Wellness and health – heart rate, active commuting and leisure time physical activity in foreign students from the Faculty of Medicine in Wrocław

Dobrostan i zdrowie – aktywność komunikacyjna oraz prozdrowotna aktywność fizyczna u studentów obcokrajowców na Wydziale Lekarskim we Wrocławiu

Key words: students awareness, LTPA, young adults, risk factors, CAD

The circulatory system is subject to dynamic changes during physical activity. A single physical exercise causes immediate reactions of the respiratory and cardiovascular systems [1]. An increase in heart rate is the easiest to monitor parameter of the circulatory system in response to physical exercise, and results from the changing activity of both parts of the autonomic nervous system. Shortly after the physical exercise is commenced, the activity of the vagus nerve is inhibited, causing a gradual increase in the heart rate [1,2]. After several seconds, the sympathetic nervous system and B1 adrenergic receptors become activated, producing an additional chronotropic effect. Long-term repetitive physical activity leads to immediate beneficial cardiac and vasoprotective changes. Adaptive processes in the circulatory
system persist not only during physical activity, but also during rest, in the intervals between training sessions. However, it is believed that the intervals between individual training sessions should be no longer than 72 h [3]. Significant changes in the activity of the autonomic nervous system occur in subjects taking regular physical exercise. Physical activity decreases sympathetic tone [4] and increases parasympathetic tone [5]. An 8-10-week endurance training course results in resting bradycardia usually between 50 and 60 beats/min [2]. This is a very beneficial physiological effect. In well-trained people physical exercise results in a smaller increase in the heart rate [1]. Thus, this effect contributes to greater endurance in a trained person. On the other hand, physical activity does not increase the maximum possible heart rate [6], because it is age-related and does not change depending on the exercise. Interestingly, changes in the resting heart rate in trained people are associated with a statistically significant decrease in blood pressure, usually by about 5 to 10 mmHg [1]. People taking regular exercise have lower blood pressure both at rest and during exercise. Another very important effect associated with regular physical activity is the reduced consumption of oxygen by the heart. This physiological effect is very useful during cardiac rehabilitation and has relevance in healthy young people in prolonging the "youth" of their hearts. It is also important that regular physical activity dilates coronary arteries, lowers vascular resistance, and stimulates angiogenesis in the body parts involved during exercise. Thus, physical activity also stimulates the formation of new blood vessels within the coronary circulation system [6]. The presented references confirm the crucial health-promoting role of physical activity. Lack of physical exercise has been an internationally recognized risk factor for cardiovascular diseases, as demonstrated in several multicentre randomized clinical trials. For example, investigators from the INTERHEART study group evaluated risk factors for cardiovascular diseases in 52 countries. They introduced the term "population attributable risks", and demonstrated that abnormal lipids, smoking, hypertension, diabetes, abdominal obesity, psychosocial factors, low consumption of fruits, vegetables, high consumption of alcohol, and lack of regular physical activity account for most of the risk of myocardial infarction worldwide in both sexes and at all ages in all regions [7]. Unfortunately, the development of civilisation results in the reduction of daily physical activity across the world. Lack of physical activity strongly affects adolescents [8]. In the case of future physicians this problem is not only directly reflected in their health. The lack of physical activity additionally gives a specific "example" for patients who are also inactive. The Medical University in Wrocław has launched a multi-annual programme to evaluate students' knowledge about modifiable risk factors for cardiovascular disease, along with the analysis of health-enhancing physical activity. The first preliminary findings obtained from students of the Faculty of Medicine were published in 2012 [10,11] and 2013 [12,13]. The findings indicated the surprisingly poor knowledge of Polish students, and difficulties in the implementation of health-related recommendations. The aim of this article is to determine the level of active commuting among medical students and to evaluate its correlation with heart rate at rest and during exercise, and with overall health-enhancing physical activity. Active commuting, despite being a non-
leisure form of physical activity, is considered to be a factor improving human health [14]. Walking or riding a bicycle to reach work or school has been recognized as one of the factors reducing cardiovascular outcomes [15].

MATERIALS

The study was conducted on a group of 81 first-year students of the Faculty of Medicine, English Division, Medical University of Wroclaw (mean age 20.46 ± 1.54 years) in 2012-2013. The study group consisted of 37 women (mean age 20.24 ± 1.77 years) and 42 men (mean age 20.69 ± 1.84 years). The age difference between the sexes was not statistically significant. Students came from many countries. Detailed data are presented in Table I. All students had a very good command of English.

Table I. Study participants by country of birth. F - females, M - males

<table>
<thead>
<tr>
<th>Birth country</th>
<th>All</th>
<th>F</th>
<th>M</th>
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</thead>
<tbody>
<tr>
<td>AFGHANISTAN</td>
<td>4</td>
<td>2</td>
<td>2</td>
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<tr>
<td>SAUDI ARABIA</td>
<td>11</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>CANADA</td>
<td>7</td>
<td>4</td>
<td>3</td>
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<tr>
<td>INDIA</td>
<td>1</td>
<td>1</td>
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<tr>
<td>IRAQ</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<tr>
<td>IRAN</td>
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<tr>
<td>KUWAIT</td>
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<tr>
<td>GERMANY</td>
<td>10</td>
<td>6</td>
<td>4</td>
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<tr>
<td>NORWAY</td>
<td>2</td>
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<td>0</td>
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<tr>
<td>POLAND</td>
<td>3</td>
<td>3</td>
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<tr>
<td>RUSSIA</td>
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<tr>
<td>SOUTH AFRICA</td>
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<td>1</td>
<td>0</td>
</tr>
<tr>
<td>SWEDEN</td>
<td>28</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>TURKEY</td>
<td>1</td>
<td>1</td>
<td></td>
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<tr>
<td>US</td>
<td>6</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>UNITED ARAB EMIRATES</td>
<td>2</td>
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</table>

For data structuring, countries of birth were organized into 5 groups: Europe, Poland, Middle East, America and other (Figure 1).
Because study participants have an international origin, we additionally specified the country in which they obtained their secondary school leaving certificate. Data are presented in Figure 2.

Figure 1. Geographic distribution of birth places for study participants

Figure 2. Geographic distribution of countries in which study participants obtained their secondary school leaving certificate. UAE – United Arab Emirates
Methods

The questionnaire used in the study consisted of two parts. Part one, designed by the authors, included 27 questions in 3 specific sets. The first set of questions concerned basic information on the education, origin and past life of study participants. The second set of questions concerned the knowledge of students on the risk factors for cardiovascular diseases (CVD). In this part students had to define 5 major, in their opinion, risk factors for CVD. The third part of the survey was focused on how students implement basic recommendations on a healthy lifestyle. In the first part of the survey students also had to complete a task which in a simple way preliminarily assessed their physical fitness. The task consisted in assessing their own heart rate before and after 10 sit-ups. The heart rate was measured on the common carotid artery and on the carotid trigone. Study participants were instructed on how to properly measure heart rate at those locations. In part two of the study survey we used a physical activity questionnaire based on the Framingham questionnaire. We analysed one-week estimated intensity of leisure time physical activity (LTPA), which is defined as planned, deliberate and regular health-enhancing physical activity and active commuting on foot or by bicycle, provided that each time it lasted for a time longer than 15 minutes. Respondents were divided into 3 groups of physical activity: <1000, 1000-1999, and ≥ 2000 kcal/week. According to the recommended standard, minimum and optimum level of leisure time physical activity was adopted at ≥ 1000 and ≥ 2000 kcal/week, respectively. The study protocol was approved by the local bioethics committee. Results were analysed using a statistical software package. Results were statistically significant at p<0.05. After at least 6 weeks the same survey was repeated in 50% of students, and the results were compared to those from the first and second surveys. The differences were not statistically significant (p = 0.0894).

Results

In the group of respondents the mean resting heart rate was 77.81 (SD = 10.60) beats/min (79.05 beats/min in women (SD = 9.62) and 77.07 beats/min (SD = 11.29) in men). The value of the resting heart rate was not correlated with the declared self-estimated physical fitness.

The mean post-exercise heart rate, measured after 10 full sit-ups was 113.34 (SD = 17.74) beats/min. The post-exercise heart rate was 113.02 (SD = 20.43) in women and 113.63 (SD = 15.60) in men. The value of the post-exercise heart rate was correlated with the declared self-estimated physical fitness. Pearson’s coefficient of correlation for the whole group of respondents was 0.304269. The full correlation data are presented in figure 3.
On the day before the survey 64 students (79.01%) from the study group met the criteria for active commuting, i.e. they walked or rode a bicycle for at least 15 minutes to get to the university. Of those, 51 students walked and 13 used a bicycle to get to their school. Other students either used a passenger car or public transport to get to the university. In the entire group of respondents students used 143.52 kcal (SD 167.72) for active commuting. Energy expenditure was higher in women (159.26 kcal, SD 212.54) than in men (129.62 kcal, SD 115.61). The differences between sexes were statistically significant. The active commuting declared by students was not correlated with the declared self-estimated physical fitness in either sex. Neither was it correlated with resting or post-exercise heart rate. Furthermore, no correlation was found between the level of active commuting and LTPA values (p=0.48).

In the study group, respondents expended 1,035 kcal/week (SD 2086.34) for the overall leisure time physical activity (LTPA), which was slightly more than the standard established for the minimum level of health-enhancing physical activity. In women the mean LTPA was 521.64 +/- 684 kcal/week, which was below the recommended levels. For men the mean LTPA value was 1477 +/- 2731 kcal/week. A
detailed analysis of these findings was presented in our previous paper [12,13]. Detailed statistical analysis carried out in 2013 revealed a correlation between the resting heart rate and LTPA level in men ($r=-0.395838$). Such a correlation was not demonstrated for women.

Due to the nature of the study group (medical students potentially spending a lot of time on passive self-study at home) we decided to further evaluate whether there were any relationships between the study time and physical activity, or other risk factors. Detailed statistical analysis revealed a correlation between study time and active commuting in men ($R_{Spearman}=0.348454$). This correlation was not found in women.

Interestingly, statistical analysis of basic data collected during the project also revealed one more very surprising fact (Figure 4). It was shown that students addicted to nicotine spent more time at home studying than their peers who were free of this addiction.

![Figure 4](image)

Figure 4. A graph of coincidence between smoking and mean self-study time at home. Legend: respondent niepalący = non-smoking respondent; respondent palący = smoking respondent

Most importantly, no relationship between the declared self-study time and learning outcomes was found when we analyzed the results of one examination on normal human anatomy. Therefore, smoking students spend more time studying, but it did not result in their improved performance when taking a test on anatomy.
OVERVIEW OF OUR OWN RESEARCH RESULTS

The analysis of the surveyed group of student demonstrated a relatively high resting heart rate and a very high post-exercise heart rate. A higher mean resting heart rate was also reported in the study by Abu Hanifah et al. [16]. In the group of boys the mean resting heart rate was about 90 beats/min, while in the group of girls it was surprisingly lower, by about 5 beats/min. However, Abu Hanifah studied children of mean age 13.5 years. On the other hand, in a study carried out in adults, Cole et al. [17] found a mean heart rate of 76 beats/min in the population of 55-year-old patients screened for ischaemic heart disease. In another study by Cole et al. [18] the mean resting heart rate in healthy 40-year-old subjects was about 79-84 beats/min. Thus, the resting heart rate in students of medicine is close to that found in healthy 40-year-old volunteers. Another study carried out by Sloan [19] on a group of 30-year-old volunteers demonstrated that before the commencement of a series of exercises the mean resting heart rate was about 69.5 beats/min in women, and 72.5 beats/min in men. The resting heart rates reported in our study are therefore surprisingly high and, in our opinion, reflect the very low physical fitness of the respondents. By comparing the available literature data we can conclude that the hearts of the medical students have the same performance as the hearts of healthy volunteers aged about 40 years.

The comparison between post-exercise heart rates is very difficult due to the different methodologies used in studies. However, the rapid increase in the heart rate demonstrated in our study is typical of subjects who are not used to physical activity [1]. Nevertheless, the fact that as many as 79% of the surveyed students do active commuting is an optimistic finding. Landsberg et al. [20] reported that active commuters accounted only for 62.6% of the studied population (14-15-year-old children). In addition, Landsberg et al. pointed out the fact that children reaching school on foot or by bike usually live much closer to the school than the respondents who are not active commuters. This information is in line with findings from the studies carried out among students in Wroclaw [10,11,12,13].

The intensity of physical activity associated with active commuting is important in the prevention of cardiovascular diseases [21,22,23,24]. Manson et al. [21] demonstrated in their study that a weekly energetic expenditure greater than 6 METs (Metabolic Equivalent of Task – MET) significantly reduced the risk of cardiovascular events. In our study, the surveyed students spent on average only 143 kcal on active commuting, which means energy expenditure of about 2 METs per week. This value is not high enough to significantly reduce the overall risk of CVD. However, Manson et al. [21] demonstrated that even vigorous physical activity at the level of 3.2 METS/week reduces the risk of cardiovascular events by ten or so per cent. Most of the surveyed students presented such total physical activity. However, this mainly results from the educational curriculum at the Medical University, which until 2012 required participation in 60 h of physical education classes per year in order to pass the first year of studies. Unfortunately, when the effects of physical education classes are not taken into account, physical activity among medical stu-
dents is very low, even in the group who come to school on foot or use a bike to move around the city.

CONCLUSIONS
1. The resting heart rate among the surveyed students was high (mean 78 beats/min).
2. Post-exercise heart rate among the surveyed students was very high (mean 113 beats/min).
3. Active commuting, defined as the distance from home to the university and back, on foot or by bicycle, provided that each time it lasted for longer than 15 minutes, is at a very low level and accounts for an average energy expenditure of 134 kcal per week.
4. The overall leisure time physical activity (LTPA) met the minimum standards established by the Polish Cardiac Society (PTK) only in the group of male students.
5. A statistically significant correlation was found between the LTPA level and resting heart rate in men.

LIMITATIONS
The study was limited by the following factors:
1. The small group of students included for analysis.
2. The survey was carried out only among the students of one faculty.
3. Real-time analysis was not carried out – data collected from the survey was biased with a higher risk of error.

REFERENCES


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ABSTRACT

Resting and post-exercise heart rates and physical activity are parameters defining the physical fitness of people. The aim of the study was to assess these parameters in a group of students of the Faculty of Medicine, English Division, in Wroclaw. 81 students were included in the study. All participants completed a specially designed questionnaire. The study demonstrated a relatively high resting heart rate, significantly increasing after a simple physical exercise, and a low level of declared active commuting. The overall level of declared leisure time physical activity, only in men, was slightly above the minimum level recommended for the Polish population. All these data support the hypothesis on the low physical fitness of medical student in the early 21st century. Further studies are necessary to identify causative factors and methods to combat this problem.

STRESZCZENIE


Artykuł zawiera 24682 znaki ze spacjami + grafika