186)	***Postmenopausal (N=114)***	***Total (N=300)***
0	**19.89(37)**	**12.28(14)**	**17(51)**
1	**43.01(80)**	**21.92(25)**	**35(105)**
2	**23.65(44)**	**14.91(17)**	**20.33(61)**
3	**10.75(20)**	**20.17(23)**	**14.3(43)**
4	**1.07(2)**	**17.54(20)**	**7.3(22)**
5	**00**	**7.01(8)**	**2.7(8)**

Figures in parenthesis indicate the number of subjects
NCEP ATP-III (National Cholesterol Education Program Adult Treatment Panel- III)
mNCEP ATP-III (modified National Cholesterol Education Program Adult Treatment Panel-III)
IDF (International Diabetes Federation)

Table 3 manifests the clustering of the number of components of MS in the studied females. According to ATP-III criterion, 45.69% of premenopausal and 22.80% of postmenopausal women had at least one risk factor, 25.80% of premenopausal and 19.29% of postmenopausal had atleast two risk factors, 6.98% of premenopausal and 26.31% of postmenopausal had at least three risk factors, 0.53% of premenopausal and 17.54% of postmenopausal had any four risk factors. None of the premenopausal had all the five risk factors whereas 0.88% of postmenopausal women had all the five risk factors of MS. This shows that about half of the postmenopausal females had two and three risk factors. Almost similar results were observed while applying IDF and mATP-III criteria.

Discussion

In developed and developing countries, now these days, CVD is the leading cause of mortality in the postmenopausal women *(Matthews et al, 1989; Carr, 2003, Mesch et al, 2006; Lejskova et al, 2011).* Various scientists *(Kannel, et al, 1976; Kannel, 1987; Carr, 2003, Cameron et al, 2004, Eshtiaghi et al, 2010)* observed that menopause is a risk factor for CVD which may be due to estrogen hormone deficiency. According to *Gohlke-Barwolf (2009)* and *Spadafranca et al. (2013)* estrogen deficiency play an important role as a determinant of MS in postmenopausal women which makes these females susceptible to CVD. Estrogen has protective effects on the cardiovascular system due to which there is an increase in the prevalence of CVDs in the postmenopausal women. In India, few studies *(Pandey et al, 2010, Tandon et al, 2010, Chhabra et al, 2014)* have investigated the prevalence of MS in premenopausal and postmenopausal women but not much information is available regarding MS among rural women from Punjab. Therefore, in the present study, the prevalence of MS was estimated in rural premenopausal and postmenopausal women of Amritsar (Punjab).

The overall prevalence of MS in the pooled sample was 21.66%, 24.33% and 25.66% using ATP-III, IDF and mATP-III criteria, respectively. The postmenopausal females were observed to have significantly higher prevalence of MS than premenopausal females (Table 1). Slightly higher prevalence of MS by using mATP-III and IDF criteria can be explained by lower cut-off points of WC than used by original ATP-III criterion. It is also observed that the difference in the percentage prevalence estimated by these three criteria was small and statistically non-significant. Further kappa statistics was applied for finding agreement between the three definitions. The degree of agreement between mATP-III and IDF was 0.87, between IDF and ATP-III was 0.85 while it was 0.76 between mATP-III and ATP-III which shows that mATP-III has more concordance with IDF and less concordance with ATP-III criterion. It can be concluded from the present results that we can use mATP-III or IDF criterion in future studies for detection of MS even though all these criteria have significant agreement but the maximum agreement was observed between mATP-III and IDF criteria. It is interesting to observe that out of 300 rural females, (18.3%) 55 females

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were screened positive for MS by using all these three criteria despite the fact that these three criteria share most of the components but still misclassify a number of subjects as having MS.

Table 4: Percentage Prevalence of Metabolic Syndrome among Rural Indian Females

Area	Age	Number of females	Criteria used	Percentage prevalence	Investigator
Mandur /Goa	**>25**	**176**	**ATP-III**	**39.80**	***Peixoto and Shah (2014)***
North Indian population	**Pre-M=25-40 Post-M=45-60**	**200**	**ATP-III**	**Pre-M=20.00 Post-M=41.00**	***Chhabra et al. (2014)***
Tumkur/Karnataka	**≥18**	**433**	**mATP-III**	**55.19**	***Shalini et al. (2013)***
Ambala/Haryana	**≥20**	**627**	**IDF**	**11.64**	***Pathania et al. (2013)***
Thiruvallur /TamilNadu	**30-50**	**150**	**ATP-III mATP-III**	**30.70 36.00**	***Selvaraj et al. (2012)***
Jammu & Kashmir	**Mean age=49.35 (Post-M women)**	**500**	**ATP-III**	**13.00**	***Tandon et al. (2010)***
Chandigarh	**≥18**	**315**	**ATP-III IDF**	**34.90 41.30**	***Mangat et al. (2010)***
Wardha/Mumbai	**≥18**	**131**	**ATP-III**	**7.60**	***Kamble et al. (2010)***
Amritsar females	**25-55**	**300 Pre-M=186 Post-M=114**	**ATP-III IDF mATP-III**	**21.66 24.33 25.66**	***Present study***

The magnitude of the MS in rural females of Punjab can be best judged via comparison with the prevalence of MS in other rural populations of India. The data on the prevalence of MS in some rural Indian populations is shown in Table 4. It is evident from this table that most of the studies have used ATP-III criterion for screening of MS whereas very few studies have used IDF and mATP-III criteria. The prevalence rate of MS among rural Indian females varies considerably from one region to another region. The present study presents one of the first report on the comparison of the prevalence of MS among rural premenopausal and postmenopausal Punjabi females using three international criteria namely ATP, IDF and mATP-III. No study from Punjab is available till date in literature which has compared these three criteria to assess the prevalence of MS. While *Deepa et al. (2007)* compared the prevalence of MS in South Indian population by using three criteria in which again mATP-III was not used for screening of MS. The results of the premenopausal and postmenopausal women of the present study regarding the prevalence of MS were compared with general women population studies conducted in India because only one study is available in literature on premenopausal and postmenopausal women.

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Chhabra et al. (2014) studied North Indian premenopausal and postmenopausal females and reported higher prevalence of MS using ATP-III criterion as compared to the rural females of Amritsar. This study highlights the high prevalence of MS among rural women which could increase the burden of diabetes and CVDs in near present future in Punjabi population. If the present trend continues, the situation can get worse even within a decade and MS and its associated diseases can emerge as important public health problem in rural adults of Punjab. The economic cost attributable to MS is so high that country like India can ill-afford to spend its meagre resources on the co-morbidities which are strongly influenced by MS. There is an urgent need to establish magnitude of the problem and the risk estimates for various NCDs and incorporate management prevention strategies within the existing health infrastructure.

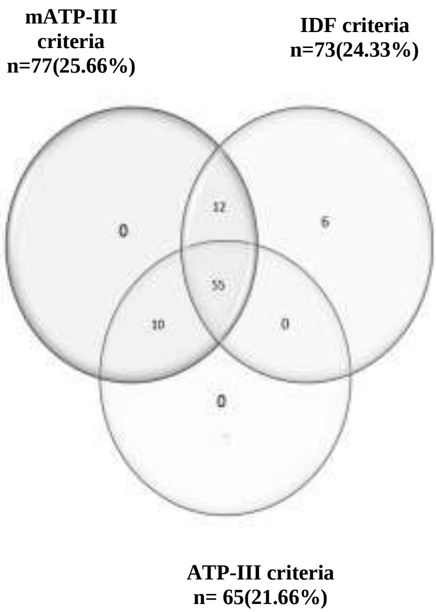

Fig: Showing the Overlapping of Subjects withMetabolic Syndrome Based on ThreeCriteria

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Author Disclosure Statement

No conflicts of interest. The authors have no disclosures to make in relation to the content of this manuscript.

References

Ford, E.S. 2004. Prevalence of the metabolic syndrome in US populations. *Endocrinology and Metabolism Clinics of North America*, 2004, 33(2):333-350.

Kraja, A.T., Rao, D.C., Weder, A.B., Mosley, T.H., Turner, S.T., Hsiung, C.A., Quertermous, T., Cooper. R., Curb, J.D., Province, M.A. 2005. An evaluation of the Metabolic Syndrome in a large mutli-ethnic study: the family blood pressure program. *Nutrition and Metabolism*, **2(17):** 1-13.

Allal-Elasmi, M., Taieb-Haj, S., Hsairi, M., Zayani, Y., Omar, S., Sanhaji, H., Jeema, R., Feki, M., Elati J, Mebazaa A, Kaabachi N. 2010. The metabolic syndrome: prevalence, main characteriatics and association with socio-economic status in adults living in Great Tunis. *Diabetes and Metabolism*., **36(3):** 204-208.

Sidorenkov O, Nilssen O, Brenn T, Martiushov S, Arkhipousky VL, Grjibouski AM. 2010. Prevalence of metabolic syndrome and its components in Northwest Russia: the Arkhangelsk study. *BMC Public Health*, **10:** 23.

Mozumdar A and Liguori G. 2011. Persistant increase of prevalence of metabolic syndrome among U.S. adults: NHANES III to NHANES 1999-2006.*Diabetes Care***, 34(1):**216-219.

Okafor C.I. 2012. The metabolic syndrome in Africa: current trends. *Indian J Endocrinal Metabolism* , **16(1):** 56-66.

Shen J, Goyal A and Speiling L. 2012. The Emerging Epidemic of Obesity, Diabetes and the Metabolic Syndrome in China. *Cardiology Research and Practice* Article ID 178675, 5 pages, doi:10.1155/2012/178675

Kaur, J. 2014. Assessment and screening of the risk factors in metabolic syndrome. *Medical Sciences*, **2:** 140-152.

Stern, M.P., Williams, K., Gonzalez-Villalpando, C., Hunt, K.J., Haffner, S.M. 2004. Does the Metabolic Syndrome improve indentification of Individuals at risk of Type 2 Diabetes and/or Cardiovascular Disease? *Diabetes Care*,**27(11):** 2676-2681.

Enas, E.A., Mohan, V., Deepa, M., Farooq, S., Pazhoor, S., Chennikkara, H. 2007. The Metabolic syndrome and dyslipidemia among Asian Indians: a population with high rates of diabetes and premature coronary artery disease. *Journal of the Cardio Metabolic Syndrome***, 2(4):** 267-75.

Enzi, G., Busetto, L., Inelmen, E.M., Corn, A., Sergi, G. 2003. Historical perspective: Visceral obesity and related comorbidity in Joannes Baptista Morgagni'sDe Sedibus et Causis Morborum per Anatomen Indagata'. *Int. J. Obes.*, **27:** 534-535.

Kylin, E. 1923. Studien ueber das Hypertonie-Hyperglyca "mie-Hyperurika" miesyndrom".*Zentralblatt fuer Innere Medizin*, **44:** 105-127.

Vague, J. 1947. Sexual differentiation. A factor affecting the forms of obesity. *Press Medicale***, 30:S** 39-S40.

Avogaro, P. and Crepaldi, G. 1965. Essential hyperlipidemia, obesity and diabetes. *Diabetologia* , **Vol 1:** p 137.

Reaven, G.M. 1988. Role of insulin resistance in human disease. *Diabetes*, **37(12):** 1595-1607.

Kaplan, N.M. 1989. The deadly quartet. Upper-body obesity, glucose intolerance, hypertriglyceridemia and hypertension. *Archives of Internal Medicine*, **149(7):** 1514-1520.

Alberti, K.G. and Zimmet, P.Z. 1988. Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. *Diabetic Medicine*, **15(7):** 539-553.

Balkau, B. and Charles, M.A. 1999. Comment on the provisional report from the WHO consultation: European Group for the tudy of Insulin Resistance (EGIR). *Diabetic Medicine*, **16(5):** 442-443.

Expert Panel on Detection Evaluation 2001. THBCA: Executive summary of the third report of the National Cholestero lEducation Program (NCEP) expert panel on detection, evaluation and treatment of high blood cholesterol in adults (adult treatment panel III). *Jama Med Assoc*, **285(19):** 2486-2497.

International Diabetes Federation. 2005. The IDF consensus worldwide definition of the metabolic syndrome Brussels: IDF,. Available at: http://www.idf.org/webdata/ducs/IDF_Metasyndrome definition.pdf (accessed May 2005).

Grundy, S.M., Cleeman, J.I.,Daniels, S.R., Donato, K.A., Eckel, R.H., franklin, Ba, Gordon, D.J., Krauss, R.M., Savage, P.J., Smith, S.C., Spertus, J.A.. 2005. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung and Blood Institute scientific statement. *Circulation*, **112(17):** 2735-2752.

Kawamoto, R., Tabara, Y., Kohara, K., Miki, T., Kusunoki, T., Takayama, S., Abe ,M., Katoh, T., Ohtsuka, N. 2011. Relationships between lipid profiles and metabolic syndrome, insulin resistance and serum high molecular adiponectin in Japanese community-dwelling adults. *Lipids in Health and Disease*, **10(79):** 1-7.

Arthur, F.K.N., Adu-Frimpong, M., Osei-Yeboah, J., Mensah, F.O., Owusu, L. 2012. Prediction of metabolic syndrome among postmenopausal Ghanian women using obesity and atherogenic markers. *Lipids in Health and Disease*, **11(101):** 1-13.

Marjani, A., Hezarkhani, S., Shahini,N. 2012. Prevalence of metabolic syndrome among Fars Ethnic women in North East of Iran. *World Journal of Medical Sciences*, **7(1):**17-22.

Liu, P., Ma, F., Lou, H., Liu, Y. 2013. The utility of fat mass index vs. body mass index and percentage of body fat in screening of metabolic syndrome. *BMC Public Health*, **13:** 629.

Shahbazian, H., Latifi, S.M., Jalali, M.T., Shahbazian, H., Amani, R., Nikhoo, A., Aleali, A.M. 2013. Metabolic syndrome and its correlated factors in an urban population in South West of Iran. *Journal of Diabetes and Metabolism*, **12(11):** 1-6.

Ali, S.B., Belfki-Benali, H., Aounallah-Skhiri, H., traissae, P., Maire, B., Delpeuch, N.A., Romdhane, H.B. 2014. Menopause and metabolic syndrome in Tunisian women. *Biomed Research International*, Article ID 457131. Available at http://dx.doi.org/10.1155/2014/457131

Xu, S., Ming, J., Yang, C., Gao, B., Wan, Y., Xing, Y., Zhang, L., Qiuhe, J. 2014. Urban, semi-urban and rural difference in the prevalence of metabolic syndrome in Shaanxi province, Northwestern China: a population based survey. *BMC Public Health*, **14:** 104.

Weiner, J.S. and Lourie, J.A. 1981. Practical Human Biology, Academic Press, Inc., New York,.

Ataman, S.L., Cooper, R., Rotimi, C., McGee, D., Osotimehin, B., Kadiri, S., Kinque, S., Muna, W., Fraser, H., Forrester, T., Wilks, R. 2005. Standardization of blood pressure measurement in an international comparative study. *Journal of Clinical Epidemiology*, **49:c** 869-77.

Matthews, K.A., Meilahn, E., Kuller, L.H., Kelsey, S.F., Caggiula, A.W., Wing, R.R. 1989. Menopause and risk factors for coronary heart disease. *N Engl Jour Med***., 321:** 641-646.

Carr, M.C., 2003. The emergence of the metabolic syndrome with menopause. *J Clin Endocrinol Metab.*, **88(6):** 2404-11.

Mesch, V.R., Boero, L.E., Siseles. N.O., Royer, M., Prada, M., Sayegh, F., Schreier, L., Benencia, H.J., Berg, G.A. 2006. Metabolic syndrome throughout the menopausal transition: Influence of age and menopausal status. *Climacteric*, **9:** 40-8.

Lejskova, M., Alusik, S., Suchanek, M., Zecova, S., Pitha, J. 2011. Menopause: Clustering of metabolic syndrome components and population changes in insulin resistance. *Climacteric*, **14(1):** 83-91.

Kannel, W.B., Hjortland, M.C., Mcnamara, P.M., Gordon, T. 1976. Menopause and risk of CVD. *Ann. Intern. Med.*, **85(4):** 447-52.

Kannel, W.B. 1987. Metabolic risk factors for coronary heart disease in women: perspective from the Framingham study. *Am Heart J*, **114(2):** 413-9.

Cameron, A.J., Shaw, J.E., Zimmet, P.Z. 2004. The metabolic syndrome: prevalence in worldwide populations. *Endocrinology and Metabolism clinics of North America*, **33(2):** 351-375.

Eshtiaghi, R., Esteghamati, A., Nakhjavani, M. 2010. Menopause is an independent predictor of metabolic syndrome in Iranian women. *Maturitas*, **65:** 262-266.

Gohlke-Barwolf, C. 2000. Coronary Artery Disease: Is menopause a risk factor? *BasicRes Cardiol.*, **95:** 177-83.

Spadafraca, A., Vignati, L, Battezzati, A., Bettoli, S. 2013. Body composition and Metabolic risk factors in postmenopausal women: Effects of a dietary weight loss program. *Food and Nutrition scoences*, **4:** 420-29.

Pandey, S., Srinivas, M., Agashe, S, Joshi, J, Galvankar, P., Prakasam, C.P., Vaidhya, R. 2010. Menopause and metabolic syndrome: a study of 498 urban women from western India. *Journal of Mid life Health*,, **1(2):** 63-69.

Tandon, V.R., Mahajan, A., Sharma, S., Sharma, A. 2010. Prevalence of cardiovascular risk factors in postmenopausal women: A rural study. *Journal of Mid life Health*, 1**(1):** 26-29.

Chhabra, N., Sodhi, K., Kukreja, S., Chhabra, S., Vijayasarathy, S., Chhabra, S., Ramessur, K. 2014. Central obesity and prevalence of metabolic syndrome in postmenopausal women. *Webmedcentral Obesity*, **5(1):** WMC004532.

Deepa, M., Farroq, S., Datta, M., Deepa, R., Mohan, V. 2007. Prevalence of metabolic syndrome using WHO, ATP-III and IDF definitions in Asian Indians: The Chennai urban rural epidemiology study (CURES-34). *Diabetes/Metabolism Research and Reviews*, **23:** 127-134.

Shalini, M., Babu, S.K.P., Murthy, S.A.G., Girish, B., Mounika, K., Vaishnavi, B.2013. Metabolic syndrome among urban and rural women population- A cross sectional study. *Journal of Clinical and Diagnostic Research*, **7(9):** 1938-1940.

Selvaraj, I., Gopalakrishnan, S., Logaraj, M. 2012. Prevalence of metabolic syndrome among rural women in a primary health centre area in Tamil Nadu. *Indian Journal of Public Health*, 56**(4):** 314-317.

Mangat, C., Goel, N.K., Walia, D.K., Agarwal, N., Sharma MK, Kaur J, Singh R, Singh G. 2010. Metabolic syndrome: a challenging health issue in highly urbanized union territory of North India. *Diabetology and Metabolic Syndrome*, 2**(19):** 1-8.

Pathania, D., Bunger, R., Mishra, P., Pathak, R., Arora, A. 2013. A study to assess prevalence of metabolic syndrome and its socio-demographic risk factors in rural area of diatrict Ambala, Haryana. *Community Medicine and Health Education*, **3:** 226.

Peixoto, C., and Shah, H.K. 2014. Prevalence of metabolic syndrome among adult population in a rural area of Goa. *J. Pub. Health Med. Res*, **2(1):** 34-37.

Kamble, P., Deshmukh, P.R., Garg, N. 2010. Metabolic syndrome in adult population of rural Wardha, Central India. *Indian Journal Med Res*, **132:** 701-705.

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The effect of "Structured Neuro-muscular Postural Training" in balance modulation and fall prevention strategy in osteoarthritis knee

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Abstract

Background and purpose: Postural impairments and functional limitations are linked to osteoarthritis knee adults. The purpose of this study was to identify the balance & postural impairments in osteoarthritis adults and compare the efficacy of two treatment strategies, Structured Neuromuscular Postural Training (SNPT) with conventional treatment (CT). *Methods:* In a prospective study design, Fifty-seven osteoarthritis knee subjects were evaluated and analyzed for balance variables such as viz. Timed up and go test (TUG), Berg balance test (BBT), Modified WOMAC (MW) and its subgroups pain (WP), stiffness (WS) and physical function (WPF) at the baseline and after 6-weeks of treatment. Data were analyzed to determine treatment efficacy. *Results:* The application of SNPT had statistical significance for the balance variable TUG, at baseline and 6 weeks follow up for both pre elderly and elderly subjects. Further, SNPT shows non- statistically significant higher scores for other qualitative balance variables in pre elderly osteoarthritis knee. However, conventional groups demonstrated better efficacy for the qualitative parameters MS, WS and WPF than SNPT in elderly group. *Conclusion:* SNPT treatment intervention has better efficacy for pre elderly and conventional for elderly in osteoarthritis knee subjects. Hence present study concludes that one should use treatment strategy depending upon the age i.e. SNPT intervention in pre elderly and conventional in elderly subjects. Further, blending strength training (CT) with balance training (SNPT) may have better functional outcome for individuals >40 years of age.

Introduction

Fundamentally the 'Balance' is a skill often compromised with advancing age. The loss of confidence or fear of fall frequently results in reduced physical activity that in turn, may affect & further deteriorate the postural stability & quality of life. The standard clinical balance assessment can help to assess fall risk and determine the underlying reasons for balance disorders. *Mancini & Horak (2010)* narrated that the controlled balance involves maintaining posture, facilitating movement & recouping equilibrium. An assessment of the postural control performance reveals indirectly the character of the postural control capacity *(Hoffer et al, 1996; Raju, 2012),* and in the assessment of postural control capacity, the character of the environment and the task are highly relevant *(Shum way-Cook et al, 2000; Roger et al, 2003).* The environmental factors are influenced by the proprioceptive & somatosensory information, which is necessary for the neuromuscular control of the dynamic restraints *(Riemann et al, 2009). Braun (1998) and Shimada et al (2003)* found that the balance demands during the locomotive activities are different from the demands when standing still. Further, *Winter et al (1990)* noticed that the responses to postural perturbations are task- and perturbation specific. Currently, postural balance is studied using motion analysis and the techniques of biodynamic. *Sutherland (2002)* stated that neither kinematics nor electromyography is stand-alone components of clinical gait analysis. *Cordo and Nashner(1982) and Horak et al (1997)* researches on postural responses to surface translations has shown that balance is not based on a fixed set of equilibrium reflexes but on a flexible, automatic postural adjustments and functional motor skill, that can adapt with training and experience. A growing research indicates that the learning adaptation have an important influence on balance responses based on motor learning. It occurs due to the repetitions of the platform perturbation, prior experience; feed forward anticipatory control and accommodation of biomechanical constraints. *(Horak et al,1997; Tang et al, 1998; Park et al, 2004; Kisner & Colby, 2007).*

Brach & Van-Swearingen (2002) & *Shubert et al (2010)* research describe, participation in a multi-component exercise program or an intervention that primarily focus on strength and balance skills can have a positive impact on cognitive as well as physical outcomes. Much of the previous researches provide various forms of interventions. *Tinetti et al (1994)* described multifactorial interventions while *Campbell et al (2007)* narrated single factor component intervention. *Gillespie et al (2009) & Cameron et al (2010)* provoked multi-component exercise program, while *Sherrington et al (2008)* emphasized on moderate/high challenge balance exercise programs. The most effective fall risk research interventions Otago exercise program *(Campbell & Robertson, 2007)* and modular obstacle program *(Rogers et al, 2013)* provides safe challenges to fall risk.

The Structured Neuromuscular Postural Training (SNPT) is a specially designed strategy aimed to modify neurophysiology and biomechanical changes. The approach incorporates mass to individual moment technique of proprioceptive neuromuscular facilitation by changing graded functional tasks. According to *Hurley et al (1998),* both neurophysiologic and biomechanical techniques affect the musculoskeletal system in functional context. The goal of SNPT strategy is to optimize postural stability, performance enhancement and balance modulation. It uses sensorimotor training intervention to improve both static and dynamic mechanism of balance as well as the huge number of postural control balance strategies used by *Rogers and Page (2013). Hurley et al (1998)* specified the component of technique involved are sensorimotor experience (manual contact), selective stretch to augment dynamic motor response and concept of synergy to strengthen specific muscles.

The SNPT intervention strategy in context to knee osteoarthritis is known to consist oftwo phases viz: *Phase 1Adaptive phase:*In the primary phase; co-contraction of agonist and antagonist along with distraction and manual glide help to manage recurrent pain and swelling. Isometric and isotonic exercises without resistance is preceded. This incorporates basic neurophysiologic principles of Sherrington and Kabath of proprioceptive neuromuscular facilitation viz. joint traction, irradiation and co-contraction.

Further, resistive exercise regimen emphasis on, focused muscle training of Hip, knee and ankle joints viz. vastus medialis oblique, ankle dorsi flexors, peronias, gastrocnemius-soleus, gluteus medius, gluteus maximus, hip ext. rotators and lateral compartment knee. *(Vincent and Vincent, 2012)*The goal is to achieve joint stability, which in turn can improvise proprioceptive and kinesthetic sensation.Active stretch of hamstring muscle along with posterior capsule was performed in functional positions. Synergistic coupling movement along with proprioceptive re-education during mass moment of hip, knee and ankle is targeted to enhance neuromuscular control i.e. medicine ball / gym ball activity. *(Hurley et al, 1998).*

Subsequently, sensorimotor training adaptations improves rate of force development during voluntary isometric contraction performed to improve functional joint or postural stability. *(Bruhn et al, 2004).*

Phase 2: *Dynamic task phase:* In secondary phase; Get Up and Go test (3 metre walk) along with balance training is planned to restore neuromuscular control and coordination. This regimen

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emphasizes joint loading and unloading, planter weight distribution, weight shift, postural accommodation during various ADL task within functional context under dynamic conditions (viz. balance board, trampoline activities, Frankel's Exercise and Get-up-and-go test). This phase is aimed to modify neuromuscular control and coordination improvising functional joint stability, proprioception and kinesthetic awareness.

The purpose of this study was to identify the balance & postural impairments in osteoarthritis adults andcompare the efficacy of two treatment strategies viz. Structured Neuromuscular Postural Training (SNPT) with conventional treatment (CT).

Material and Method:

Symptomatic osteoarthritis knee patients visiting university hospital outpatient services of the Institute of Medical Sciences, BHU were recruited for the study. The individuals with radiographic confirmed knee osteoarthritis ranging between 41 to 80 years and having a risk/fear of fall gave their written consent and participated in full data collection. Exclusion criteria of study were sport injury/traumatic knee, inflammatory arthritis and metabolic disorders; along with specific vestibular, proprioceptive or visual impairment.

After checking inclusion/exclusion criteria's and ethical consent at entry level, sixty-two male subjects randomized from Sept' 2011 up to March' 2013, according to random number table in two groups i.e. Conventional and Structured Neuromuscular postural training (SNPT) groups by fiveyears age interval match. The subjects were divided into pre elderly (40-60 Years) & elderly (>61 years) groups age wise. However, 5 subjects in SNPT group did not complete follow-up hence were excluded from the analysis. Main reasons given for not completing the trial included health (n=2), family (n=2) and transport (n=1) problems. Thus, study is presented for 57 male subjects.

Subjects were evaluated for the balance variables such as viz. Timed up and go test (TUG), Berg balance test (BBT), Modified WOMAC (MW) and its subgroups pain (WP), stiffness(WS) and physical function(WPF) at entry level.

Control group subjects have undergone conventional approach (quadriceps strengthening & hamstring stretching) while, the study Group was subjected to Structured Neuromuscular Postural Training (SNPT) approach (strengthening focused muscle, knee joint distraction and dynamic balance training) for a week in OPD as per their allocation and training program to each group and latter for 5 weeks at home. Further, SNPT Patientswere instructed to carry out Frankel's exercise, proprioceptive reeducation & TUG at home, except

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balance board, trampoline training carried out as outpatient.

They were again measured for all the balance variables after 6 weeks.

Observations and results:

Basic characteristics of the subjects were assessed *at baseline* to see the correlation among the study groups. Pre elderly conventional subjects (n=19) mean demographics are as (age 49.79±5.73 yrs.; height 170.42±5.32 cm.; weight 71.11±8.84 kg. and BMI 24.61±2.02) while that of SNPT group (n=14) are as (age 52.57 ± 5.23 yrs; height 171.57 ± 4.80 cm.; weight 76.21 ± 8.61 kg. and BMI 26.04 ± 2.61). Similarly, elderly conventional subjects (n=12) mean demographics are as (age 67. 50 ± 4.58 yrs.; height 169.92 ± 5.05 cm; weight 71.67 ± 4.81 kg. and BMI 24.96 ± 2.02) while that of SNPT group (n=12) are as (age 67.92 ± 5.07 yrs.; height 166.50 ± 6.33 cm.; weight 70.17 ± 7.08 kg. and BMI 25.68 ± 3.32). There was no statistically significant difference at baseline in both pre elderly and elderly groups. It shows even distribution of age, height, weight and BMI of subjects within the treatment groups.

The difference of balance parameters in osteoarthritis knee subjects between groups is presented in Figure 1-1 in pre elderly and elderly subjects.

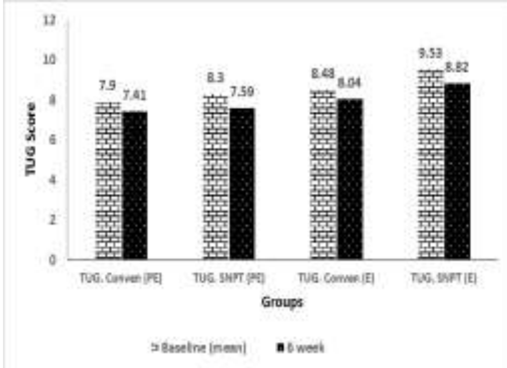

Fig. 1: Comparison of balance, &TUG variables in pre elderly & elderly subjects

Fig. 1 shows the intergroup comparison of difference of quantitative balance TUG variables between baselines to 6 weeks follow up among pre elderly (PE) and elderly (E) group subjects. The difference was found to be statistically significant (t=3.81, p=0.001) for TUG in pre elderly SNPT treatment groups. Mean difference from baseline to follow up for TUG in SNPT was 0.71 sec. and 0.49 sec. in the convention group. This difference of mean was observed to be statistically highly significant (t=3.81, p<0.001) for SNPT treatment group compared to the conventional group. Similarly, in elderly subjects, mean difference (post treatment – baseline) for TUG in SNPT group was found to be 0.72 sec. compared to 0.44 sec. in conventional group showing better efficacy of SNPT treatment. High statistically significant difference (t=5.54, p<0.001) was observed for SNPT treatment.

The percent change of speed from initial to 6 weeks follow up was observed as 6.28±1.69 for the conventional group as compared to 8.63±2.60 in SNPT pre elderly subjects (t=3.14, p=0.004). Similarly % change of speed was observed as 5.21±0.60 for the conventional group as compared to 7.56±2.00 in SNPT elderly subjects (t=3.89, p=0.001). This shows greater rate of speed improvement in SNPT intervention group compared to the conventional treatment group in both pre elderly and elderly subjects.

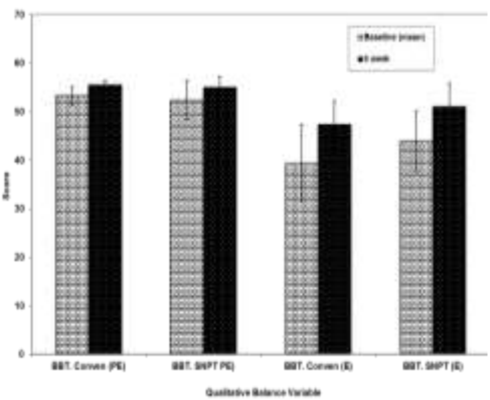

Fig. 2: Comparison of balance variable BBT in pre elderly & elderly subjects

Fig. 2 shows that the validity of BBT could not be seen in studied qualitative scale BBT (Berg balance test) as it was statistically insignificant in both pre elderly and elderly group subjects. Non-statistically significant high scores in SNPT treatment group (2.57) was seen compared to the conventional group (2.27) in pre elderly subjects. Similarly non-statistically significant high scores in conventional treatment (8.0) was seen compared to SNPT (7.17) in elderly subjects.

Fig. 3 shows that in the pre elderly subjects though statistical significance ($p<0.05$) was visible comparing initial and 6 weeks follow up for modified WOMAC subgroup pain (WP), other parameters were insignificant. Further, at pre elderly level SNPT maneuver shows higher scores for all the balance variables and its impact is reliable and encouraging in pre elderly osteoarthritis knee.

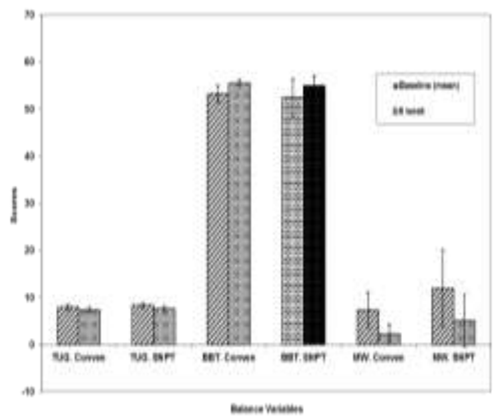

Fig. 3: Comparison of Balance and Functional variables at baseline and 6 weeks followup in pre elderly group

The intergroup comparison of difference of balance assessment variable between baselines to 6 weeks follow up among elderly group is depicted in Fig. 4. It shows statistically high significant difference for balance assessment variables *MW (modified WOMAC test)* and it's subgroups WS (stiffness) and WPF (physical function) test.

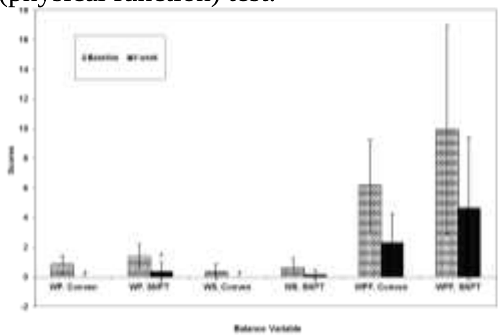

Fig 4: Comparison of subgroups of balance variable Mod. WOMAC (WP, WS and WPF) in elderly subjects

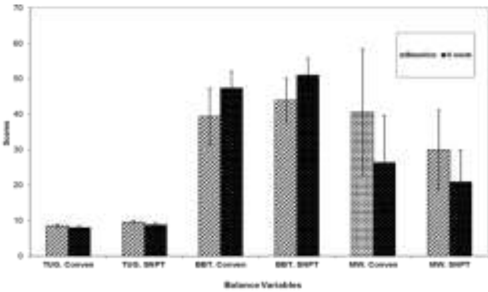

Figure 5: Comparison of balance variables among groups

The mean difference for balance parameters overall MW was statistically significant (t=2.55, p=0.018). However, mean difference of subgroups of MW for balance parameters WS and WPF was statistically significant (t=2.55, p=0.018, t=2.16, p=0.042 respectively) showing conventional group to be better in efficacy compared to the SNPT group in elderly subjects.

On the whole, quantitative balance parameter TUG has better efficacy in both the pre elderly and elderly subjects. At pre elderly level SNPT maneuver shows higher scores for all the balance variables and its impact is reliable and encouraging in pre elderly osteoarthritis knee. However, conventional groups shows better efficacy for the qualitative parameters MS, WS and WPF than SNPT in elderly group. Thus, SNPT was better in efficacy for pre elderly and conventional for elderly in osteoarthritis knee subjects.

Discussion:

The objective of the study was to assess the impact of balance variables in age related study groups. The intergroup comparison of difference of balance assessment showed that there was statistically high significant differences among elderly groups for variables TUG, MW, WS and WPF. Pre elderly group showed higher significance for TUG variable and significant for MW and WP.

In the present study, TUG average mean time score was 8.47 seconds at 58.02 years age and has been statistically significant in both pre elderly and elderly age groups. This finding is consistent with prior research that has shown the mean time score in TUG calculated as 9.4 seconds by *Bohannon, (2006);and Pondaland Del ser, (2008)*.

However, significance and validity of BBT could not be seen in any of the treatment groups in our study subjects i.e.

both were equally effective. This is in agreement with similar findings reported by *Bogle Thorbahn et al (1996)* study who also found no relationship between increasing age and decreasing performance. Decreased scores did not predict increased frequency of falls. Studies by *Thorp e al (2010) and Juhl et al (2012)* were also consistent with our results which have similar effect of WOMAC and its subscales. *Juhl et al (2012)* meta-analyses in knee osteoarthritis scaled WOMAC "pain" and "function" subscales were the most responsive composite scores. In our study WOMAC pain subscale was responsive in pre elderly and stiffness and physical function were responsive in elderly group subjects.

It could be argued that the kinematic differences in TUG may be indicative of characteristic gait adaptations due to knee OA rather than joint instability. Individuals with OA exhibit reduced walking speed/cadence *(Broströmet al, 2012)* likely due to alterations in the neuromuscular strategy of the lower extremity kinetic chain in response to joint pain or muscle weakness. *(Zeni and Higginson, 2011).* Further, *Gok et al (2002)* reported an increased dynamic varus malalignment during the loading response phase of gait in medial knee OA subjects. Thus, the exact contribution of either knee OA or joint instability to the reported alterations in knee joint kinematics cannot be readily elucidated.

Fall-prevention research interventions *(Shumway-Cook et al, 1997; Robitaille et al, 2005 and Shubert, 2011)* suggest that for best possible results, the exercise program needs to be structured, progressed, and must accomplish the minimum dose of exercise over a definite period of time *(Cameron et al, 2010).* The program designed has to be progressive and challenging as individual master's different strength, balance and coordination skills *(Thorp et al, 2010).*

The postural stability and balance has impact of feed-forward anticipatory control, in the form of SNPT approach based on motor learning. The strength training by way of high resistance improves the mechanical efficacy of the efferent drive on the motoneurons, while sensorimotor training alters the afferent input on the CNS. *(Bruhn et al, 2004).*

Summary & Conclusions: When focus is placed merely on the balance assessment in healthy and active elderly, it becomes difficult to find good suggestions for a valid test battery for fall risk assessment. Present study concludes that one should use treatment strategy depending upon the age i.e. SNPT in pre elderly and conventional in elderly subjects. The compared treatment strategies strength vs balance training were found to be equally effective and superior to each other at few balance parameters, indicates the need to blending of strength training with balance training for better outcome.

References:

Bogle Thorbahn, L.D., Newton, R.A. 1996. Use of the Berg Balance Test to predict falls in elderly persons. Phys. Ther. **76(6):** 576-83

Bohannon, R.W. 2006. Reference values for the timed up and go test: a descriptive meta-analysis. *J. Geriatr. Phys. Ther*; **29:** 64-8.

Brach, J.S., VanSwearingen, J.M. 2002. Physical impairment and disability: relationship to performance of activities of daily living in community-dwelling older men. *Phys. Ther.,* **82(8):** 752-61

Braun, B.L.1998. Knowledge and perception of fall-related risk factors and fall-reduction techniques among community-dwelling elderly individuals.*Phys. Ther.,* **78(12):** 1262-76.

Broström, E.W., Esbjörnsson, A.C., von Heideken, J., Iversen, M.D. 2012. Gait deviations in individuals with inflammatory joint diseases and osteoarthritis and the usage of three-dimensional gait analysis. *Best Pract. Res. Clin. Rheumatol.;* **26(3):** 409-22.

Bruhn, S., Kullmann, N., Gollhofer, A. 2004. The effects of a sensorimotor training and a strength training on postural stabilisation, maximum isometric contraction and jump performance. *Int. J. Sports Med.,* **25(1):** 56-60.

Cameron, I.D., Murray, G.R., Gillespie, L.D., Robertson, M.C., Hill, K.D., Cumming, R.G., Kerse, N. 2010. Interventions for preventing falls in older people in nursing care facilities and hospitals. Cochrane Database Syst Rev.:CD005465doi: 10.1002/14651858.CD005465.pub2.

Campbell, A.J., Robertson, M.C. 2003. Otago Exercise Programme to prevent falls in older people: A home-based, individually tailored strength and balance retraining program. Otago.

Campbell, A.J., Robertson, M.C. 2007. Rethinking individual and community fall prevention strategies: a meta-regression comparing single and multifactorial interventions. *Age Ageing,***36:**656-662

Cordo, P.J., Nashner, L.M. 1982. Properties of postural adjustments associated with rapid arm movements. *J. Neurophysiol*., **47(2):** 287-302.

Frank, J.S., Earl, M. 1990. Coordination of posture and movement. *Phys. Ther.,* **70:** 855-863.

Gahery, Y. 1987. Associated movements, postur al adjustments and synergies: some comments about the history and significance of three motor concepts. *Arch. Ital. Biol.,* **125: 345**–36

Gillespie, L. D., Gillespie, W. J., Robertson, M. C., Lamb, S. E., Cumming, R. G., & Rowe, B. H. 2001. "Interventions for preventing falls in elderly people", Cochrane.Database.*Syst.Rev*.No. 3, p. CD000340.

Gok, H., Ergin, S., Yavuzer, G. 2002. Kinetic and kinematic characteristics of gait in patients with medial knee arthrosis. *Acta Orthop. Scand.,***73:**647–52.

Hoffer JA, Stein RB, Haugland MK, Sinkjaer T, Durfee WK, Schwartz AB, Loeb GE, Kantor C (1996). Neural signals for command control and feedback in functional neuromuscular stimulation : A review. Journal of Rehabilitation Research and Development **33(2):** 145-157

Horak, F.B., Henry, S.M., Shumway-Cook, A. 1997. Postural perturbations: new insights for treatment of balance disorders. Phys Ther.**77(5):**517-33

Hurley, M.V., Scott, D.L 1998. Quadriceps sensorimotor function and disability of patients with knee osteoarthritis following a clinical practicable exercise regime. The British Journal of Rheumatology, **37:** 1181-1187

Juhl, C., Lund, H, Roos, E.M., Zhang, W. and Christensen, R. 2012. A Hierarchy of patient-reported outcomes for meta-analysis of knee osteoarthritis trials: Empirical evidence from a survey of high impact journals. *Arthritis,* 17 pages. Available at http://dx.doi.org/10.1155/2012/136245

Kandel, E.R., Schwartz, J.H. & Jessell, T.M., 2000. Principles of Neural Science, 4th edit, Mc Graw-Hill, New York

Kisner, C. and Colby, L.A. 2007. Therapeutic Exercise: Foundations and Techniques, 5th edit, FA Davis company

Mancini, M., Horak, F.B. 2010. The relevance of clinical balance assessment tools to differentiate balance deficits. *Eur. J. Phys. Rehabil. Med.* **46(2):** 239–248.

Park, S., Horak F.B., Kuo, A.D. 2004. Postural feedback responses scale with biomechanical constraints in human standing.*Exp Brain Res*., **154(4):** 417-27.

Pondal, M., del Ser, T. 2008. Normative data and determinants for the timed "up and go" test in a population-based sample of elderly individuals without gait disturbances. *J. Geriatr. Phys. Ther.,* **31(2):** 57-63

Raju, Y.S. 2012. Maintenance of Balance and RehaBilitation in the elderly.Medicine Update, **22:** 725-29.

Riemann, B.L., Lephart, S.M. 2002. The Sensorimotor System, Part II: The Role of Proprioception in Motor Control and Functional Joint Stability. *J. Athl. Train,* **37(1):** 80-4.

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Robitaille, Y., Laforest, S., Fournier, M., Gauvin, L., Parisien, M., Corriveau, H., Trickey, F., and Damestoy, N. 2005. Moving forward in fall prevention: An intervention to improve balance among older adults in real-world settings. *Am. J. Public Health.,* **95(11):** 2049–2056.

Rogers, M.E., Page, P. 2013. Current concepts Review: Balance training for older athelete. *Int. Journal of Sport Physical Therapy,* **8(4):** 517-30.

Rogers, M.E., Rogers, N.L., Takeshima, N., Islam, M.M. 2003. Methods to assess and improve the physical parameters associated with fall risk in older adults. *Preventive Medicine,* **36:** 255-264.

Sherrington, C., Whitney, J.C., Lord, S.R., Herbert, R.D., Cumming, R.G., Close, J.C. 2008. Effective exercise for the prevention of falls: a systematic review and meta analysis. *J. Am. Geriatr. Soc.,* **56:** 2234-2243.

Shimada, S., Kobayashi, S., Wada, M., Uchida, K., Sasaki, S., Kawahara, H., Yayama, T., Kitade, I., Kamei, K., Kubota, M., Baba, H. 2006. Effects of disease severity on response to lateral wedged shoe insole for medial compartment knee osteoarthritis. *Arch. Phys. Med. Rehabil.,* **87(11):** 1436-41.

Shubert, T.E. 2011. Evidence based exercise prescription for balance and falls prevention: A current review of the literature. *J. Geriatric Physical Therapy,* **34(3):** 100-108.

Shubert, T.E., Mc Culloch, K., Hartman, M., Giuliani, C.A. 2010. The effect of an exercise-based balance intervention on physical and cognitive performance for older adults: A Pilot study. *J. Geriatric Physical Therapy,* **33(4):** 157-164.

Shumway-Cook, A. and Woollacott, M. 2000. “Attentional demands and postural control: The effect of sensory context,” *J. Biological Sciences and Medical Sciences,* **55(1):** M10–M16.

Shumway-Cook, A., Baldwin, M., Polissar, N.L., Gruber, W. 1997. Predicting the probability for falls in community-dwelling older adults.*Phys. Ther.,***77(8):** 812-9.

Sutherland, D.H. 2002. The evolution of clinical gait analysis. Part II kinematics. *Gait Posture,* **16(2):** 159-79.

Tang, P.F., Woollacott, M.H., Chong, R.K. 1998. Control of reactive balance adjustments in perturbed human walking: roles of proximal and distal postural muscle activity. *Exp. Brain. Res.,***119(2):** 141-52.

Thorp, L.E., Wimmer, M.A., Foucher, K.C., Sumner, D.R., Shakoor, N., Block, J.A. 2010. The biomechanical effects of focused muscle training on medial knee loads in OA of the knee: a tpilot, proof of concept study. *J. Musculoskele. Neuronal. Interact.,* **10(2):** 166-173.

Tinetti, M.E., Baker, D.I., McAvay, G., Claus, E.B., Garrett, P., Gottschalk, M., Koch, M.L., Trainor, K., Horwitz, R.I. 1994. A multifactorial intervention to reduce the risk of falling among elderly people living in the community. *N. Engl. J. Med.,* **331(13):** 821-7.

Vincent, K.R., Vincent, H.K. 2012. Resistance exercise for knee osteoarthritis. P M & R: *The Journal of Injury, Function and Rehabilitation.* **4(5 Suppl):** 45-52.

Winter, D.A., Patla, A.E., Frank, J.S., Walt, S.E. 1990. Biomechanical walking pattern changes in the fit and healthy elderly. *Phys. Ther.,* **70(6):** 340-7.

Zeni, J.A., Higginson, J.S. 2011. Knee osteoarthritis affects the distribution of joint moments during gait. *Knee.* **18(3):** 156-9.

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Audio and Visual Response Time of Type 2 Diabetics and Non-Diabetics

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Abstract

Aim: To study the audio and visual response time of type 2 diabetics and non-diabetics. *Materials & Method:* Thirty type 2 diabetics (age 49±7 years) and thirty non- diabetics (45±5 years) males volunteered to participate in this study as subjects. Response Analyzer was used to measure the audio and visual response times. *Result:* Audio-1 (0.960 ± 0.34ms), Audio-2 (1.043±0.79ms), Audio-3 (1.082±0.86ms), Audio-4 (0.986±0.46ms) and combined auditory response time (1.048±0.57ms) of type 2 diabetics. Audio-1, Audio-2, Audio-3, Audio-4 and combined auditory response time of non-diabetics was 0.841±0.23ms, 0.782±0.35ms, 0.762±0.40ms, 0.793±0.25ms and 0.797±0.17ms respectively. Visual-1 (0.736±0.28ms), Visual-2 (0.653± 0.27ms), Visual-3 (0.649 ± 0.34ms), Visual-4 (0.654± 0.21ms) and combined visual response times (0.679± 0.25ms) of type 2 diabetics and Visual-1, Visual- 2, Visual-3, Visual-4 and combined visual response time of non-diabetics was 0.618 ± 0.14ms, 0.571 ± 0.07ms, 0.604 ± 0.10ms, 0.631 ± 0.14ms, and 0.604 ± 0.07ms respectively. The absolute and percent difference between various audio and visual response time of type 2 diabetic and non-diabetics were statistical significant. *Conclusion:* It was concluded that type 2 diabetics respond slowly to the various audio and visual stimuli as compared to non-diabetics. Thus, auditory and visual response time can be considered as an ideal tool for measuring audio-visual sensory motor association in type 2 diabetics and to highlight the importance of auditory and visual response time testing in routine examination of type 2 diabetics. We can manage the complications of neuropathy in type 2 diabetics which may lead to morbidity in them.

Introduction

The Diabetes mellitus is becoming more and more prevalent in Indian society. In India, it is estimated that approximately 2% of the population, 15 million people have diabetes *(Swami, 1984).* The number of cases is said to be rising by 5%-6% each year and an estimated 300,000 people die from diabetes and its complication *(Herman et al., 1984).* There are about 3.5crore diabetics in India and the figure will rise to about 5.2 crore by 2025. Every 5th patient visiting a consulting physician is a diabetic, and, every 7th patient visiting a family physician is a diabetic. Keeping in view the alarming increase in the incidence and prevalence of diabetics in India, WHO has declared India as the "Diabetic Capital of the World" *(Vijay, 2002).* The most common neuropathy affecting individuals with diabetes is diffuse neuropathy of the distal symmetric sensor motor type *(Brown & Asbury 1984).* Diabetic retinopathy, a secondary microvascular complication of diabetes mellitus is the leading cause of blindness in the United State amongst individuals age 20 to 64 *(National Institutes of Health 2007 and World Health Organization 2007).* Diabetes retinopathy is most concerning since it poses the greatest threat of vision loss *(International Diabetes Federation 2005).* All persons with diabetes are at risk of developing retinal complication. Diabetes mellitus is responsible for abnormality in various organs, as well as hearing system and sudden deafness *(Fukiui et al., 2004).* The sense organ of hearing- the organ of corti has complex components and arrangement which makes it a potential target for hyperglycemic damage. Damage of any part of the hearing mechanism can lead to hearing loss. Studies have shown positive correlation between hearing loss and Diabetes Mellitus *(U.S Department of Health and Human Services 2010).* Rosen and Davis, who sought a possible correlation between sensor-neural hearing loss and microangiopathy in diabetic patients, conclude that hearing loss is definitely common in diabetes patients *(Rosen & Devis 1971).* Vascular changes in the inner ear are regarded as the most important changes in diabetes *(Schuknecht, 1993; Tomisawa, 2000).* Several authors reported a higher incidence of hearing loss in diabetic patient in comparison to the general population *(Tomisawa, 2000; Kasemsuwan at al, 2001).* Auditory and visual response time is considered as an ideal tool for measuring sensory motor association *(Shenvi & Balasubramanian 1994; Griard & Peronnet 1999; Ashok et al., 2014).* There is paucity of data relating to the auditory and visual response time among Punjabi type 2 diabetics, therefore the study was undertaken to highlight the importance of auditory and visual response time in routine examination of type 2 diabetic subjects and to reduce the neuropathy related morbidity *(Porciatti et al., 1999; Perryman & Fitten 1996; Lewis and Brown 1994; Brooke et al., 1989).* The aim of the present study was to observe and compare the audio-visually response time of type 2 diabetics and non diabetics.

Material and Methods

Sixty males voluntarily participated in this study as subjects. Out of sixty subjects, thirty were type 2 diabetic and thirty non-diabetics and their age ranged from 40 to 60 years. All the subjects were right handed, non-smokers and non-alcoholic. The audio-visual response time in milliseconds was measured with help of digital response analyzer. The audio response time was recorded for very high frequency (Audio-1), high (Audio-2), medium (Audio-3) and low (Audio-4) sound stimuli. The visual response time was recorded for red (Visual -1), green (Visual -2), blue/indigo (Visual -3) and yellow/amber light stimuli (Visual -4). The subject was required to respond to the stimulus by pressing an appropriate button. The display screen of digital response analyzer indicated the response time in milliseconds. All subjects were given practice trials and instructed to respond as quickly as possible. The average of the three readings was taken as the value for audio and visual response times.

Statistical Analysis: Data were statistically analyzed with an appropriate tests by using the SPSS Software (SPSS 16.0 free trial version for Windows, SPSS Inc., Chicago, IL, USA). Results were represented as mean and standard deviation.

Result and Discussion

Table 1 shows mean of audio response times for different frequency sounds in Type 2 diabetics and Non-diabetics.

Table 1. Audio Response Time of Type 2 diabetics & Non-diabetics

Variable	Group	Mean	SD	Difference	%
Audio 1 (Very high Freq. Sound), msec	T2D	0.960*	0.34	-0.119	- 12.39
	ND	0.841*	0.23		
Audio 2 (high Freq. Sound), msec	T2D	0.986*	0.46	-0.203	- 20.68
	ND	0.782*	0.35		
Audio 3 (Medium Freq. Sound), msec	T2D	1.043*	0.79	-0.281	- 26.84
	ND	0.762	0.40		
Audio 4 (Low Freq. Sound), msec	T2D	1.082*	0.86	-0.289	- 26.70
	ND	0.794*	0.83		
Combined (Audio 1,2,3 & 4)), msec	T2D	1.048*	0.57	-0.251	- 23.95
	ND	1.097*	0.17		

T2D: Type 2 Diabetics, ND: Non Diabetic, * significant at the 0.05 level

The mean audio response time of type 2 diabetics for audio 1-very high frequency sound, audio 2-high frequency sound, audio 3- medium frequency sound, audio 4-low frequency sound and combined audio response times were 0.960±0.34msec, 0.986±0.46, 1.043±0.79, 1.082±0.86msec and 1.048±0.57msec respectively. The mean audio response time of non-diabetics for audio 1 sound, audio 2 sound, audio 3 sound, audio 4 sound and combined audio response times were 0.841±0.23msec, 0.782±0.35msec, 0.762±0.40 msec, 0.793±0.24 msec and 0.797±0.17msec respectively. The absolute (and percent) mean difference between Type 2 diabetics and Non-diabetics for audio 1, audio 2, audio 3, audio 4 and combined audio response time were -0.119 msec (-12.39%), -0.203msec (-20.68%), - 0.281msec (-26.94%), -

0.289msec (-26.70%) and -0.251msec (-23.95%) respectively. The differences in various audio response times between type 2 diabetics and non-diabetics were statistically significant with diabetics taking significantly greater time to respond to different frequency of audio stimuli.

Table 2 shows mean of visual response times for different colour lights in Type 2 diabetics and Non-diabetics. The mean visual response time of type 2 diabetics for visual 1-red light, visual 2-blue/indigo light, visual 3- green light, visual 4-yellow/amber light and combined visual response time were 0.736±0.28msec, 0.653±0.27, 0.649±0.34, 0.654±0.21 and 0.679±0.25msec respectively. The mean visual response time of non-diabetics for visual 1 light, visual 2 light, visual 3 light, visual 4 light and combined visual response time were 0.618±0.13msec, 0.571±0.07msec, 0.604±0.10 msec, 0.631±0.14 msec and 0.604± 0.07msec respectively. The absolute (and percent) mean difference between Type 2 diabetics and Non-diabetics for visual 1-red light, visual 2-blue/indigo light, visual 3-green light, visual 4-yellow/amber light and combined visual were -0.117msec (-16.03%), -0.082msec (-14.36%), -0.045msec (-6.93%), -0.022msec (-3.51%) and -0.075msec (-11.04%) respectively. The differences in various visual response times between type 2 diabetics and non-diabetics were statistically significant with diabetics taking significantly longer time to respond to different colours of light stimuli.

Table 2. Visual Response Time of Type 2 diabetics & Non-diabetics

Variable	Group	Mean	SD	Difference	%
Visual 1 (Red Light), msec	T2D	**0.736***	**0.28**	**-0.117**	-16.03
	ND	0.618*	0.13		
Visual 2 (Blue/Indigo), msec	T2D	0.653*	0.27	-0.082	-14.36
	ND	0.571*	0.07		
Visual 3 (GreenLight), msec	T2D	0.649*	0.34	-0.045	-6.93
	ND	0.604	0.10		
Visual 4 (Yellow/Amber), msec	T2D	0.654*	0.21	-0.022	-3.51
	ND	0.631*	0.14		
Combined (Visual 1,2,3 & 4)), msec	T2D	0.679*	0.25	-0.075	-11.04
	ND	0.604*	0.07		

T2D: Type 2 Diabetics, ND: Non Diabetic, * significant at the 0.05 level

Table 3 shows comparison of audio and visual response time for different sound and colour light stimulus of Type 2 diabetics. The absolute (and percent) mean difference for audio 1- very high frequency sound vs. visual 1-red light, audio 2- high frequency sound vs. visual 2-blue/indigo light, audio 3- medium frequency sound vs. visual 3-green light, audio 4- low frequency sound vs. visual 4-yellow/amber light and combined audio vs. combined visual were -0.224msec (-23.33%), -0.333msec (-33.77%), -0.394msec (-37.77%), -0.428msec (-39.55%) and -0.369msec (-35.20%) respectively. The differences in various audio and visual response times of type 2 diabetics were statistically significan with diabetics taking significantly greater time to respond to different frequency of audio stimuli & different colours of light stimuli.

Table 4 shows comparison of audio and visual response time for different sound and colour light stimuli in non-diabetics. The absolute (and percent) mean difference for audio 1- very high frequency sound vs. visual 1-red light, audio 2- high frequency sound vs. visual 2-blue/indigo light, audio 3- medium frequency sound vs. visual 3-green light, audio 4- low frequency sound vs. visual 4-yellow/amber light and combined audio vs. combined visual was -0.223msec (--26.51%), -0.211msec (-26.98%), -0.158msec (-20.73%), -0.162msec (-20.42%) and -0.193msec (-24.21%) respectively. The differences in various audio and visual response times of non- diabetics were statistically significant.

Table 3. Comparison of Audio and Visual Response Time of Type 2 diabetics

Variables	Mean	SD	Absolute difference	Difference %
Audio 1 (very high frequency sound) (msec)	0.960*	0.34	-0.224	-23.33
Visual 1 (red light) (msec)	0.736*	0.28		
Audio 2 (high frequency sound) (msec)	0.986*	0.46	-0.333	-33.77
Visual 2 (blue/indigo light) (msec)	0.653*	0.27		
Audio 3 (medium frequency sound) (msec)	1.043*	0.79	-0.394	-37.77
Visual 3 (green light) (msec)	0.649*	0.34		
Audio 4 (low frequency sound) (msec)	1.082*	0.86	-0.428	-39.55
Visual 4 (yellow/amber light) msec)	0.654*	0.21		
Combined Audio (1+2+3+4) msec	1.048*	0.57	-0.369	-35.20
Combined Visual(1+2+3+4) (msec)	0.679*	0.25		

***significant at the 0.05 level**

Table 4. Comparison of Audio and Visual Response Time of Non- diabetics

Variables	Mean	Std. Deviation	Absolute difference	%Percent Difference
Audio 1 (very high frequency sound) (msec)	0.841*	0.23	-0.223	-26.51
Visual 1 (red light) (msec)	0.618*	0.13		
Audio 2 (high frequency sound) (msec)	0.782*	0.35	-0.211	-26.98
Visual 2 (blue/indigo light) (msec)	0.571*	0.07		
Audio 3 (medium frequency sound) (msec)	0.762*	0.40	-0.158	-20.73
Visual 3 (green light) (msec)	0.604*	0.10		
Audio 4 (low frequency sound) (msec)	0.793*	0.24	-0.162	-20.42
Visual 4 (yellow/amber light) msec)	0.631*	0.14		
Combined Audio (1+2+3+4) msec	0.797*	0.17	-0.193	-24.21
Combined Visual(1+2+3+4) (msec)	0.604*	0.07		

***significant at the 0.05 level**

Delayed audio-visual response time in Type 2 diabetics without clinical neuropathy symptom can be taken as a sensitive indicator of early nerve damage without clinical signs or symptoms. Diabetes mellitus is responsible for abnormality in various organs, as well as hearing system and sudden deafness *(Fukiui et al., 2004).* The sense organ of hearing- the organ of corti has complex components and arrangement which makes it a potential target for hyperglycemic damage. Damage of any part of the hearing mechanism can lead to hearing loss. Studies have shown positive correlation between hearing loss and Diabetes Mellitus *(U.S Department of Health and Human Services 2010).* Vascular changes in the inner ear are regarded as the most important changes in diabetes *(Tomisawa, 2000; Schuknecht, 1993).* Several authors reported a higher incidence of hearing loss in diabetic patient in comparison to the general population *(Kumar et al., 2014; Kasemsuwan at al,*

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2001; Tomisawa, 2000). Conclusion: It was concluded that type 2 diabetics respond slowly to the various audio and visual stimuli as compared to non-diabetics that is audio-visual response time of type 2 diabetics were more than non-diabetics. Thus, auditory and visual response times can be considered as an alternative tools for measuring audio-visual sensory motor association in type 2 diabetics and to highlight the importance of auditory and visual response time testing in routine examination of type 2 diabetics. We can manage the complications of neuropathy in type 2 diabetics which may lead to morbidity in them.

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Reference

Kumar, Ashok; Kumar, Vishal and Kaur, Nariender. 2014. A Study of Auditory Response Time of Type 2 Diabetic and Non-Diabetics. In a book "*Women's Health and Empowerment*", editor Dr. Gobind Singh, Publised by Twentyfirst Century Publications Patiala (Punjab) in association with Kala Mandir Distributors, Delhi, pp. 54- 57.

Brooke, J.D.; Singh R.; Wilson M.K.; and Yoon P. 1989. Aging of human segmental oligosynaptic reflexes for control of leg movement. *Nuerobiolagy of Aging,* **10:** 721-725.

Brown, M.J. and Asbury, A.K. 1984. Diabetic Neuropathy. *Ann Neurol* 15:2-12.

Fukiui, M., Kitagawa, Y., Nakamura, N., Kadono, M., Mogami, S, and Ohnishi, M. 2004. Ididopatheic sudden hearing loss in patients with type 2 diabetes. *Diabetes Res. Clin. Pract.,* **63:** 204-11.

Giard, M. H.; and Peronnet, F. 1999. Audiotory-Visual Intergration during Multimodal Object Recognition in Humans; A Behavioral and Electrophysiological Study, *J. Cog. Neuroscin.,* **11(5):** 473-490.

Herman, W.H., Sinnock, P., Brenner, E., Brimberry, J.L., Langford, D., Nakashima, A., Sepe, S.J., Teutsch, S.M. & Mazze, R.S. 1984. An Epidemiologic model for diabetes mellitus: incidence, prevalence & mortality. *Diabetes Care,* **7:** 367-371.

International Diabetes Federation. Diabetes atlas. 2005. htt://www.eatlas.idf.org.

Kasemsuwan, L., Sriwanyong, S., Krittiyawong, S., Sunetrworakul, J., and Jiamsuchon, K. 2001. Hearing in young diabetic patients. *J. Med. Assoc. Thai.,* **84**: 1389-1394.

Lewis, R.D. and Brown, J.M.M. 1994. Influence of muscle activation dynamics on reaction time in the elderly. *Eur. J. Appl. Physiol*., **69:** 344-349.

National Institutes of Health. 2007. Available at: www.nei.nih.gov/eyedatap.

Perryman, K.M. and Fitten, J. 1996. Effects of Normal Aging on Performance of Motor-Vehile Operational Skills. *J. Geriatr. Psychiatry Neurol*., **9:** 136-141.

Porciatti, V., Fiorentini, A., Morrone, M.C., Burr D.C. 1999. The effects of ageing on reaction times to motion onset. *Vision Res*., **39:** 2157-2164.

Rosen, Z., and Devis, E. 1971. Microangiopathy in diabetics with hearing disorders. *Eye Ear Nose Throat Mon*., **50:** 479-482.

Schuknecht, H.F. 1993. *Pathology of ear* 2ed. Philadelphia, Baltimore, Hong Kong, London, Munich: Lea and Febiger, 312-314.

Shenvi, D. and Balasubramanian, P. 1994. A comparative study of visual and auditory reaction time in males and females. *Ind. J. Physiol. Pharmacol.* **38:** 229-231.

Swami Shankardevananda, Saraswati. 1984. *In Yogic management of asthma & diabetes*. Publisher: Bihar Scool of Yoga, Bihar, India.

Tomisawa, H. 2000. Diabetic changes in the strain vascularis in human-a study of PAS-stained temporal bone sections. *Nippon Jibinakoka Gakkai Kaiho,* **103(11):** 1227-1237.

U.S Department of health and human services. National institutes of health news. Hearing loss Is Common in people with Diabetes. Available at: htt://www.nih.gov/news/heath/jun2008/niddk-16.htm accessed on December 1st, 2010.

Gupta, Vijay 2002. Diabetes in Elderly Patients. *J. K. Practitioner*, **91(4):** 258-259.

World Health Organization.2007. Available at: htt://www.who.int/mediacentre/factsheets

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Analysis of Gait Characteristics Using a Dynamic Foot Scanner in Type 2 Diabetes Mellitus without Peripheral Neuropathy

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Abstract

Objectives: The objective of the present study was to identify the gait changes in T2DM subjects without PN (Peripheral Neuropathy). *Methods:* 36 T2DM subjects without PN and 32 age matched non-diabetic subjects (NDM) were recruited. Gait characteristics were analyzed using Win-track dynamic foot scanner. Data were analyzed using independent 't' test. Level of significance was kept at P<0.05. *Results:* Analysis showed no significant differences in gait characteristics in T2DM subjects without PN as compared to NDM subjects. *Conclusions:* T2DM subjects without PN presents with a gait same as subjects without T2DM. Gait changes in T2DM are dependent on loss of protective sensation of the foot and intrinsic foot muscle atrophy. Therefore, dynamic foot analysis should be incorporated in routine diabetic foot evaluation to understand the gait in T2DM and hence many complications can be prevented.

Introduction

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Type 2 diabetes mellitus (T2DM) is a multi-system, metabolic disease characterized by increased blood glucose and has become one of the major health troubles in the world *(Wyatt & Ferrance, 2006).* According to the International Diabetes Federation *(IDF, 2013),* the total number of people with diabetes in all age-groups worldwide was estimated to be 382 million in 2013 and expected to grow to 592 million by 2035. In India alone, it was anticipated to be about 65.1 million in 2013, and likely to rise to 109.0 million by 2035 *(IDF, 2013).*

In normal everyday life activities, lower limbs readily accommodate even and uneven surfaces. Efficiency to overcome all these daily activities depends on structural and operational ability of the lower limbs during walking *(Baker, 2006).* Normal walking consists of two phases, stance and swing. Stance phase is subdivided into three intervals (initial double stance, single limb support and terminal double support *(Atkinson et al, 2005).*

Peripheral neuropathy (PN) is the well-known diabetic complication attributed to chronic hyperglycemia *(Bansal et al, 2014).* Studies reported that T2DM subjects with PN are 15 times more prone to report injuries due to altered gait than T2DM subjects without PN *(Bansal et al, 2014).* Altered gait changes may contribute to various complications like callus formation, toe deformities and plantar ulcers where most of these users developed during walking *(Richardson et al, 1992).* Studies reported that gait changes and falls are dependent of PN and this gait change does not usually occur until late diabetes and long duration after balance impairments seen *(Muelleret al, 1989; Dingwell et al, 2000; Richardson, 2002).* A study conducted by *Petroskey et al (2005)* reported that whatever the mechanism, subjects with diabetes presents deficits in gait before the objective loss of protective sensation in the feet *(Brach et al, 2008).* These contradictory studies underscore the fact that the movements of gait abnormalities in T2DM are not light and under debate.

Gait analysis plays a major role in diagnosis of functional locomotion impairments. Studies have utilized several methods like 3D gait analysis in a gait lab with high definition cameras and reflective markers, power plates, accelerometers to study the biomechanical characteristics of the gait in diabetic subjects *(Katoulis et al, 1997; Richardson et al, 2004; Petrofsky et al, 2005)*. These methods involve a special gait lab, which is expensive and this process is time consuming and difficult to perform in routine clinical foot assessment. Looking at all these factors, the objective of the present work is to examine the gait characteristics using a dynamic foot scanner in T2DM with no PN.

Materials & Methods

The present study was approved by the Institutional Ethical Committee (IEC). Thirty six type 2 diabetes mellitus subjects without peripheral neuropathy and 32 age matched healthy subjects were screened and recruited. A written informed consent was obtained from all the subjects and detailed baseline clinical evaluations were done. Subjects without peripheral neuropathy, no foot deformities, foot ulcers and who were able to walk independently were included in the study. Subjects with hypothyroidism, retinopathy, musculoskeletal disorder and other neurological disease were excluded. Absence of peripheral neuropathy was confirmed by doing following clinical evaluations:

10g monofilament (5.07) testing: The sensory test was performed with the subject in supine lying and the result was recorded as absent, reduced or present depending on the subject's response. *Vibration perception threshold (VPT)***:** The vibration threshold was examined using Biothesiometer with the subject in supine lying and the result was recorded and 5mv-14mv is considered absence of peripheral neuropathy and 15mv-24mv is considered risk for developing peripheral neuropathy and above 25mv is considered presence of peripheral neuropathy.

Michigan Neuropathy screening instrument: During the examination, subject's foot was inspected for abnormalities in the foot. Each foot with any abnormality received a mark of 1. Each foot was also examined for ulcers and each foot with an ulcer received a score of 1. The ankle reflexes were elicited. If the reflex was present and it's scored as 0, the reflex designated as present with reinforcement and was scored as 0.5. If the reflex was absent and it was scored as 1. Vibration sensation tested same as above mention in VPT. Vibration was scored as present if the subject was able to feel within 8Mv and scored as 0, if the subject was able to sense from 15mv- 24mv, he was given score of 0.5 and if the subject was not able to feel or feel in within an above 25mv he was given score of 1. The total potential score is 8 and, in the published score algorithm, a score ≤ 2.5 is considered absence of peripheral neuropathy, score of 2.5-4 is considered risk for developing peripheral neuropathy and above 4 is considered presence of peripheral neuropathy.

Dynamic gait analysis: Gait characteristics analysis was performed using Win-Track (MEDICAPTEURS Technology France) – Dynamic foot scanner. The win - track consisted of a 4m long walkway and a data processing system that checked the dynamic scanner through software. Test procedures were demonstrated and made familiar to all the subjects. Subjects were instructed to look ahead and walk on the platform at a comfortable speed. The data were transmitted to the computer through win-track software for analysis. SPSS version 16.0 for windows was used for data analysis. Normality test was held out and independent 't' test was employed to determine the difference between the groups. Level of significance was kept at $P<0.05$.

Results

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In the present study, a total of 68 subjects (47 males and 21 females) were included. 36 type 2 diabetes mellitus subjects without peripheral neuropathy had a mean age of (48.22 ± 8.163yrs), mean BMI (24.15 ± 2.49) and Mean duration of type 2 diabetes mellitus was 9.39 ± 5.05 yrs. 32 non diabetic subjects had a mean age of (48.59 ±12.33yrs), mean Body Mass Index (24.07 ± 3.80) as presented in Table 1.

Table 1. Descriptive characteristics of T2DM subjects with no PN and NDM subjects.

	Group	N	Mean ± SD
Gender	**Males**	**47**	
	females	**21**	
Age (years)	**T2DM with no PN**	**36**	**48.22 ± 8.163**
	NDM	**32**	**48.59 ±12.33**
BMI	**T2DM with no PN**	**36**	**24.15 ± 2.49**
	NDM	**32**	**24.07 ± 3.80**
Duration of Diabetes	**T2DM with no PN**	**36**	**9.39 ± 5.05**

T2DM: Type 2 diabetes mellitus, PN: peripheral neuropathy, NDM: Non diabetes mellitus, BMI: Body mass index

Table 2. Comparison of gait parameters between T2DM subjects without PN and NDM subjects.

Parameters	T2DM with no PN (mean ± SD)	NDM subjects (mean ± SD)	95% Confidence Interval (lower, upper)	p-value
Step duration Right	**600.28 ± 164.95**	**646.22 ± 224.36**	**-140.59, 48.70**	**0.336**
Step duration Left	**636.89 ± 199.88**	**694.69 ± 221.50**	**-159.81, 44.22**	**0.262**
Step length Right	**498.47 ± 198.45**	**528.88 ± 114.53**	**-110.17, 49.37**	**0.449**
Step length Left	**498.58 ± 210.80**	**502.94 ± 147.56**	**-93.52, 84.81**	**0.923**
Gait cycle length Right	**866.58 ± 241.43**	**947.75 ± 194.37**	**-186.83, 24.49**	**0.130**
Gait cycle length Light	**906.28 ± 196.23**	**980.78 ± 165.20**	**-162.05, 13.04**	**0.094**
Gait cycle duration	**1220.00 ± 265.51**	**1253.59 ± 237.69**	**-156.23, 89.04**	**0.586**
Stride duration	**1774.72 ± 240.24**	**1680.94 ± 327.60**	**-44.28, 234.80**	**0.180**

T2DM: Type 2 diabetes mellitus, PN: peripheral neuropathy, NDM: Non diabetes mellitus.

Gait characteristics of T2DM subjects without PN and NDM subjects are summarized in Table 2. During walking, T2DM without PN group showed no difference in all the gait characteristics compared to NDM subjects, step duration (right p=0.336, left p=0.262), gait cycle length (right p=0.449, left p=0.923), gait cycle duration (p=0.586), stride duration (p=0.180) compared to NDM subjects.

Discussion

In the present study, gait characteristics were analyzed in T2DM subjects without PN. Result analysis showed no change in the gait characteristics in T2DM subjects without PN as compared to NDM subjects.

Several studies have documented that subjects with type 2 diabetes mellitus with peripheral neuropathy report altered gait characteristics *(Richardson et al, 1992; Muelleret al, 1989; Dingwell et al, 2000)*. The possible mechanism for altered gait characteristics with peripheral neuropathy could be due to several causes. The loss of proprioception, sensory loss and intrinsic foot muscle weakness occurs in later phases of diabetes mellitus that lead to changes in gait characteristics *(Brach et al, 2008; Katoulis et al, 1997; Richardson et al, 2004)*.

Very few studies documented that type 2 diabetes mellitus subjects without peripheral neuropathy report altered gait. A survey led by *Petrofsky et al (2005)* found a reduction in gait characteristics like step duration and step length walking on a floor surface. But the limitation of this work was, their study was conducted on older age group. The gait changes observed can be immediately linked to ageing. *Sawacha et al (2009)* conducted a survey to investigate gait changes in T2DM without PN and reported that these gait changes can be due to somatic motor and vestibular changes associated with T2DM. The mechanism of impairment to the vestibular, autonomic and somatic system has been considered to be due to compromised microcirculation associated with poor glycemic control in T2DM. Vestibular system in the internal ear is highly vascularized but in diabetes mellitus due to altered microcirculation an oxygen and nutrient supply is decreased, which affects somatic and autonomic reflexes leading to altered gait in T2DM without PN. Damage to the vestibule, somatic and autonomic system occurs over a period of time, which is dependent on duration of diabetes mellitus and it is proved that longer the duration of diabetes and uncontrolled diabetes higher the chance of presenting with peripheral neuropathy and altered gait. However, in the present study, we didn’t find any alteration in the gait in T2DM subjects without PN. This can be due to gait alterations are independent of the loss of protective sensation in the feet, atrophy of the intrinsic foot muscles, damage to vestibular, somatic and autonomic system occurs over a period of time and depends upon how the diabetes mellitus controlled and managed. Gait alteration can be seen in T2DM subjects with uncontrolled blood sugar levels, which diminishes the microcirculation by a damaging peripheral nervous system which includes somatic and autonomic and vestibular system leading to altered gait.

All the studies which reported on gait characteristics have used sophisticated gait labs which consists of 3D cameras and sensors on the body at the joint levels and electromyography to record the muscle activity. This may not be possible in routine clinical diabetic gait evaluation because it is expensive and time consuming. Hence, in our study, we employed a simple, cost effective and easy to perform tool Win-track (MEDICAPTEURS Technology France) – Dynamic foot scanner to analyze gait characteristics and can be performed in routine clinical diabetic gait analysis.

Conclusion: Gait changes observed in diabetes mellitus subjects are dependent on loss of proprioception, loss of protective sensation in the feet and weakness of the intrinsic foot muscles which occurs in later phases of diabetes mellitus depends upon duration of diabetes and how blood sugar levels are controlled. In regular clinical foot assessment dynamic foot scanner can be employed to evaluate gait, as it is not time consuming and doesn't need a separate clinical lab for the valuation. Therefore, we recommend using a foot scanner as one of the tools in the comprehensive clinical foot evaluation for screening patients with diabetes mellitus.

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References

Atkinson K, Coutts FJ, Hassenkamp AM, 2005. Gait assessment in the clinical situation. In Physiotherapy in Orthopedics: A Problem-Solving Approach, **5**:289-309.

Baker R, 2006. Gait analysis methods in rehabilitation. J Neuroeng Rehabil, 3:4

Bansal D, Gudala K, Muthyala H, Esam HP, Nayakallu R, Bhansali A. 2014. Prevalence and risk factors of development of peripheral diabetic neuropathy in Type 2 diabetes mellitus in a tertiary care setting.*J Diabetes Invest*,**5**: 714–721

Brach, S.J., Talkowski, J.B., Strotmeyer, E.S., Newman, A.B. 2008. Diabetes mellitus and gait dysfunction: Possible explanatory factors. *Phys. Ther.*,**88 (1)**: 1365-74

Cavanagh, P.R., Derr, J.A., Ulbrecht, J.S. 1992. Problems with gait and posture in neuropathy patients with insulin-dependent diabetes mellitus *Diabetic MED;***9**:469-474

Dingwell, J.B., Cusumano, J.P., Sternad, D., Cavanagh, P.R. 2000. Slower speeds in patients with diabetic neuropathy lead to improved local dynamic stability of continuous over ground walking. J. Biomech., **33**:1269-1277.

IDF Diabetes Atlas.2013; 6th edition

Katoulis, E.C., Ebdon-Parry, M., Lanshammar, H., Vileikyte, L., Boulton, A.J. 1997. Gait abnormalities in diabetic neuropathy. *Diabetes Care*,**20(12)**:1904–7.

Katoulis, E.C., Ebdon-Parry, M., Lanshammar, H., Vileikyte, L., Kulkarni, J., Boulton, A.J.M. 1997. Gait Abnormalities in diabetic neuropathy. *Diabetes Care*,**20**: 1904-07.

Mueller, M.J., Diamond, J.E., Delitto, A., Sinacore, D.R.1989. Insensitivity, limited joint mobility, and plantar ulcers in patients with diabetes mellitus. *Phys Ther*,**69**:453-462.

Petrofsky, J., Lee, S., Bweir, S. 2005. Gait characteristics in people with type 2 diabetes mellitus. *Eur. J. Appl. Physiol.*,**93**:640-647.

Petrofsky, J., Lee, S., Macnider, M., Navarro, E. 2005. Autonomic endothelial function and the Analysis of gait in Patients with type 1 and type 2 diabetes. *Acta. Diabetol.*,**42 (1):** 7-15.

Ramachandra, P., Maiya, A.G., Kumar, P. 2012. Test-Retest reliability of the Win-track platform in analyzing the gait parameters and plantar pressures during barefoot walking in healthy Adults. *Foot Ankle Spec.*,**5(5)**:306-12

Richardson JK, Ching C, Hurvitz EA.1992.The relationship between electromyographically documented peripheral neuropathy and falls. *J Am Geriatr Soc*,**40**:1008-1012,

Richardson, J.K. 2002. Factors associated with falls in older patients with diffuse polyneuropathy. *J. Am. Geriatr. Soc.*,**50**:1767-1773.

Richardson, J.K., Thies, S.B., DeMott, T.K., Ashton, Miller, J.A. 2004. A comparison of gait Characteristics among older women with and without peripheral neuropathy in standard and challenging environments. *J. Am. Geriatr. Soc.,***52**:1532-1537.

Sawacha, Z., Gabriella, G., Cristoferi, G., Guiotto, A., Avogaro, A., Cobelli, C. 2009. Diabetic gait and Posture abnormalities: A biomechanical investigation through three dimensional gait Analyses. *Clinical Biomechanics,***24**:722-28

Wyatt, L H, Ferrance, R J, 2006. The musculoskeletal effects of diabetes mellitus. J Can Chiropr Assoc, **50**; 1:43-50

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