Association of Anthropometric Indices with Duration of Low Back Pain

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ABSTRACT The present study deals with the estimation of nutritional status by four body indices, viz. Quetelet's index, Oliver's typologic index, Lorenz's constitutional index and muscle index in conveniently selected 106 confirmed cases of patients with low back pain (69 males and 37 females) those who came to the OPD of Aulakh Bone and Joint Centre, Tarn Taran, Punjab, India aged 21-76 years. The data was further divided into two groups, viz. duration of low back pain less than one year (n= 62, 22 males and 40 females) and duration of low back pain more than one year (n = 44, 15 males and 29 females). In the findings, no significant differences (p> .05) were found between the male and female patients regarding the duration of LBP. One way ANOVA showed statistically significant differences (p < .05 - .000) in height, weight, ideal body weight, relative body weight, circumference of the upper arm during an isometric contraction of biceps brachii, circumference of the upper arm in relaxed position of muscle biceps brachii, muscle index, circumference of thorax, shoulder width and Olivier's typologic index among these four sets of populations. When comparisons were made between male and female patients with the duration of LBP less than one year, statistically significant differences (p< .01 - .000) were found in all the variables studied, except BMI, Quetelet's index, circumference of abdomen and Lorenz's constitutional index. Similarly, when the data of male and female patients with the duration of LBP more than one year were compared, statistically significant differences (p< .001 - .000) were found in all the variables, except BMI, Quetelet's index, circumference of abdomen and Lorenz's constitutional index.

INTRODUCTION

Low back pain (LBP) is a major public health problem all over the world. It affects 60% to 80% population of US adults at some time during their lives, and upto 50% have pain within a given year (Nachemson 1984; Frymoyer 1988; McElligott et al. 1989; Deyo et al. 1990; Andersson et al. 1991; Nordin et al. 1991; Frymoyer 1992; Liebenson 1992). In India, occurrence of LBP is also alarming; nearly 60% of the people have significant back pain at some time or the other in lives (Sharma et al. 2003, Koley et al. 2008). A variety of strategies have been proposed to prevent LBP, considering its prevalence, cost and substantial impact on work disability (Snook and White 1984). Some of the most commonly used prevention strategies are back flexion, back extension, and general fitness exercises; patients' education on back mechanics and ergonomic techniques to prevent injuries; and mechanical back supports (Lahad et al. 1994). Apart from these, researchers suggest risk factor modification based on epidemiological evidence linking modifiable risk factors to the development of LBP (Deyo and Bass 1989; Deyo et al. 1990; Nordin et al. 1991).

Epidemiological studies provide important information regarding various risk factors, viz. age and sex (Cunnigham and Kelsey 1984; Leino et al. 1994; Hurwitz and Morgensterm 1997), occupation (Kelsey 1982; Bongers et al. 1988; Battie et al. 1990; Piazzi et al. 1991; Piccinni et al. 1992; Limburska et al. 1996; Nubling et al. 1997; Rothenbacher et al. 1997), life style and socio-economic status (Kendall et al. 1983; Leino et al. 1994; Hurwitz and Morgenstern 1997), smoking habit (Frymoyer et al. 1983; Beiring-Sorensen and Hilden 1984; Deyo and Bass 1989; Heliovaara 1998). All these factors affecting the development of LBP are largely divided into two major groups, viz. external or exogenous representing physical and psychological factors and internal or endogenous representing genotypical and phenotypical factors (Celan and Turk 2005).

Among the phenotypical endogenous properties, the most widely studied factor was nutritional status assessed by BMI. The American Heart Association's recommended guidelines following BMI values for the degree of nutrition are:

-BMI < 18.5 kg/m^2 indicates undernutrition
-BMI 18.5 – 24.9 kg/m^2 indicates normal values

-BMI 25.0 – 30.0 kg/m^2 indicates hypernutrition
-BMI 30.0 kg/m^2 indicates obesity
-BMI 40.0 kg/m^2 or more indicates extreme obesity.

The waist circumference of over 88 cm in women and over 102 cm in men as a risk indicator for developing cardiovascular diseases was also determined by the American Heart Association. Other anthropometric characteristics and indices were less reported as the risk indicators for LBP (Celan and Turk 2005). Therefore, the objectives of the present study were to estimate the nutritional status of LBP patients by four anthropometric indices and to search any association between these anthropometric indices and duration of low back pain among the patients.

MATERIALS AND METHODS

Subjects

The present study is based on conveniently selected 106 confirmed LBP patients (69 females and 37 males) aged 21–76 years (mean age 43.04 years ± 13.16 for females and 37.73 years ± 14.36 for males) attended in the OPD of Aulakh Bone and Joint Centre, Tarn Taran, Punjab, India, during April to September, 2010. The data was further divided into two groups, viz. duration of low back pain less than one year (n= 62, 22 males and 40 females) and duration of low back pain more than one year (n = 44, 15 males and 29 females). A written consent was obtained from the subjects. The data was collected under natural environmental conditions in morning (between 8 AM. to 12 noon). The study was approved by the local ethics committee.

Anthropometric Measurements

fourteen anthropometric characteristics, viz. height (HT), weight (WT), BMI, Quetelet's index (QI), ideal body weight (IBW), relative body weight (RBW), circumference of the upper arm during an isometric contraction of biceps brachii (CCB), circumference of the upper arm in relaxed position of muscle biceps brachii (CRB), muscle index (MI), circumference of thorax (CT), circumference of abdomen (CA), Lorenz's constitutional index (LCI), shoulder width (SW) and Olivier's typologic index (OTI) were measured on all the subjects using the standard techniques (Lohmann et al. 1988) and were measured in triplicate with the median value used as the criterion.

The height was recorded using a stadiometer (Holtain Ltd., Crymych, Dyfed, UK) to the nearest 0.1 cm, and weight was measured by digital standing scales (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. BMI was then calculated using the formula weight (kg)/height^2 (m)^2. The following body indices were calculated after Celan and Turk (2005):

Quetelet's Index (Devenport-Kaup's Adaptation)

Quetelet's index (QI) represents a measure of nutrition status. It is calculated according to the formula:

QI = BW/BH^2,

where BW means body weight (g) and BH body height (cm). People with normal nutritional status have QI values between 2.15 – 2.56.

Relative Body Weight

Relative body weight (RBW) is another possibility to describe a nutritional status and uses the following formula:

RBW = (ABW / IBW) X 100,

where ABW means measured body weight (kg) and IBW ideal body weight, formula is given below:

IBW = (BH – 100) – {(BH -150) / 4} + {(AY – 20) / 4},

where AY means age (yrs) and BH body height (cm). The values between 90-110 are representing normal nutritional status.

Muscle Index

Muscle index (MI) is an orientation method about someone's muscle development. It is calculated according to the formula:

MI = {(CCB – CRB) / CRB} X 100,

where CCB means circumference of the upper arm during an isometric contraction of muscle biceps brachii at 90^0 of elbow flexion (cm) and CRB circumference of the upper arm in relaxed position of muscle biceps brachii at 90^0 elbow flexion (cm). Values between 5 - 12 are normal, values under 5 represent obese subjects with weak muscle and values over 12 represent children with strong muscles.

Lorenz's Constitutional Index

Lorenz's Constitutional Index (LCI) gives information about body's components with a following formula:

LCI = CT – CA -14,

where CT means circumference of thorax (cm) and CA circumference of abdomen (cm). If a calculated value is a positive, then an increase in a body mass goes on the account of muscles and bone. On contrary, if it's a negative then the adipose tissue is responsible for an increased body mass.

Olivier's Typologic Index

Olivier's Typologic Index (OTI) represents quick orientation measure about body constitution. It is calculated as below:

OTI = (SW / BW) X 100,

where SW means shoulder width (cm) and BW body weight (kg). Values over 67 suggest asthenic constitution, values from 58 – 67 muscular constitution and values under 58 picnic constitutions.

Statistical Analysis

Standard descriptive statistics (mean ± standard deviation) were determined for directly measured and derived variables. One way ANOVA (analysis of variance) was tested for the comparison of data among both the sexes of patients with different durations of LBP, followed by post hoc Bonferroni test (in the case of significant differences). Pearson's correlation coefficients were applied to establish the relationships among the variables measured in patients with LBP. Data was analysed using SPSS (Statistical Package for Social Science) version 17.0. A 5% level of probability was used to indicate statistical significance.

RESULTS

Table 1 shows the association between duration of LBP and gender in the patients. 59.46% male patients and 57.97% female patients had the complaints for less than one year duration and 40.54% male patients and 42.03% female patients had the complaints for more than one year duration. However, no significant differences (p> .05) were found between the male and female patients regarding the duration of LBP.

Table 1: Association of duration of disease and sex in patients with LBP

Sex	1 year <		1 year >		χ^2	p
	Abs. No.	%	Abs. No.	%		
Males (n= 37)	22	59.46	15	40.54	0.021	P> .05
Females (n=69)	40	57.97	29	42.03		

Table 2: Descriptive statistics of 14 variables in patients with low back pain and controls

Variables	Males 1< (n=22)		Females 1< (n=40)		Males 1 > (n=15)		Females 1> (n=29)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Height (cm)*	171.34	6.67	157.68	5.73	171.81	5.31	156.93	9.97
Weight (kg)**	84.33	12.14	974.4	10.90	77.45	12.35	61.30	9.68
BMI (kg/m²)	28.67	3.54	26.12	4.27	26.29	4.46	25.03	4.55
Quetelet's index	2.87	0.35	2.61	0.43	2.63	0.45	2.50	0.45
Ideal body weight(kg)**	71.00	5.19	61.83	4.87	70.40	4.50	60.73	4.57
Relative body weight(kg)**	56.03	19.46	71.29	16.94	50..94	18.16	69.45	22.90
CCB(cm)**	32.99	2.84	29.54	2.99	30.99	3.01	28.47	2.90
CRB(cm)**	31.18	2.70	28.66	2.92	29.25	2.97	27.59	2.98
Muscle index**	5.82	2.39	3.05	1.39	6.05	3.26	3.25	1.47
CT(cm)*	100.35	8.77	92.73	8.61	90.36	19.03	90.46	10.46
CA(cm)	94.43	16.48	91.77	10.94	96.25	12.56	88.72	12.52
LCI	-8.08	17.55	-13.04	4.98	-19.89	22.48	-12.26	10.57
Shoulder width(cm)**	65.42	16.39	51.40	3.89	57.85	4.61	52.86	10.06
OTI**	180.53	63.69	123.07	29.59	181.60	61.68	140.65	52.58

*Significant at .05 level ** Significant at .001 -.000 level CCB = Circumference of the upper arm during an isometric contraction of biceps brachii; CRB = Circumference of the upper arm in relaxed position of muscle biceps brachii; CT = Circumference of thorax; CA = Circumference of abdomen; LCI = Lorenz's constitutional index; OTI = Olivier's typologic index

The descriptive statistics of selected anthropometric variables and indices in patients with LBP is shown in Table 2. One way ANOVA showed statistically significant differences (p < .05 - .000) in HT, WT, ideal body weight, relative body weight, CCB, CRB, MI, CT, SW and OTI among these four sets of populations. When comparisons were made between male and female patients with the duration of LBP less than one year, statistically significant differences (p< .01 - .000) were found in all the variables studied, except BMI, QI, CA and LCI. Similarly, when the data of male and female patients with the duration of LBP more than one year were compared, statistically significant differences (p< .001 - .000) were found in all the variables, except BMI, QI, CA and LCI.

DISCUSSION

Now-a-days LBP is one of the major health problems in society. It causes considerable disability and use of health services. Various external or exogenous and internal or endogenous risk factors have been studied. Among the endogenous properties, the most widely studied factor was nutritional status assessed by BMI. Other anthropometric characteristics and indices were less reported as the risk indicators for LBP (Celan and Turk 2005). Thus objectives of the present study were to estimate the nutritional status of LBP patients by four anthropometric indices and to search any association between these anthropometric indices and the duration of low back pain in patients.

The findings of the present study indicated that as per QI, both male and female patients of the two groups (less than and more than one year duration of low back pain) had over-nutrition, except the female patients with duration of more than one year, where the value lies within the range of normal nutritional status (2.15 – 2.56). So far IBW is concerned, values of both female and male patients were below the normal nutritional status (90-110) irrespective to duration of LBP. MI represented female patients of both the duration groups were obese with weak muscles, whereas, the male patients with both the duration groups fall within the range of normal (5 - 12). The negative values of LCI represented the adipose tissue was responsible for the increased body fat both in female and male patients of both duration groups. Finally OTI values of LBP pa-

tients of both the sexes were higher than the normal range (58 – 67) suggested asthenic constitution of their bodies, irrespective to duration of LBP. It was also found that only muscle index had statistically significant association ($X^2 = 7.69$, p < .05) with the incidence of low back pain, but not the QI, LCI and OTI. It might be stated that all these four anthropometric indices provided adequate support towards the over-fatness in the patients' body constitution, over nutritional status and less muscular development.

In earlier studies, Lean et al. (1999) observed positive correlations between body mass and LBP indicating 1.5 times higher possibility for the occurrence of symptoms of disk herniation in women with a BMI over 30 kg/m² as compared to those of with a BMI under 25. Deyo and Bass (1989) reported an increased prevalence of LBP particularly in the very obese (BMI over 29 kg/m²) in 20% of extremely obese, the risk is 1.7 times higher than in 20% of the most thin. Leboeuf et al. (1999) reported that twins with a lower weight had less low back troubles. Increased BMI is associated with more frequent occurrence of osteophytes in the thoracic and lumbar spine. In males, the presence of osteophytes was also associated with LBP (O'Neill et al. 1999). Women with BMI value 19 – 24 kg/m² had the least low back complications and eventually the best indicators of health (Brown et al. 1998). Women with a high-risk waist circumference exceeding 88 cm had 1.5 times more LBP and symptoms of disk herniation (Lean et al. 1998).

Obesity is moderately associated with LBP (Bener et al. 2003). The overweight women (or with large waist) have significant increased likehood of LBP (Han et al. 1997). In contrary, negative association between body mass and LBP indicate that the occurrence of LBP was more frequent in subjects with lower body weight (Masset et al.1991). Biering-Sorensen (1984) reported that anthropometric parameters, viz. height, weight, length of lower extremities and upper body part, had no prognostic value for the first onset of LBP. It was also reported that there was no association between body weight and BMI and the onset of LBP in men, but in women, nonetheless, association between greater body weight and onset of LBP was reported (Croft et al. 1999). There were no significant differences between men in different tertiles of waist, waist to hip ratio and BMI regarding LBP symptoms (Han et al. 1997).

CONCLUSION

It may be concluded from the present study that, muscle index is significantly associated with the incidence of LBP. It may also be concluded that, though BMI is widely used as the risk indicator for the development of LBP, anthropometric indices may also be successfully used as the risk indicators in the light of nutritional status and muscle development.

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