

VISUOMENĖS SVEIKATA

Anthropometrical data and physical fitness of Lithuanian soldiers according to the sociodemographic characteristics

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Key words: height, body mass index, physical fitness, education, place of residence.

Summary. The aim of this study was to assess the anthropometrical data and physical fitness of soldiers according to the sociodemographic characteristics during one-year compulsory military service. The height and weight of 197 soldiers were measured at the beginning and at the end of their service, and body mass index was calculated. The physical fitness was evaluated using index of ability on the basis of 2 km walking test. Conscripts from cities were taller than conscripts from rural areas. At the beginning of the service every fifth was overweight ($25 \leq$ body mass index < 30 kg/m²) or obese (body mass index ≥ 30 kg/m²): 17.9% of conscripts from rural areas as well as 17.6% from urban were overweight and 1.9% from rural as well as 1.1% from urban areas were obese. A tendency that the weight of conscripts gradually increased with the level of education was observed. There were no significant differences in index of ability according to the level of soldiers' education as well as place of residence. During one-year service the height of soldiers did not change, however, their weight increased in average by 5.5 ± 4.5 kg ($p < 0.01$). The part of overweight persons at the end of the service increased 2.3-fold. Physical fitness of soldiers after one-year service significantly decreased compared with the beginning of the service. In order to decrease the rate of overweight soldiers and to increase their physical fitness the health promotion programs in Lithuanian Army are needed.

Introduction

Army personnel must be ready for rapid mobilization as world conflicts increase in number and intensity. All enlisted men who entered Lithuanian Army as well as in other countries (1) acquired basic soldiering skills in basic combat and individual training at the battalion where they are appointed. The training courses involved classroom instruction, motor skills training, field exercises, marching, other various physical activities such as running, push-ups or sit-ups and started immediately from the beginning of the service. It is the time when recruits (conscripts) are molded into stronger, more disciplined individuals (2). From the view of combat medics in Lithuania the majority of soldiers had better physical appearance due to the increased body weight at the end of one-year compulsory military service compared with the beginning. It is obvious that regular physical training is related to the increase in muscular weight and person's physical fitness.

Some studies reported a trend toward increasing

overweight among military personnel that shows a tendency among the general population (3). Other studies revealed differences in conscripts weight depending on the place of residence and socioeconomic class especially the level of education (4).

The aim of this study is to assess anthropometrical data and physical fitness according to the sociodemographic characteristics of soldiers during one-year compulsory military service. It is a part of the first "Healthy Life Style" study performed in Lithuanian Army.

Material and methods

Anthropometrical data of soldiers such as height, weight, and body mass index were measured and analyzed according to their sociodemographic characteristics – age, level of education and place of residence (rural or urban). The measurements were performed at the beginning and at the end of one-year compulsory military service. All 197 investigated soldiers, aged 19–25 years old, served at the one of motoin-

fantry battalion located in the central part of Lithuania.

The measures were done using calibrated measuring appliances and standard methods of measuring. The height of soldiers was measured in meters (m) by height gauge and weight was assessed in kilograms (kg) using the medical scales at the medical post of military unit. All data of each soldier were registered in a special form.

Body mass index (BMI) was calculated using the formula: $BMI = \text{weight in kilograms} / \text{square of height in meters (kg/m}^2\text{)}$. We considered BMI as overweight when $25 \leq BMI < 30 \text{ kg/m}^2$, and as obesity when $BMI \geq 30 \text{ kg/m}^2$.

The physical fitness of soldiers was evaluated by using one of the main measurements of EUROFIT test – the index of ability (IA) on the basis of the results of soldier's physical exercises – 2 km walking test (5). IA was calculated (in scores) using the standard formula: $420 - (\text{min} \times 11.6 + \text{sec} \times 0.20 + \text{HBR} \times 0.56 + \text{BMI} \times 2.6) - \text{age} \times 0.2$, where min – time of 2 km walking in minutes; sec – time of 2 km walking in seconds; HBR – heart beating rate per minute at the end of walking test, BMI – body mass index in kg/m^2 . In order to evaluate the changes in physical fitness during one-year service period we compared the IA data of the same soldiers for whom this test was done at the beginning and at the end of the service. The number of those soldiers was 94.

Afterwards the data were processed using the methods of mathematic statistics. All calculations were performed with the software package Microsoft Excel 2000 and SPSS 12 (Statistical Package for Social Sciences). Differences between two means (Student's t-test and paired samples t-test) as well as two proportions were regarded as significant when p-value was < 0.05 (two-sided tests were used).

Results

According to the Lithuanian military law the age of conscripted young men is 19–25 years. The distri-

bution of studied conscripts by age is shown in Fig. 1.

The mean age of them was 20.8 ± 1.3 (where 1.3 is the standard deviation). The majority of obligatory military service conscripts (81.8%) were 19–21 years old. According to Mann-Whitney test there were no differences in age of conscripts by place of residence ($p=0.22$).

The data of height, weight, BMI and IA of soldiers were analyzed according to their sociodemographic characteristics. The distribution of conscripts by education and place of residence is presented in Table 1. The largest part of all studied conscripts has finished 9 years of schooling and vocational school; the least part has graduated from the university. In urban areas there were more conscripts with higher education (secondary and technical school, and university) than in rural areas ($\chi^2=8.98$, $df=3$, $p=0.026$). It is obvious that conscripts with the university education were older than conscripts with the lower education ($p<0.001$).

At the beginning of the service the height of conscripts ranged from 161 to 197 cm and the mean height was 176.4 ± 6.2 cm. The height of the majority of conscripts (nearly 60%) was between 170 and 180 cm (Fig. 2). The mean height of conscripts from rural areas (175.4 ± 5.9 cm) was lower than height of conscripts from urban areas (177.7 ± 6.4 cm, $p<0.01$). There were no significant differences in conscripts' height in different educational groups. A tendency that

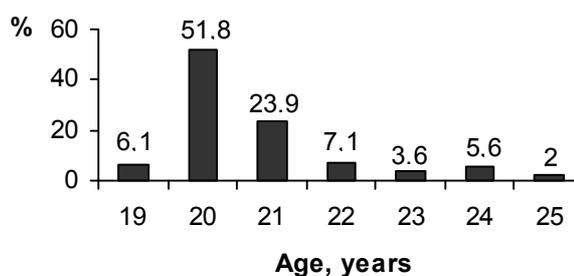


Fig. 1. The distribution of conscripts by age

Table 1. Distribution of conscripts according to sociodemographic characteristics

Degree of education	Cities (n=91) n (%)	Villages (n=106) n (%)	Total (n=197) n (%)
Incomplete secondary school – less than 9 years of schooling	11 (12.1)	20 (18.9)	31 (15.7)
9 years of schooling and vocational school	54 (59.3)	73 (68.8)	127 (64.4)
Secondary and technical school	20 (22.0)	11 (10.4)	31 (15.8)
University	6 (6.6)	2 (1.9)	8 (4.1)

$\chi^2=8.98$, $df=3$, $p=0.026$.

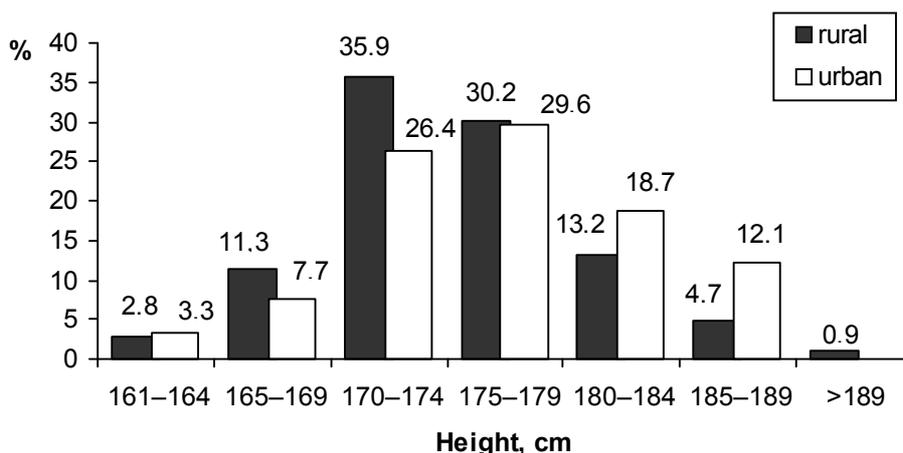


Fig. 2. The distribution of conscripts by height according to place of residence

conscripts with the highest education were taller than others was observed (Table 2).

The weight of all the studied conscripts varied from 50.0 to 101.7 kg and the mean weight was 71.6±9.4 kg. The weight of the majority (77.2%) of young obligatory service men was between 60 and 80 kg (Figure 3). There were no significant differences in weight of conscripts with different level of education as well as in weight of conscripts from rural (70.9±0.0 kg) and urban (72.3±8.7 kg) areas (Table 2). We observed a tendency that the weight of conscripts gradually increased with educational level and conscripts with university education had the highest weight (p>0.05).

After one-year service the height of soldiers did not change (the mean value was 177.2±6.3 cm) and soldiers from cities were taller than conscripts from rural areas (178.4±6.7 cm and 176.2±5.9 cm, respectively; p<0.05) as well as at the beginning of the service.

The weight of soldiers during one-year service

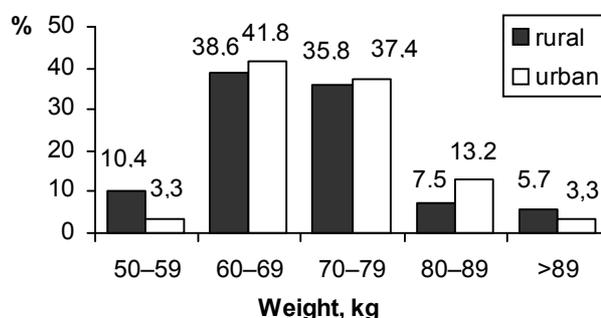


Fig. 3. The distribution of conscripts by weight according to place of residence

increased significantly (p<0.01) in average by 5.5±4.5 kg and the mean weight has reached 77.4±8.6 kg. No differences were found in weight increase among rural and urban soldiers: the increase was 5.8±4.3 kg and 5.3±4.7 kg, respectively.

At the beginning of the obligatory military service period the mean BMI of conscripts was 22.9±2.5 (from 17.7 to 31.6 kg/m²). More than 70% of them had nor-

Table 2. Means of height (cm) and weight (kg) of conscripts by educational level and place of residence

Degree of education	Cities (n=91)		Villages (n=106)		Total (n=197)	
	Height M (SD)	Weight M (SD)	Height M (SD)	Weight M (SD)	Height M (SD)	Weight M (SD)
Incomplete secondary school – less than 9 years of schooling	177.6 (6.3)	70.2 (7.5)	174.9 (5.1)	68.2 (10.6)	175.8 (5.6)	68.9 (9.5)
9 years of schooling and vocational school	177.4 (6.2)	71.3 (8.2)	175.7 (6.1)	71.6 (9.2)	176.4 (6.2)	71.5 (8.8)
Secondary and technical school	177.2 (6.7)	75.0 (9.2)	174.4 (6.4)	70.7 (14.2)	176.2 (6.6)	73.4 (11.3)
University	182.5 (7.1)	76.7 (11.8)	172.7 (1.2)	73.3 (6.7)	180.0 (7.5)	75.8 (10.4)

M – mean; SD – standard deviation.

Table 3. Changes in BMI of soldiers during the service

BMI, kg/m ²	At the beginning %	After one year %
<20	9.6	1.1
20–24.99	71.1	56.6*
25–29.99	17.8	40.6*
≥30	1.5	1.7

BMI – body mass index;

* $p < 0.05$ compared with the beginning of service.

mal BMI between 20 and 25 kg/m². BMI of every tenth conscript was less than 20 kg/m² but every fifth was overweight and 1.5% of all were obese (Table 3). Thereby, overweight and obesity were observed for 19.3% of all conscripts: 17.9% from rural areas as well as 17.6% from urban were overweight and 1.9% from rural as well as 1.1% from urban areas were obese. We indicated no significant differences in BMI according to the education and place of residence. The mean BMI of rural and urban conscripts were 23.0±2.7 and 22.8±2.3 kg/m², respectively.

After one-year service BMI of studied soldiers significantly increased because of the rising weight and the mean BMI reached 24.6±2.2 ($p < 0.001$, the power > 0.99). The number of soldiers with normal BMI has decreased and the part of overweight soldiers increased 2.3-fold. In other words, the part of overweight soldiers increased by 22.8% compared with conscripts. The rate of obese soldiers did not change (Table 3).

The physical fitness of conscripts was evaluated by using IA on the basis of the results of 2 km walking test. The mean value of IA of all tested conscripts was 120.1±19.7 (min=69 and max=167). Although

the number of soldiers for whom this test was done at the beginning and at the end of the service was smaller compared with those at the beginning, the mean age and anthropometrical values of this group (n=94) did not differ from the rest group of conscripts (n=103). The mean age of 94 conscripts was 20.7±1.1 and their mean BMI=23.1±2.6; the mean age and the mean BMI of 103 conscripts were 20.8±1.5 and 22.8±2.4, respectively ($p > 0.05$). The distribution of conscripts by IA according to education and place of residence is presented in Table 4. There were no significant differences in IA by education. We observed the significant difference in IA among conscripts from cities and villages only in university educational group, however, the mean IA of conscripts from urban areas was the same compared with that from rural areas.

After one-year service IA of soldiers significantly decreased by 13.2±9.3 scores compared with IA at the beginning ($p < 0.001$, the power > 0.99) and the mean IA value was 106.9±18.1 (109.9±17.6 from urban and 104.4±18.4 from rural areas, $p > 0.05$).

According to the IA data all studied conscripts at the beginning of the service were divided into 3 groups. Conscripts with the lowest IA (EUROFIT test as very bad, bad and moderate) were assigned to the group 1 (IA=69–110, n=28). The group 2 included conscripts with the IA as good (IA=111–130, n=39). Conscripts with the highest IA (as very good, IA >130, n=27) were assigned in the group 3. The mean IA of conscripts at the beginning of the service in those groups was 97.2±11.1, 120.2±5.1, and 143.7±8.8, respectively.

The mean BMI of conscripts in groups 1, 2, and 3 was 24.4±3.0, 23.5±2.3, and 21.4±2.0, respectively. Hereby, the conscripts with the highest IA (group 3) had the lowest mean BMI compared with other groups ($p < 0.001$). BMI profile in different IA groups at the beginning of the service is presented in Table 5.

Table 4. Means of index of ability (in scores) of conscripts by educational level and place of residence

Degree of education	Cities (n=44) M (SD)	Villages (n=50) M (SD)	Total (n=94) M (SD)
Incomplete secondary school – less than 9 years of schooling	122.0 (26.8)	119.7 (21.9)	120.6 (23.1)
9 years of schooling and vocational	121.6 (20.5)	121.9 (16.2)	121.8 (18.1)
Secondary and technical school	107.0 (24.1)	104.0 (30.1)	105.7 (25.1)
University	118.2 (8.1)	141.0 (10.0)*	122.8 (12.4)
Total	119.7 (20.9)	120.5 (18.8)	120.1 (19.7)

M – mean; SD – standard deviation; * $p < 0.05$ compared with cities.

Table 5. Percent of conscripts with different BMI in three IA groups at the beginning and after one-year service

BMI, kg/m ²	At the beginning			After one year		
	Group 1 (n=28) %	Group 2 (n=39) %	Group 3 (n=27) %	Group 1 (n=51) %	Group 2 (n=32) %	Group 3 (n=11) %
<20	7.1	5.1*	25.9	0	0	9.1
20–24.99	64.4	69.3	70.4	41.2*	68.7	81.8
Overweight (25 ≤ BMI <30)	21.4	25.6*	3.7	54.9*	31.3	9.1
Obesity (BMI ≥30)	7.1	0	0	3.9	0	0
Total, %	100	100	100	100	100	100

BMI – body mass index; IA – index of ability; *p<0.05 compared with group 3.

After one-year service the part of overweight and obese soldiers in IA groups greatly increased and the part of soldiers with the lowest BMI decreased. The mean weight of conscripts in IA group 1 during one-year service increased by 5.6±5.1 kg, in the group 2 – by 5.0±4.1 kg and in the group 3 – by 5.4±4.9 kg.

Whereas the relationship between IA and BMI was inverted, the important reason in decrease of IA after one-year service could be an increase in soldiers' BMI.

Discussion

The present paper is the first report describing the changes in anthropometrical data and physical fitness of soldiers in Lithuania during the military service. The mean age of studied conscripts was 20.8±1.2 and it was similar to the mean age of the USA Army Navy recruits – 20.1±2.9 years (6). At the beginning of the service the mean height of conscripts was 176.4±6.2 cm and no difference in height was observed after one year. Of course, one-year period is a very short time for a height change. Norway Statistics has published data on the average height of conscripts since 1910. Over the last 30 years the average height of conscripts has increased only 1 cm – in 2000 it was 179.7 cm (7).

Some sociodemographic differences in height of the studied soldiers were observed. According to our study data conscripts with the highest educational level tended to be taller than others. The previous studies reported analogous finding (8). We have noticed that conscripts from urban areas (cities) were taller than conscripts from rural areas. Polish study showed the opposite data: conscripts from rural origin were, on average, taller than conscripts from urban origin (4).

This study found that there were no significant differences in conscripts' weight compared different

educational groups as well as conscripts from rural and urban areas. We have observed a tendency that the weight of conscripts gradually increased with the level of education, so conscripts with the university education had the highest weight. After one-year service the weight of soldiers significantly increased by 5.5 kg. In our opinion, the increase of soldiers weight depends on a special military balanced diet, healthy day regiment, and relevant physical activity in the Army compared with the civil lifestyle. The recent research project in the USA has showed that even during 8 weeks of basic training special food selection was in relation to gained weight of soldiers (9).

BMI is more informative indicator than body weight and in epidemiological studies is used in order to evaluate the prevalence of overweight and obesity among population. As it is well known, enlarged BMI is one of the important risk factors of coronary heart disease, hypertension, cancer, and other non-communicable diseases (10, 11). At the beginning of obligatory military service period the mean BMI of conscripts was 22.9±2.5 kg/m², every fifth conscript was overweight and 1.5% of all were obese. The part of obese studied conscripts was similar to the appropriate Lithuanian adult population: 1.8% of men aged 19–24 were obese (12). Likewise, the average BMI among Portuguese young males aged 20 years old was 22.5 kg/m² and 2.1% of them were obese. Furthermore, a tendency of increase in schooling was noticed while increasing BMI (13). Results obtained in the study of US military service members indicated that mean BMI was 25.2 kg/m² among active duty personnel (14).

According to our findings, at the end of obligatory military service period (one year) a mean BMI of soldiers significantly increased and the main reason

was the increase in soldiers' weight. After one-year service the part of overweight soldiers increased more than twice (from 17.8% to 40.6%).

The analysis of IA data at the end of service revealed the decrease in this indicator of physical fitness. Looking for the causes of decrease of the IA we suggested that the main reason should be associated with the increase in weight and time of repeatable walking test. It should be mentioned that physical training during the second part of one-year service in the Lithuanian Army is not so intensive as during basic military training at the beginning of service (3 months). On the other hand, some studies reported that the rise in overweight among the military personnel is not explained by a decrease in physical activity (3, 15).

In order to reveal the deeper links between physical fitness and anthropometrical data the further investigations are needed.

Conclusions

1. The conscripts from cities were taller than the conscripts from rural areas. There were no changes observed in soldiers' height during one-year service.

2. The weight of conscripts as well as their body mass index has increased during one-year service. A tendency that the weight of conscripts gradually increased with the level of education was observed.

3. Physical fitness of soldiers after one-year service significantly decreased compared with the beginning of the service.

Lietuvos kareivių antropometriniai duomenys ir fizinis pajėgumas atsižvelgiant į sociodemografines charakteristikas

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Raktažodžiai: ūgis, kūno masės indeksas, fizinis pajėgumas, išsimokslinimas, gyvenamoji vieta.

Santrauka. *Darbo tikslas.* Įvertinti Lietuvos kareivių antropometrinius duomenis ir fizinį pajėgumą vienerių metų privalomosios tarnybos laikotarpiu atsižvelgiant į jų sociodemografines charakteristikas. Tyrime dalyvavo 197 kareiviai, kuriems tarnybos pradžioje ir pabaigoje, naudojant standartinę matavimo metodiką, buvo matuotas ūgis, svoris bei apskaičiuotas kūno masės indeksas. Fizinis pajėgumas, susijęs su sveikata, vertintas pagal pajėgumo indeksą, apskaičiuotą naudojant 2 km ėjimo testo rodiklius. Tyrimo duomenimis, gyvenantys miestuose šauktiniai, buvo aukštesni negu gyvenantys kaimo vietovėse. Kas penktam šauktiniui nustatytas padidėjęs svoris: 17,9 proc. gyvenusiems kaimo vietovėse ir 17,6 proc. gyvenusiems miestuose nustatytas antsvoris ($25 \leq$ kūno masės indeksas $< 30 \text{ kg/m}^2$) ir, atitinkamai – 1,9 ir 1,1 proc. buvo nutukę (kūno masės indeksas $\geq 30 \text{ kg/m}^2$). Užfiksuota kareivių svorio didėjimo tendencija didėjant jų išsimokslinimui. Vertinant pajėgumo indeksą, atsižvelgiant į tiriamųjų išsimokslinimą bei gyvenamąją vietą, reikšmingų skirtumų nerasta. Po metų tarnybos kareivių ūgis nepasikeitė, o svoris padidėjo vidutiniškai $5,5 \pm 4,5 \text{ kg}$ ($p < 0,01$). Lyginant su šauktiniais, dalis kareivių, kuriems nustatytas antsvoris, tarnybos pabaigoje jis padidėjo 2,3 karto. Didėjant svoriui, žymiai sumažėjo kareivių fizinis pajėgumas. Karių fizinis pajėgumas yra vienas iš kariuomenės kovinės parengties vertinimo kriterijų, todėl ypač svarbu diegti fizinio pajėgumo stiprinimo ir sveikatos gerinimo programas Lietuvos kariuomenėje.

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References

- Henderson N, Knapik J, Shaffer S, McKenzie T, Schneider G. Injuries and injury risk factors among men and women in US Army combat medic advanced individual training. *Milit Med* 2000;165(9):647-52.
- Clemons EP. Monitoring anxiety levels and coping skills among military recruits. *Milit Med* 1996;161(1):18-21.
- Lindquist CH, Bray RM. Trends in overweight and physical activity among US military personnel, 1995–1998. *Prev Med* 2001;32(1):57-65.
- Kolodziej H, Szklarska A, Malina RM. Young adult height of offspring born to rural-to-urban migrant parents and urban-born parents. *Am J Human Biol* 2001;13(1):30-4.
- EUROFIT. Handbook for the EUROFIT tests of physical fitness. 2nd edition. Council of Europe. Strasbourg: Committee for Development of Sport; 1993.
- Trank TV, Ryman DH, Minagawa RY, Trone DW, Shaffer

- RA. Running mileage, movement mileage, and fitness in male US Navy recruits. *Med Sci Sports Exerc* 2001;33(6):1033-8.
7. Bjerkedal T, Beckstrom JR, Brevic JI, Skaden K. Height, weight and body mass index measured among men born 1967–1980. *Tidsskr Nor Laegeforen* 2001;121(6):674-7.
 8. Bielicki T, Szklarska A. Secular trends in stature in Poland: national and social class-specific. *Ann Hum Biol* 1999;26(3): 251-8.
 9. Williamson DA, Martin PD, Allen HR, Most MM, Alfonso AJ, Thomas V, et al. Changes in food intake and body weight associated with basic combat training. *Milit Med* 2002;167(3): 248-53.
 10. Berlin IA, Colditz GA. A meta-analysis of physical activity in the prevention of coronary heart disease. *Amer J Epidem* 1990;132:612-28.
 11. Park HS, Oh SW, Choi WH, Kim YS. The metabolic syndrome and associated lifestyle factors among South Korean adults. *Int J Epidemiol* 2004;33(2):328-36.
 12. Grabauskas V, Klumbiene J, Petkeviciene J, Dregval L, Saferis V, Prattala R, et al. Health behaviour among Lithuanian adult population, 2000. Helsinki; 2001.
 13. De Castro JJ, Baptista F, Dias JA, Nobre EL, Alves AC, Teles AG. Relationship between obesity and educational level in Portuguese young males. *Acta Med Port* 2000;13(1-2):1-6.
 14. Harrison L, Brennan MA, Levine AM. Physical activity patterns and body mass index scores among military service members. *Am J Health Promot* 2000;15(2):77-80.
 15. Deforche B, Leferve J, Bourdeaudhuij JD, Hills AP, Duguet W, Bouckaert J. Physical fitness and physical activity in obese and nonobese Flemish youth. *Obesity Res* 2003;11:434-41.

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