

The estimation scale of the daily pedometry of senior students

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Abstract

Purpose: To create the estimation scale of the daily pedometry of senior students with different levels of motor activity. To determine the dependence of students' life quality on the volume of step locomotions.

Material: The students of Irkutsk National Research Technical University (Irkutsk, Russia) (n = 235: females - n = 78, males - n = 157: 19-20 years old) participated in the study. The daily pedometry of students for 7 days was studied. The number of daily steps was recorded by Simple Design Ltd application for smartphones. The sigma deviation method was used to develop an individual daily pedometry estimation scale. The daily pedometry scale was developed based on the distribution of this characteristic by 5 sigma classes ("low", "below average", "average", "above average", "high"). Students' life quality was studied using a Russian-language version of SF-36 (Short Form Health Survey). The survey presents the characteristics of physical (PH), mental (MH) and general (GH) health. The answers were estimated in points (0-100).

Results: Most students have an "average" level of step locomotions. 10% of males and about 8% of females have "above average" or "high" pedometry level. This group of students is actively engaged in sports activities. 4.8% of males and 7.5% of females have a "low" pedometry level. In this group of students, motor activity is limited only by locomotions related to educational and household activities. Students with "high" and "above average" pedometry levels have the highest values of life quality indicators. Such students are in a safe zone of non-communicable diseases. The "low" level of daily step locomotions is considered as a predictor of insufficient physical activity, low general and mental health of students.

Conclusions: The sigma deviation method allows distributing any population of people by the number of daily locomotions into five sigma classes. The level of daily step locomotions can be considered as a marker of physical activity, general and mental health. This approach makes it possible to refer a person to a safe health zone or a risk group of non-communicable diseases. The results of the study can be used in the recommendations for improving the students' life quality. It is also recommended to use our recommendations to increase students' self-motor activity during their university studies.

Keywords: motor activity, step locomotions, daily locomotions, life quality.

Introduction

The important condition for the harmonious development of an individual is his regular motor activity. This is especially important in adolescent ontogeny. The term "physical activity" includes the total value of various human movements over some time [1]. In the last decade in Russia [2] and foreign countries [3-5] there is an expressed hypokinesia of students against the learning process complication and computerization [6].

The decrease in student health indicators [7] is due to: the influence of psycho-emotional factors in learning; increased time for self-training; diet violation [8]; significant spread of social-negative phenomena in the youth environment [9-11].

One of the effective ways of overcoming hypokinesia is cyclic physical activity in the form of locomotions [12]. This allows compensating for the deficit of the students' motor activity. This is especially important in senior courses because such students no longer have obligatory physical education classes. In the scientific literature,

there are actual discussions on the normalization of the required number of steps in the daily physical activity of students [13].

The motor activity can be expressed in energy consumed units or the number of performed movements (locomotions). The objective and unified method for a person's motor activity estimation is pedometry [14-16].

The literature gives various recommendations on the daily step locomotions performance by a person: not less than 10 thousand [17] or 14-19 thousand steps per day [18]. It is proposed the standards of 20-25 thousand steps per day for females and 25-30 thousand steps for males [19]. Such a significant variation of the recommended norm of daily pedometry is explained by the authors as the body specifications of each individual. The influence of genetic factors on the motor potential of a particular person has been experimentally proved [20]. It is determined the features of the influence of natural and climatic and environmental [21], social and household [17] and other factors on the morphofunctional development and motor activity of people. According to the authors' opinion, the volume estimation of the daily motor activity of a person

by average standards is not correct enough [22].

The sigma deviation method is used to characterize the studied indicator by the levels of distribution. This method is widely used in biomedical research to evaluate the physical development of Russian children [23, 24] and ecological situation in the territories of the population [25]. It is also used in clinical practice to predict the risk of cardiovascular pathology developing in the form of a Z-score modification [26].

We have not found any studies devoted to the use of the sigma deviation method for the development of individual daily pedometry assessment scales. This approach considers gender, age, place of birth and residence of the studied contingent. These studies are considered to be promising.

The methods of studying health concerning human life quality (LQ) assessment have been widespread in recent years [27]. The international SF-36 (Short Form Health Survey) is used for this purpose [28]. This survey has been tested in many studies in different countries [29]. It allows determining the quantitative characteristic of human activity, i.e. the condition of his physical, general and mental health.

The study of the correlation between locomotions (number of steps) and the life quality of university students is of scientific and practical interest.

The purpose of the study. To create the estimation scale of daily pedometry of senior students with different levels of motor activity. To determine the dependence of students' life quality on the volume of step locomotions.

Material and methods.

Participants. The students of Irkutsk National Research Technical University (Irkutsk, Russia) ($n = 235$: females - $n = 78$, males - $n = 157$: 19-20 years old) participated in the study.

Design of the study. The daily pedometry survey and a survey on students' life quality were conducted in 2019 during a week. The surveys were conducted after the course "Optional Course in Physical Culture and Sports" completed by students.

The parallel pilot study of the number of students steps locomotions was conducted at the beginning of the work to select a valid method of recording the daily pedometry.

Two groups of students (20 people for each method) participated in the experiment. The daily volume of steps was recorded in the first group using the "OMRON HJ-005" pedometer and in the second group using Simple Design Ltd application for the smartphone. There was no significant difference between the results of daily pedometry measurement performed by the abovementioned methods ($p > 0.05$). The second method was chosen for the study. The advantage of this method is the availability and possibility of simultaneous mass examination of students. Also, this method needs no financial expenses. During the week, students recorded the number of daily steps and types of physical activity in the self-control diary.

The first stage of the study was to measure the average weekly number of student's steps. In the next stage,

the possibility of using the sigma deviation method in the pedometry was considered. For this purpose, the normality of step locomotions' distribution was assessed according to the Kolmogorov-Smirnov criterion [30]. After confirming the normality of the sample distribution proceeded to the third stage - the calculation of sigma (standard deviation) by the formula:

$$\sigma = [(x_i - \bar{x})^2/n]^{-2}$$

where, x_i - is the i^{th} element of the sample, \bar{x} - is the arithmetic mean of the sample, and n - is the volume of sample.

The fourth stage was to develop an estimation scale of individual step locomotions: it was determined sigma deviation from the arithmetic mean value and the level of the student's pedometry.

The results of each student were divided into 5 sigma classes (gradations): the criterion is an individual indicator of the number of steps per day. If the value of the indicator corresponded to the gradation $M \pm 0.67\sigma$ - the level of pedometry was estimated as "average". In the gradation interval from $M \pm 0.67\sigma$ to $M \pm 1.34\sigma$, the level of pedometry was estimated as "above average" or "below average". If the value of the indicator was out the $M \pm 1.34\sigma$ gradation, then the student's pedometry level was estimated as "high" or "low".

The students' life quality was studied using a Russian-language version of the Short Form Health Survey (SF-36) [28]. The survey has: 36 questions (8 scales) and includes characteristics of physical (PH), mental (MH) and general (GH) health. The answers were estimated in points (0-100). The higher is the points, the higher is the respondent's estimation of life quality.

The performed work does not limit the rights and endanger the well-being of the students following the ethics standards of the Committee on Experiments of the 2008 Helsinki Declaration [31].

Statistical analysis. The programs «Microsoft Excel», «StatSoft Statistica 6.1» were used in the study. The sample volume (n), mean (M), minimum, maximum, standard deviation (σ), and standard error were estimated. The reliability of indicators' differences was determined by Student's parametric t-test. The Mann-Whitney U-criterion non-parametric method was used for comparing the results of two methods of parallel daily estimation the number of steps. The differences were considered significant at the level of $p < 0.05$ [30].

Results.

We created a scale of daily pedometry levels in the surveyed students using the sigma deviation method (Table).

The average daily number of step locomotions in males is 10.7% higher than in females (8434.8 ± 369.7 and 7534.7 ± 298.6 , respectively), $p < 0.05$. The range of daily steps for males was from 2825 to 26830, for females - from 2429 to 16725. Fig. 1 presents the distribution of the number of students surveyed by levels of daily pedometry.

Table. The estimation scale of the daily pedometry of senior students

Sigma class (gradation)	Pedometry level	Number of steps	
		Males	Females
M low – 1,34 σ	Low	<6248,2	<5640,1
M from – 0,67 to – 1,34 σ	Below average	7341,5 - 6248,2	6587,4 - 5640,1
M \pm 0,67 σ	average	7341,5 - 9528,1	6587,4 - 8482,0
M from + 0,67 to + 1,34 σ	Above average	9528,1 - 10621,4	8482,0 - 9429,3
M high +1,34 σ	High	>10621,4	>9429,3
M \pm m		8434,8 \pm 369,7	7534,7 \pm 298,6
σ		1631,8	1413,9

Note. M is the arithmetic mean of the daily number of steps; σ is the sigma (standard) deviation of the indicator

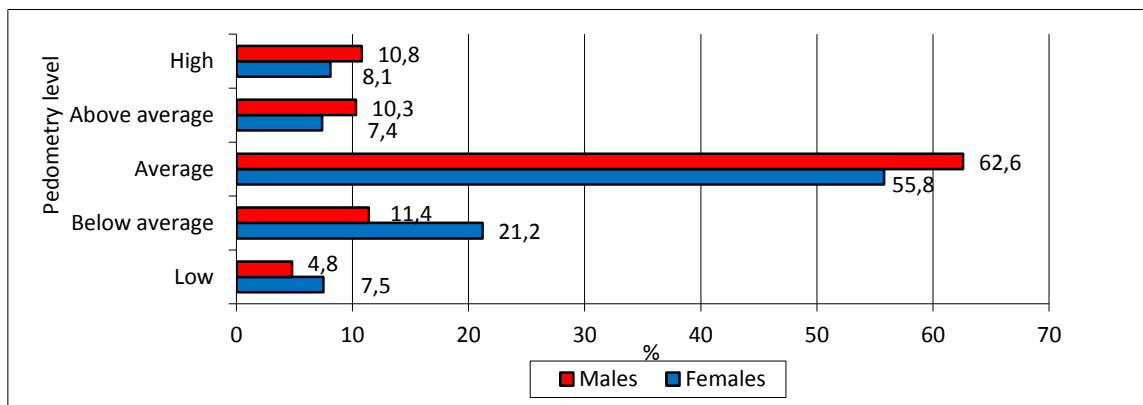


Figure 1. Number of senior students with different levels of daily pedometry (%)

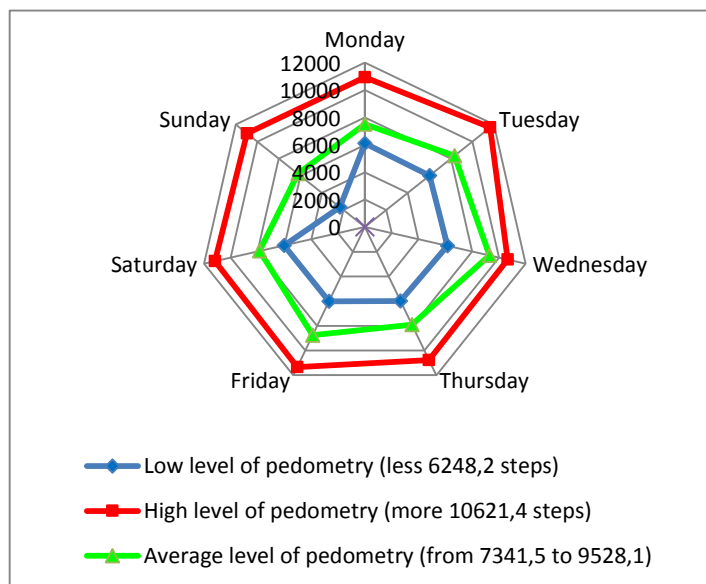


Figure 2. Distribution of the number of steps in males per day of the week

4.8% of males and 7.5% of females have a “low” level of pedometry (Fig. 1). Females with a “low” level are 56.2% more than males. It was registered 11.4% of males and 21.2% of females with a pedometry level “below average”. Moreover, the number of females with this level is 85.9% higher than males.

Most students have an “average” level of steps per day. And the females were 12.2% less than the males.

According to our study, 10% of males and about 8% of females have “above average” or “high” levels of pedometry. They are actively engaged in sports activities. The number of males exceeds the number of females.

Analysis of the students’ weekly pedometry determined that the most interesting characteristics of the indicators were determined on Sunday (Fig. 2).

The number of daily step locomotions in students with a “high” level of daily pedometry is approximately the same by day of the week (including Sunday) (Figs. 2, 3). These are mostly student-athletes.

Students with “low” levels of daily pedometry reduce the number of steps on Sunday days: in males by 61.6%, in females by 77.3%.

Students with an “average” level of pedometry the number of daily walking locomotives on Sunday days is reduced: by 24.7% in males and by 33.2% in females.

The characteristics of life quality (LQ) components of students with different levels of daily pedometry are presented in Figs. 4 (males), in fig. 5 (females).

Students with “high” and “above average” levels of daily pedometry have the highest level of physical activity, high points of mental and general health (Figs. 4, 5).

Males and females with “low” and “below average” levels of step locomotions have the lowest points of life quality components.

Discussion

At present time, the sigma deviation method of the studied indicator is used in scientific research: for the estimation of physical development of youth [23, 24]; in monitoring the ecological situation in the territories of the population [25]; in the prediction of the cardiovascular

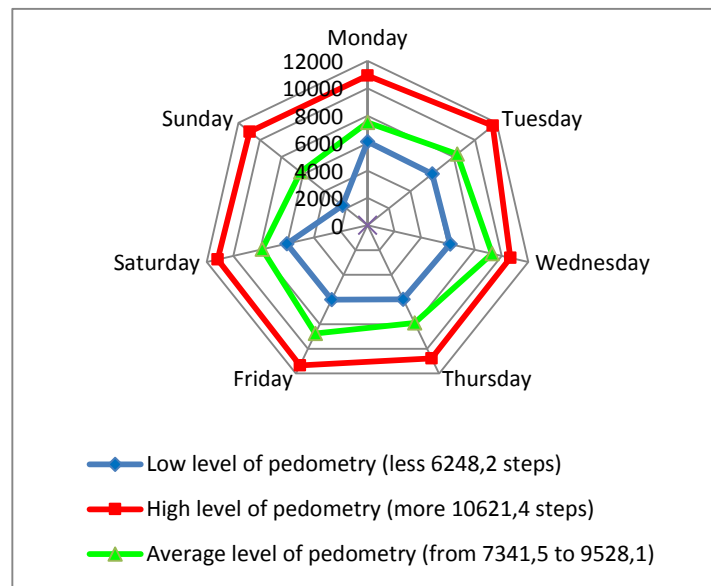


Figure 3. Distribution of the number of steps in females per day of the week

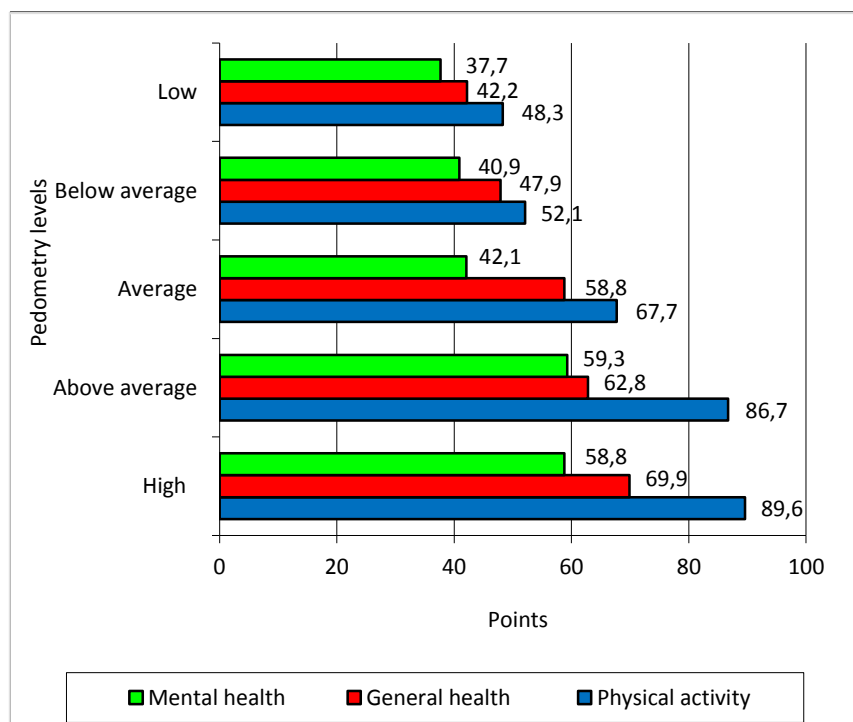


Figure 4. Life quality components of males with different levels of pedometry (in points)

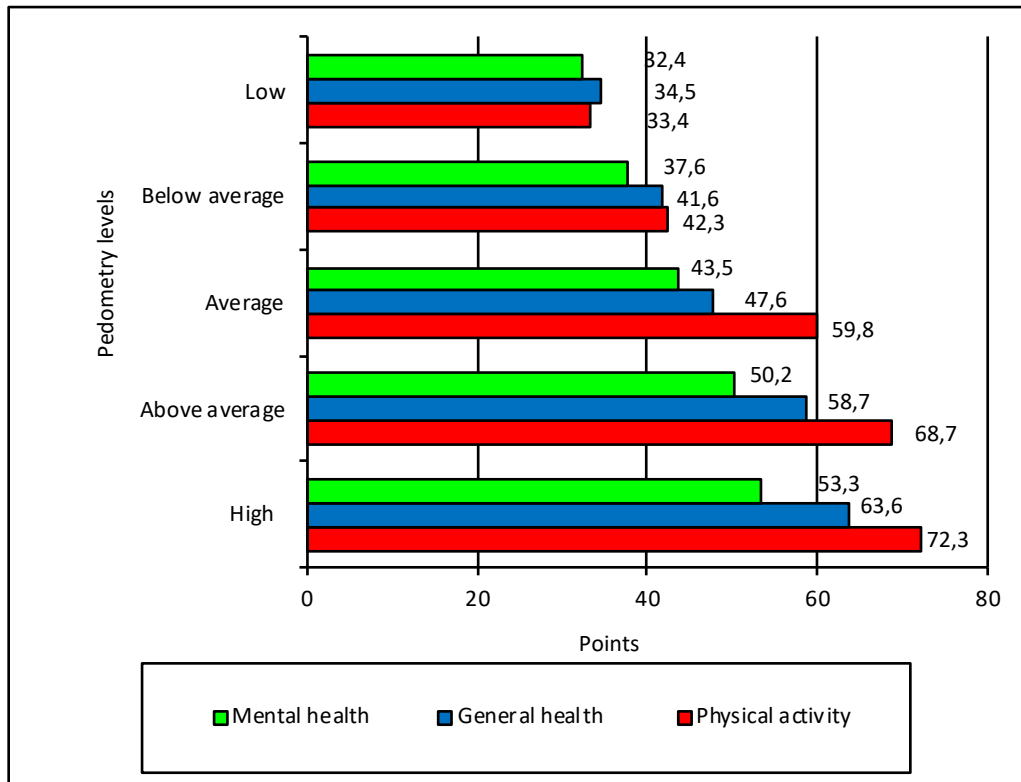


Figure 5. Life quality components of females with different levels of pedometry (in points)

pathology risk [26]. In our work, we used this method to design an estimation scale for determining the levels of students' daily pedometry.

More than half of the studied males and females have an "average" level of daily pedometry. They also have average values for life quality estimation. In addition to the step locomotions of educational and household activities, students visit fitness clubs; bicycling in summer; skiing in winter; sports and mass events at the university. Such motion activity was determined in students of St. Petersburg Humanitarian and Trade Union University [32].

Among students with "above average" and "high" levels of pedometry (high points in the life quality estimation), there are more males than females. This is compliant with the opinions of other authors about the high physical activity of the male population compared with the female population [33-35]. These males and females are constantly practicing sports. The research presents data on increasing students' interest in physical activity: at Altai University (Russia) [36, 37]; in the Republic of Belarus [38, 39]; in China [40, 41]; in Romania and Spain [42-44]; in Poland [45-46]. Confirmation is our data on the presence of high step locomotions in student-athletes.

Females with "low" and "below average" levels of daily pedometry are registered more than males. The study results of students with "low" and "below average" levels of step locomotions showed that their motor activity is limited only by locomotions in educational and household activities. The life quality of these students is estimated by low points. Other researchers have emphasized the low health condition of persons with hypodynamia in their

works [4, 6].

The analysis of daily step locomotions of students with a "high" level of pedometry showed that they have an approximately equal number of steps per day of the week (including Sunday). The authors from Belgorod [47] emphasized the importance of the high motor activity of students on Sundays (as an obligatory element of a healthy lifestyle).

It was determined that in studied students with a "low" level of pedometry, the number of steps decreased on Sunday days compared to the working days. According to the results of the survey, these students perform only household locomotions on Sundays. Our data is confirmed by the works of authors from the Tumen region (Russia). The authors emphasize that the motor activity of some students is less than 2% of their spare time on Sundays [48].

In the studied students with an "average" level of pedometry, the number of daily step locomotions decreased slightly on Sunday days. More than 55% of such students in their answers indicated a combination of study and work. Therefore, on Sundays, they have no spare time for physical exercises or sports. This is compliant with studies done by other authors devoted to the deficit of time in working students [49].

Physical activity (as a component of life quality) shows a person's potential ability to perform physical activity. In using nordic walking in the educational process (Institute of Physical Education of the Republic of Sakha, Yakutia, Russia) is determined the increase of physical and mental components of life quality and functional indicators of the students' body [50]. Therefore, the next stage of our study

was to study the correlation between daily pedometry and life quality (LQ) in students of a technical university.

According to our data, males, and females with “high” and “above average” levels of pedometry have the highest physical activity (89.6 and 69.9 points and 72.3 and 63.6 points, respectively). This is compliant with the results of a student survey in Nizhny Novgorod (Russia) [51]. The physical activity in students exceeds 95 points. The studied males and females with “high” and “above average” levels of pedometry have a high level of general health (69.9 and 62.8 points and 63.6 and 58.7 points, respectively) and mental health (58.8 and 59.3 points and 53.3 and 50.2 points respectively). This is compliant with the study of authors’ from Minsk (the Republic of Belarus) [52]. In our opinion, such students can be attributed to the group of the safe zone of disease risk.

The “low” level of daily step locomotions of students is considered as a predictor of insufficient physical activity, low general and mental health of the person. The author from Donetsk (Ukraine) [53] and other researchers [54, 55] reported the influence of the physical activity level on the health condition of the human body.

In our previous survey, we found that more than 20% of them consider themselves healthy and therefore do not have to worry about their health; 37.4% have lack of willpower to take care of their health; 33.9% do not have spare time for regular physical education or sports [56].

The analysis of the students’ survey answers showed that males and females with a “low” level of pedometry are indifferent to their condition and do not show concern for their health.

We confirmed that the indicators of physical activity, general and mental components of health in all females are lower than in males (Figs. 4, 5). This is compliant with the results of other authors [57-59]. The authors proved that the quality of the male population is higher in comparison with the female population.

The designed by us estimated daily pedometry scale (based on the sigma deviation method) excludes an incorrect average statistical approach to determining the volume of human step locomotions and the nature of the motor activity.

Conclusions

1. The use of the sigma deviation method allows distributing any studied population of people by the number of daily step locomotions into five sigma classes (by the level of step locomotions - “low”, “below average”, “average”, “above average”, “high”). It also allows for developing recommendations for improving the life quality of different population groups.

2. Teachers of the Physical Education Department should advise students to rationally organize the day regime with time for sports; increase the walking time. This will allow students to increase motor activity, life quality, and health.

We believe that the results of our study can be considered in the recommendations for students’ adaption to the learning process and improving their life quality.

Conflict of interest

The authors declare no conflict of interest.

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