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The Impact of Anthropometric Parameters on the Incidence of Low Back Pain

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ABSTRACT

Endogenic factors as one of possible reasons for low back pain were investigated and discussed in this study. The study included 122 male bus drivers, average age 44.2 years, average period of active service 24.4 years. The following anthropometric indexes have been calculated: Quetelet's index, percentage of body fat, relative body weight, Olivier's typologic index, Lorenz's constitution index and muscle index. According to inquiry form regarding history of low back pain the subjects were divided in two groups: 36 had no low back pain history and 76 had a history of recurrent low back pain. The results showed statistically nonsignificant differences in the anthropometric parameters and the calculated indexes between these two groups of subjects. The chosen subject sample showed that nutritional status, body build, constitution and muscular development are not associated with the incidence of low back pain.

Key words: *low back pain, anthropometric parameters, body mass index*

Introduction

Low back pain (LBP) represents one of the most frequent health complaints of modern man. In numerous professional papers dealing with low back pain, we repeatedly find statements on a 60–90% life prevalence and a 5% yearly incidence, as already established by Frymoyer in 1988[1].

LBP belongs in the category of diseases induced by multiple factors. The factors affecting the development of the disease are numerous and they are divided into two large groups: external or exogenous (representing physical and psyhosocial factors) and internal or endogenous (representing genotypical and phenotypical factors).

The phenotypical endogenous properties were studied from different points of view. The most frequently studied factor was nutritional status. The most often observed criterion was »Body Mass Index« – the relation between body weight and the square of the height (in the further text abbreviated BMI). Guideline recommendations of the American Heart Association give the following BMI values for the degree of nutrition (however, they are derived from the comprehension of the risk of occurring cardiovascular diseases):

- 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 or more indicates obesity,
- BMI 40.0 kg/m^2 or more indicates extreme obesity.

Rarely other parameters of nutritional status were observed. The American Heart Association guidelines were also taken into consideration, which determine a waist circumference of over 88 cm in women and over 102 cm in men as a risk indicator for developing cardiovascular diseases.

Numerous newer studies exist, dealing with the various associations between nutritional status and different viewpoints of LBP, which can be classified into three groups; studies showing a positive association between body mass and LBP, studies showing a negative association between body mass and LBP and studies showing that the BMI is not associated with the incidence of LBP. Studies showing a positive association between body mass and LBP indicate 1.5 times higher possibility for the occurrence of symptoms of disk herniation in women with a BMI over 30 kg/m^2 as compared to those with a BMI under 25 [2], and show increased prevalence of LBP particularly in the very obese (BMI over 29 kg/m^2), in 20% of the extremely obese the risk is 1.7 times higher than in 20% of the most thin[3]. Twins with a lower weight reported less low back troubles[4]. Increased

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BMI is associated with more frequent occurrence of osteophytes in the thoracic and lumbar spine. In male subjects the presence of osteophytes was also associated with LBP[5]. The optimal BMI value is 19–24 kg/m^2, women with such values had the least low back complaints and the best indicators of health[6]. Smaller body height, greater body weight, and higher BMI were all associated with a poorer postoperative outcome one year after lumbar disk surgery[7]. In overweight recreation runners the LBP occurred more frequently[8]. Women with a high-risk waist circumference exceeding 88 cm had 1.5 times more LBP and symptoms of disk herniation[9]. Obesity is moderately associated with LBP[10]. Women who are overweight or with large waist have significant increased likehood of LBP[11]. Studies showing a negative association between body mass and LBP indicate that the occurrence of LBP was more frequent in subjects with lower body weight[12], and that a lower BMI proved to be a risk factor for the onset of LBP in male army recruits exposed to physical strain for 14 days[13]. Studies showing that the BMI is not associated with the incidence of LBP determined that the BMI was not associated with the incidence of LBP[14], and anthropometric parameters (body height, weight, length of lower extremities and upper part of body) have no prognostic value for the first onset of LBP and recurrence of troubles in one year follow-up study[15]. In 5-year prospective study there were no significant differences regarding body height or weight between subjects with low back troubles and those without such troubles[16]. In the investigated factory workers the obesity presented no risk indicator for the onset of LBP[17]. A prospective cohort study revealed that there was no association between body weight (and BMI) and the onset of LBP in men. In women, however, a greater body weight was associated with the occurrence of such troubles[18]. There were no significant differences between men in different tertiles of waist, waist to hip ratio and BMI regarding LBP symptoms[11].

Thus the review of numerous studies shows that no uniform opinion exists on the association between the nutritional state, mostly shown by BMI, and the incidence of LBP. The studies are also quite differently designed. Most often the observed criterion is LBP, less often affection due to pain and the incapacity of performing one's job, rarely the morphologic properties of the lumbar spine. Only few studies are dealing with other aspects of the phenotypical properties of the human body as a risk factor for such troubles.

Reviewing the literature, no study was found which would analyze the constitution of the human body or muscular development. Some target-specific studies analyze individual viewpoints of muscular development, such as the power and endurance of muscles of the trunk. It is a known fact that in patients with chronic LBP a weakness of the multifidus muscle and the transversus abdominis muscle is present[19]. Muscular weakness, particularly of the extensors of the back, but also of the flexors and adductors of the hip as well as of abdominal muscles, is associated with LBP[20,21]. In a cohort study Rissanen et al. revealed that a good dynamic trunk extensor performance plays a protective role against permanent work disability due to low back troubles[22].

Subjects and Methods

Subjects

On account of the tendency towards decreasing the variability of strain at work, subjects of a closed sample took part in the study – bus drivers employed by Certus, a Maribor municipal transport company. All subjects were men with a similar workload and the same educational level. Other characteristics regarding the socioeconomic status have not been assessed, however taking into consideraton the one stated above very similar socio-economic status can be expected.

The study included 122 subjects who were available at the time of carrying out the inquiry and the measurements. Their selection from among the entire population of 300 bus drivers employed by Certus was random. An independent non-medical educated personnel officer at Certus made a list of those who later came for examinations and measurements. Only inclusion criteria were male sex, and age over 30 years.

The average age of the subjects was 44.2 years (SD 5.6 years), the youngest was 31 and the oldest was 56 years old.

The average length of service amounted to 24.4 years (SD 6.0 yrs), the shortest was 10 years and the longest 36 years.

Methods

The study was planned as an observational study of the »case-control« type in a specific group of subjects, in which anamnestic data (the life prevalence of LBP) were included and anthropometric measurements were carried out.

The following anthropometric measurements were carried out; the main criterion of choice was simplicity and therefore clinical applicability: body height, body weight, percentage of body fat (measured by impedance scales »Tanita TBF 515«), shoulder width, circumference of thorax and abdomen, and circumference of right upper arm in contracted and relaxed *m. biceps brachii.*

Using these data, the following guideline anthropologic indexes stated in the literature were calculated[23].

Quetelet's index (devenport-kaup's adaptation)

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

$$RBW = (ABW / IBW) \times 100,$$

where ABW means measured body weight (kg) and IBW ideal body weight according to Demol.

Formula for men is as follows:

$$IBW = (BH - 100) - ((BH - 150) / 4) + ((AY - 20) / 4),$$

where AY means age in years (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 a formula:

$$MI = ((CCB - CRB) / CRB) \times 100,$$

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

Lorenz's constitutional index

Lorenz's constitutional index (LKI) 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, than an increase in a body mass goes on the account of muscles and bones. 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 (OLI) represents quick orientation measure about body constitution. It is calculated:

$$OTI = (SW / BW) \times 100,$$

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 constitution.

Statistical analyis

The study had to give an answer to the question of whether differences existed in the size of anthropometric parameters between those subjects whose history contained no mention of low back problems and those reporting such problems. With regard to this question, two subgroups were formed from the entire group of subjects: Group NO and Group YES. Group NO consisted of 36 subjects giving a negative answer to the question about previous LBP – NO LOW BACK PROBLEMS. Group YES contained those subjects whose answer to the question regarding anamnestic low back problems was »3 times or more«, as our special interest was to detect possible anthropometric peculiarities of patients with chronic-recurrent low back problems. There were 76 subjects with RECURRENT LOW BACK PROBLEMS (Group YES).

Of the entire sample of 122 subjects, 10 were excluded at this stage of the statistical analysis as they had stated merely one or two experiences of LBP. Since these subjects had a history of only individual or very few problems, they could not be included in the group with recurrent problems.

In the so-formed subgroups, a statistical analysis was done. After performing the basic descriptive analysis, the age difference between the subgroups was analyzed. Due to the difference in age structure, an analysis of the impact of age on various anthropometric parameters was done using the correlation test. This was followed by a univariate analysis according to individual observed anthropometric parameters. Data showed normal distribution using one-sample Kolmogorov-Smirnov test and thus t-test for independent groups was used for a comparison of numeric variables between subgroups.

Results

The comparison of the age structure of both groups of subjects showed a statistically significantly higher ($p= 0.011$) age of the subjects with a history of LBP (mean 45.0 years) than subjects without LBP anamnesis (mean 42.2 years). A comparison of anthropometric parameters between the two different age groups only makes sense if age has no significant impact on the magnitude of the observed parameter. The relationships between age and individual parameters were analyzed using correlation tests, which showed low values of the coefficient of correlation (Table 1). The small values of the factors of correlation point out that in the observed group age has no greater (linear) impact on anthropometric parameters, making a comparison of the value of

TABLE 1
CORRELATION BETWEEN AGE AND ANTHROPOMETRIC PARAMETERS

Anthropometric parameter	Correlation factor – r
Quetelet's index	0.21
Percentage of fat	0.17
Relative BW	0.07
Olivier's typologic index	–0.07
Lorenz's constit. Index	–0.13
Muscle index	–0.16

TABLE 2
ANALYSIS OF DIFFERENCES IN VALUES OF OBSERVED PARAMETERS IN BOTH GROUPS USING THE t-TEST

Parameter	Gr. NO	Gr. YES	t	p
Quetelet's index (g/cm^2)	2.77	2.79	0.27	0.79
Percentage of fat (%)	25.54	26.39	–0.79	0.43
Relat. BW (%)	114.10	114.20	–0.01	0.92
Olivier's typ. index (cm/kg)	47.65	46.85	0.74	0.46
Lorenz's const. Index	–7.11	–7.33	0.17	0.86
Muscle index	8.99	8.79	0.34	0.73

these parameters possible between two groups differing in age structure.

Comparison of the average values of individual observed parameters in the group of subjects without low back complaints and in the one reporting recurrent problems of this kind is shown in Table 2. Statistical analysis showed that no statistically significant difference was found between the investigated groups in any of the observed anthropometric parameters (all $p>0.05$).

Discussion

In the statistical analysis procedure, the entire group of 122 subjects was divided into two groups. The group with recurrent LBP comprised 76 subjects reporting a history of 3 or more experiences of such problems. The control group was made up of 36 subjects with no history of LBP. The average age of the control group was statistically significantly lower ($p<0.05$) than of the LBP group. Further comparison of anthropometric parameters between groups with different age structure would be problematic, if age had an influence on the various parameters observed. The calculation of the factors of correlation between age and individual observed anthropometric parameters showed that age had no major impact on them, making the further analysis of the differences in the parameters between the incompletely age-matched groups possible.

Statistical analysis of the differences in the observed parameters between the group of 36 subjects without a history of LBP and in the 76 subjects stating recurrent LBP showed that in all three parameters of nutritional status, in the parameter of constitution, body build and muscular development there were no significant differences between the two groups.

These results, although obtained on a smaller sample of a closed circle of subjects, all of which were males, support the findings of researchers[11,13–18] who did not establish an association between the degree of nutrition and the occurrence of LBP in larger studies.

From the viewpoint of LBP prevalence, it seems that this disease occurs with equal frequency in individuals with very different physical properties. LBP may occur in the very tall or very short, in fat as well as lean people, in those with more and in those with less muscular development, and in people of different body build. So from the viewpoint of prevention and treatment of LBP, there is no expert-confirmed demand for a decrease in excess BW. So far, in the field of pathology of the locomotor system, only an association with the occurrence of degenerative changes in the knee joints has been proved.

A sufficient number of other medical arguments exists designating obesity as a serious disease and an urgent medical and social problem. However, the impact of obesity on the incidence of LBP has not been absolutely confirmed by our study either.

The ethiologic factors for the occurrence of LBP are still insufficiently confirmed.

The present study analyzes the physical anthropometric factors of individual. The results demonstrate that in chosen sample of subjects there were no significant differences in the values of observed anthropometric parameters and calculated indexes between the two group subjects with and without anamnesis of low back pain. In studied sample group the anamnesis of low back pain was present in individuals regardless of their physical characteristics – nutritional status, body build, constitution and muscular development.

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UTJECAJ ANTROPOMETRIJSKIH PARAMETARA NA INCIDENCIJU KRIŽOBOLJE

SAŽETAK

Predmet ovog rada su tjelesne značajke kao mogući unutarnji čimbenici u pojavi križobolje. Istraživanje je bilo opservacijsko i s kontrolnom skupinom uključilo je ukupno 122 muškarca, vozača autobusa, prosječne starosti 44,2 godine i prosječnog radnog staža 24,4 godine. Metode su uključivale izvedbu antropometrijskih mjerenja i računanje sljedećih antropometrijskih indeksa: Queteletov index, postotak tjelesne masti, relativna tjelesna težina, Olivierov tipološki indeks, Lorenzov konstitucijski indeks i mišićni indeks. Pomoću ispitivanja anamneze o poteškoćama s križima formirane su dve grupe: 36 ispitanika bez anamnestičkih bolova u križima i 76 onih, koji su javljali rekurentne poteškoće. Rezultati pokazuju statistički neznačajne razlike u vrijednostima promatranih antropometrijskih pokazatelja i računanih indeksa između obiju skupina. Na izabranom uzorku osoba pokazali smo da prehrambeni status, tjelesna gradnja, konstitucija i mišićna razvijenost nisu povezani s incidencijom križobolje.