

CHANGES IN LEISURE-TIME PHYSICAL ACTIVITY LEVELS AND PERCEIVED BARRIERS AMONG ESTONIAN ADULTS OVER A TWO-YEAR PERIOD

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ABSTRACT

The aim of this study is to describe the changes in leisure-time physical activity (LTPA) levels among the Estonian adult population in the years 2013–2015 in order to examine the relationships between LTPA level and socioeconomic status (SES) and health indicators, and also to explore perceived barriers to LTPA. Data from the National Physical Activity Survey were used. The sample consisted of 1009 participants aged 15–69 in 2013 and 1004 respondents in 2015. The proportion of Estonian adults exercising regularly at least four times per week increased from 39% in 2013 to 45% in 2015. Being in the older age groups increased the odds for physical inactivity 2.07–4.74 times compared to the youngest age group (15–24) ($p < 0.01$). Having primary, basic, or secondary education increased the odds of being inactive 2.33–3.14 times compared to respondents with higher education ($p < 0.01$). The most prevalent barriers to physical activity reported by inactive adults were: 1) the absence of interest or unwillingness to make an effort, 2) tiredness at work, and 3) lack of time. In conclusion, despite a slight positive trend, LTPA levels are low. As the perceived barriers depend on age, public health strategies should involve age-specific solutions, especially for older adults.

Keywords: *leisure-time physical activity, national survey, sociodemographic groups, barriers, Estonia*

INTRODUCTION

Unhealthy environments and behaviours are the result of the three global trends: globalization, population-ageing, and rapid unplanned urbanization [59]. Physical activity, including sports, is considered to be an important component of a healthy lifestyle [4]. Adults who are physically more active are less likely to develop many chronic diseases compared to adults who are physically less active [33]. In addition, regular exercise and physical activity help to maintain and improve mental and physical health in various adult age groups [14, 35, 37, 42, 59].

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure [9]. Physical inactivity has been proven to be the fourth highest risk factor for global mortality, causing an estimated 3.2 million deaths globally [58]. Physical inactivity is one of the main health challenges in developed countries and can be described as a worldwide epidemic [11]. According to the recommendations [59], adults aged 18–64 should do at least 150 min of moderate-intensity aerobic physical activity per week or at least 75 min of vigorous-intensity aerobic physical activity per week. These two can also be combined. Aerobic activity should be performed at intervals of at least 10 min [59]. In order to improve physical condition, avoid weight gain, and reduce the risk of chronic diseases, at least the minimum recommended level of physical activity should be achieved [10].

According to a Eurobarometer survey conducted in 28 EU Member States, 59% of respondents aged 15 and older practice some form of exercise less than once a week or do not exercise at all [19]. People in the Nordic countries are the most physically active whereas people in Southern Europe are the least physically active. The proportion of adults exercising or playing sports at least once per week is 70% in Sweden, 68% in Denmark, and 66% in Finland. However, the greatest proportion of people who responded that they never exercise or play sports can be found in Bulgaria (78%), Malta (75%), and Portugal (64%). Among the Baltic States, the proportion of adults who never exercise or play sport was 36% in Estonia, 39% in Latvia, and 46% in Lithuania [19]. Surveys conducted in Estonia in 2013 and 2014 showed that the proportion of people who engage in leisure-time physical activity at least two times per week for a minimum 30 minutes ranges between 35.8% and 38.3% [32, 50].

Previous studies have shown a strong correlation between the implementation of recommendations for physical activity and body mass index (physical inactivity is one of the risk factors regarding metabolic health) [46, 49]. In Estonia more than half of the adult population is classified as overweight

(body mass index above 25.0 kg/m²) and an increase in this proportion has been particularly noticeable during the last decade. According to studies, in 2004 excessive weight was identified in 45.7% of the male and 42.8% of the female population [17], whereas in 2016 it was 59.9% and 51.7%, respectively [51]. It has been advised that public recommendations being developed for combating excessive weight and obesity should focus on both promoting physical activity and decreasing the desire to participate in sedentary activities [47]. Moreover, the physical activity of the population should regularly be monitored, and it is important to pay attention to the differences between subgroups in order to plan and implement strategies promoting physical activity in the population overall.

Physical activity is a physical and dynamic process. Previous research has established that correlates of physical activity could be classified as either: (a) demographic and biological factors, (b) psychological, cognitive, and emotional factors, (c) behavioural attributes and skills, (d) social and cultural factors, (e) physical environment factors, and (f) physical activity characteristics [52]. Previous studies have shown that differences with regard to gender, age, and level of education have been detected [31, 45]. Participation in physical activity is higher among men than women [22, 29, 52] and physical activity decreases with age [23, 54]. People with a higher level of education are more likely to participate in leisure-time physical activity than those with a lower level of education [52]. However, there are studies offering contradictory findings concerning age groups and gender. For example, Scheerder et al. [44] found the smallest gender differences in physical activity in Flanders, France, the Netherlands, and Switzerland (remaining under 3%), whereas Denmark stood out from other European countries with its proportion of physically active women being higher than men. The study carried out in England showed that both men and women in the age group of 50–64 reported their physical activity as more active than the respondents aged 19–24 years, which is different from other countries in Europe [40].

In order to develop physical activity policies and intervention programs, it is important to identify factors that can influence the physical behaviour of adults. One approach is the identification of psychological factors such as knowledge, attitudes, and perceived motivators and barriers in terms of physical activity in different population groups in order to promote effective behaviour change programs [56, 39]. Perceived barriers to physical activity behaviours are an important construct in major health behaviour theories and models, including social cognitive theory [3], the theory of planned behaviour [1], the transtheoretical model [38], and the health belief model [25].

According to the Eurobarometer survey, the main reason for not engaging in sports or physical activity in EU Member States is a shortage of time (42%) [19]. Other factors included the lack of motivation or interest (20%), having a disability or illness (13%), or that it is too expensive (10%) [19]. These findings are supported by several national studies comprising the whole population of one country and examining the perceived barriers to physical activity. In Australia, physically inactive adults reported lack of time (50%), lack of enjoyment (43.9%), and preferring to do other things (42.9%) as the main obstacles to being physically active [24]. Finnish adults also outlined lack of time (55.6% in men; 57.5% in women) as the main barrier, followed by a lack of motivation (25.6% in men; 21.6% in women), lack of company to be active with (15.9% in men; 18.8% in women), and high expenses (9.4% in men; 9.6% in women) [7]. A previously conducted study among Estonian adults outlined insufficient interest or will (44%), lack of time (40%), tiredness after work (36%), and the excessive cost of sports (14%) as the main perceived barriers [41]. However, the earliest studies in Estonia did not reveal the perception of perceived barriers of being physically active by different population groups. Therefore, the novelty of the current study is that it is the first to identify the perceived barriers of leisure-time physical activity according to sex, education, and age.

The aims of this study are to:

1. Describe the changes in LTPA levels among Estonian adult population during a two-year period.
2. Examine the relationships between LTPA level and SES and health indicators.
3. Explore the perceived barriers to physical activity according to different age, gender and educational groups.

The study results add important knowledge and help to plan interventions for increasing the physical activity of the population, which is stated in the document *The Fundamentals of the Estonian sports policy until 2030* [18].

MATERIALS AND METHODS

Subjects

The target groups of the studies consisted of participants aged 15–69 whose permanent place of residence was in Estonia. The sample of the study was put together based on the population data of the year of conducting the study on 1 January (according to Statistics Estonia) with 1,000 persons deemed an appropriate size for a representative sample. 1009 participants took part in the survey of 2013 and 1004 respondents in the survey of 2015.

Procedures

Cross-sectional Estonian population-based data were collected in two waves. The first study was conducted in the periods of 28/08–4/09 and 11–18/09/2013 and was commissioned by the Estonian Olympic Committee. The second study was conducted in 14/09–4/10/2015 and was commissioned by the Estonian Ministry of Culture. Both studies were conducted by the market research company TNS EMOR. To find respondents, a proportional model of the general population was used in which all residents had an equal chance of being included in the sample. The socio-demographic structure of the sample, which formed in the course of surveying, was compared to the respective indicators of the general population by gender, age, nationality, and place of residence, and, in order to ensure representativeness, the sample was weighted to achieve compatibility with the distribution of the general population. Tablet-Assisted Personal Interviews (TAPI) were conducted by the data collectors of TNS EMOR at the respondents' homes after they had agreed to participate.

Table 1 summarises the socio-demographic characteristics of respondents by gender in both survey waves, 2013 and 2015. On the whole, the sample compositions were similar in 2013 and 2015 surveys. However, based on Pearson's chi-squared test, in 2013 there were statistically significant gender differences regarding education ($p=0.000$) and body mass index ($p=0.034$) and in 2015 regarding age ($p=0.002$) and education ($p=0.000$). Between surveys, when comparing 2013 and 2015 samples, statistical differences were evident in the case of age ($p=0.000$) and gender ($p=0.000$).

Table 1. Socio-demographic characteristics of the respondents by gender in 2013 and 2015.

	2013				2015			
	Men		Women		Men		Women	
	%	(n)	%	(n)	%	(n)	%	(n)
Age ^{***, §}								
15–24	16.9	(81)	14.3	(76)	18.5	(78)	14.1	(82)
25–34	20.0	(96)	17.4	(92)	22.3	(94)	17.5	(102)
35–49	28.0	(134)	25.7	(136)	30.8	(130)	27.7	(161)
50–64	25.1	(120)	27.7	(147)	21.6	(91)	29.9	(174)
65–74	10.0	(48)	14.9	(79)	6.9	(29)	10.8	(63)

	2013				2015			
	Men		Women		Men		Women	
	%	(n)	%	(n)	%	(n)	%	(n)
Ethnicity								
Estonian	70.4	(338)	67.2	(356)	73.0	(308)	72.3	(421)
Other	29.6	(142)	32.8	(174)	27.0	(114)	27.7	(161)
Education ^{#,§}								
Primary or basic	20.4	(98)	13.0	(69)	23.5	(99)	15.5	(90)
Secondary	59.2	(284)	58.3	(309)	56.6	(239)	55.2	(321)
Higher	20.4	(98)	28.7	(152)	19.9	(84)	29.4	(171)
Body mass index [#]								
Underweight or normal weight	46.1	(221)	52.8	(280)	52.1	(220)	48.8	(284)
Overweight or Obese	53.9	(258)	47.2	(250)	47.9	(202)	51.2	(298)
Satisfaction with health								
Completely or mostly satisfied	75.9	(363)	74.8	(395)	79.6	(335)	78.7	(458)
Mostly not or completely not satisfied	24.1	(115)	25.2	(133)	20.4	(86)	21.3	(124)

n=number of respondents;

gender difference between surveys: ***significant at level $p<0.01$; **significant at level $p<0.05$; *significant at level $p<0.10$; gender differences within a survey: [#] in 2013, [§] in 2015.

Measurements

Physical activity level. To collect data about physical activity, a questionnaire developed by the sports sociology laboratory of the University of Tallinn in 2003 was used. The same questionnaire was also used in previous nationwide surveys in Estonia conducted in 2003, 2004, and 2006 [2, 16, 41].

LTPA was defined as regularly doing physical exercises for at least 30 min per day. The respondents were asked: "How often do you practice active hobbies, such as running, cycling, aerobics, ball games, working out in a gym, or other such activities at least 30 min at a time?" The answers to choose from included: a) at least four times per week; b) 2–3 times per week; c) on average, once per week; d) a few times per month; e) less frequently; f) not at all. For the analysis a) to d) were coded as physically active and e) to f) as inactive.

Health indicators. The following question was asked to assess the health condition of the respondents: “How satisfied are you with your health in general?” The respondents were required to choose one of the following answers: a) completely; b) mostly; c) mostly not; d) not at all; e) I am not sure. For the analysis, answers were recoded as follows: a) and b) as satisfied; c) and d) not satisfied; those who were unsure were excluded from the analysis (two respondents in 2013 and one respondent in 2015).

The participants were asked to report their body height and weight in order to calculate their body mass index (BMI, kg/m²).

Perceived barriers. The respondents who said that they practiced in LTPA on average once per week or less were asked by the interviewer to explain which factors prevented them from practicing physical hobbies: “I will read out various reasons which may prevent people from regularly practicing physical hobbies. Please state to what extent each reason applies to you.” a) lack of time; b) lack of a place to play sports (hall, court, etc.); c) poor physical condition; d) I am not sufficiently interested or cannot be bothered; e) playing sports is too expensive; e) I do not have the company or people to train with; g) no means of transport for travelling for the location of playing sports; h) insufficient skills to play sports; i) tiredness after work; j) other. The respondents were asked to respond to the statements by using a three-level scale: a) this, above all; b) this, too; c) not this reason. In the analysis, the first two categories (a and b) were coded together.

Statistical analysis

Statistical analyses were carried out with Statistical Package for the Social Sciences – SPSS, V22.0 (Chicago, IL, USA). The main descriptions of physical activity level and perceived barriers to exercise in 2013 and 2015 were presented in cross-tabulations. In addition, a chi-square (χ^2) statistics was used to investigate whether distributions of categorical variables differ from one another. However, in cases of statistically significant difference, chi-square does not indicate between which categories the difference lies exactly. The interrelation between physical activity (dependent variable) and socio-demographic characteristics, health-related variables, and barriers to exercise were studied in binary logistic regression models. The regression results were presented as odds ratios, which indicate the odds of the observed group (physically inactive) relative to the odds of the reference group (active) in their level of physical activity. In the dependent variable, those who are *not physically active* were defined as respondents who exercise less than a couple of times per month or not at all; and *physically active* are respondents who exercise from a couple of times per month up to four times per week. The

odds ratio of 1 shows that the odds for being physically active are equal, while the odds above 1 indicate by how many times the odds of the observed group are higher than the odds of the reference group, and *vice versa* if the odds ratio is below 1.

RESULTS

When comparing physical activity in two survey waves (2013 and 2015), it appeared that in Estonia the proportion of physically active adults has statistically significantly increased ($\chi^2=10.12$, $df(3)$, $p=0.020$) – in 2013 39% of them exercised two to three times per week or more, while in 2015 this proportion had increased to 45% (Figure 1). At the same time, the proportion of adults who were active once per week or a couple of times per month and less often or not at all active decreased by three percentage points in both groups.

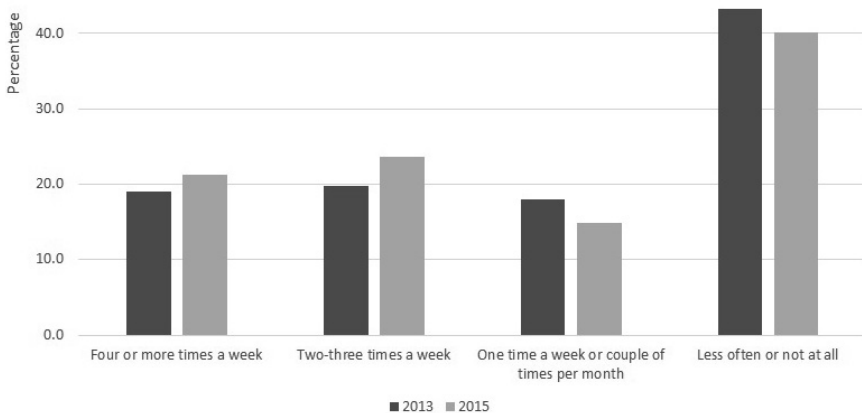


Figure 1. Leisure-time physical activity of Estonian adults in 2013 and 2015 (%; n = 2013).

Socio-demographic and health-related characteristics juxtaposed with the likelihood of being physically inactive are presented in Table 2. One of the strongest determinants in both years was age. The analysis showed that being in the older age group increased the odds for physical inactivity compared to the youngest age group (15–24 years) ($p=0.001$) (Table 2). Although the odds ratios for age groups were somewhat lower in 2015 than 2013, still in 2015 the 25–34-year-olds had two times greater odds of being physically inactive compared to the youngest age group, and among those older than 50, it was more than four times greater.

Education is another significant predictor of physical inactivity – having primary or basic education increased the odds of being inactive more than two times and having secondary education more than three times compared to respondents with higher education ($p=0.000$). As for ethnicity, there was no statistically significant difference in physical activity in 2015 ($p=0.752$). Satisfaction with health had a statistically significant effect on the odds of being physically inactive ($p=0.000$) – in 2015 those who were not satisfied with their health had 2.5 times higher odds of being physically inactive.

Gender and body mass index showed no correlation with one's physical activity.

Table 2. The odds of being physically inactive during leisure-time physical activity among adult population in 2013 and 2015.

Predictor	2013		2015	
	OR	95% CI	OR	95% CI
Gender (ref Female)				
Male	1.22	0.92–1.61	1.10	0.83–1.56
Age (ref 15–24)				
25–34	2.49***	1.45–4.26	2.07***	1.22–3.54
35–49	3.07***	1.86–5.10	3.51***	2.10–5.85
50–64	5.57***	3.32–9.33	4.14***	2.45–7.02
65–74	7.53***	4.17–13.60	4.74***	2.51–8.93
Education (ref Higher)				
Primary or basic	2.48***	1.75–3.50	2.33***	1.65–3.30
Secondary	3.84***	2.35–6.28	3.14***	1.95–5.07
Ethnicity (ref Estonian)				
Other	1.81***	1.34–2.43	1.05	0.77–1.43
Satisfaction with health (ref Satisfied)				
Not satisfied	1.52**	1.09–2.12	2.51***	1.78–3.53
Body mass index group (ref Underweight or normal)				
Overweight or obese	1.11	0.83–1.48	1.25	0.94–1.66
Constant	0.07***		0.08***	
Pseudo R-Square, Nagelkerke	0.21		0.18	
N	1,005		1,003	

***significant at level $p<0.01$; **significant at level $p<0.05$.

Figure 2 shows barriers to exercising as perceived by those who are physically inactive. In 2015, almost all barriers were less frequently mentioned than in 2013, with the exception of feeling tired after work (respectively 55% and 48%; $p=0.003$). The most frequently reported barrier for not being physically active was the absence of interest and unwillingness to make an effort (in both years more than 55%). This was followed by tiredness after work and lack of time.

Between the two survey years, a significant decrease was present in three barriers: 1) sports being too expensive ($p=0.009$), 2) lack of sports venues ($p=0.007$) and 3) lack of transportation to reach training locations ($p=0.000$). A decreasing trend ($p<0.1$) was also present for poor health ($p=0.084$) and not enough sporting skills ($p=0.072$).

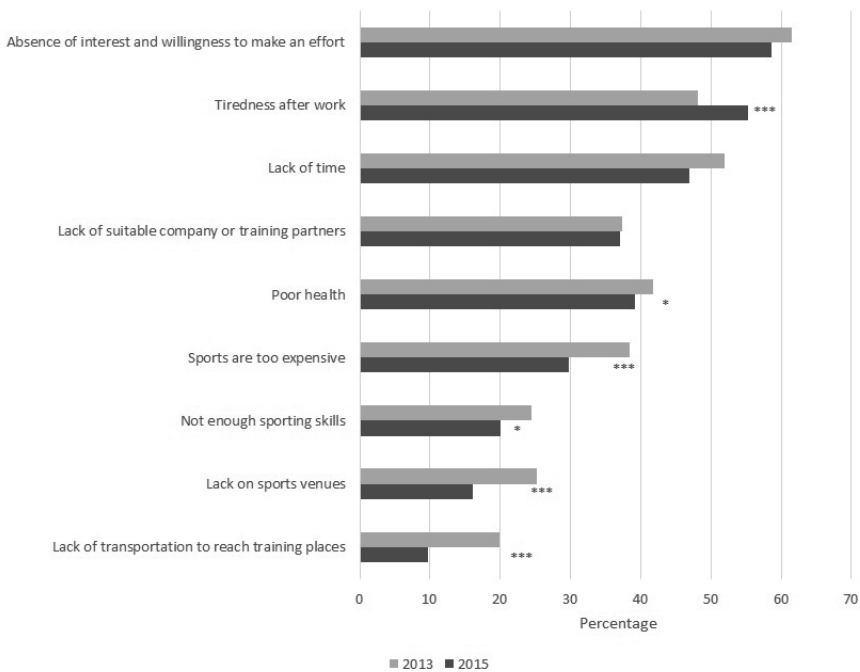


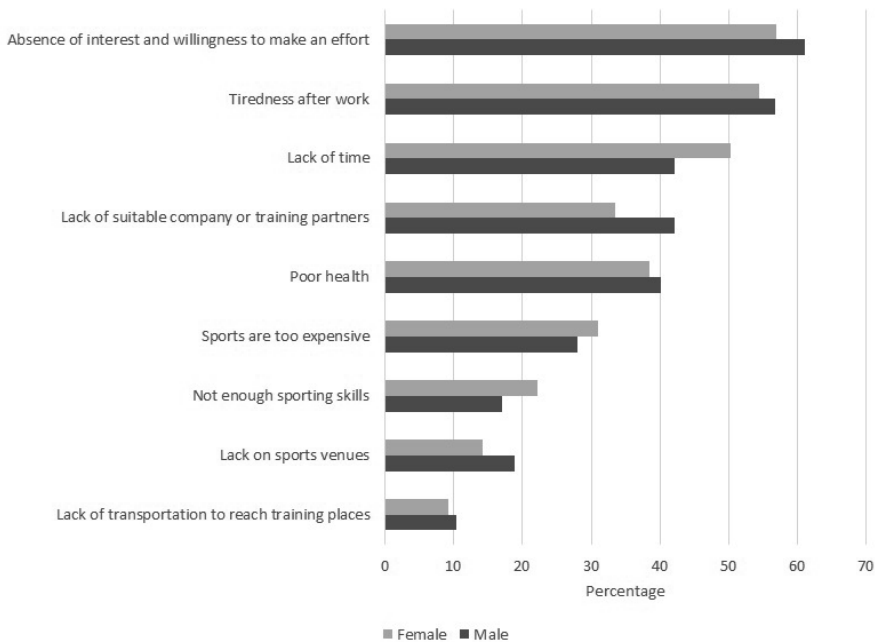
Figure 2. Barriers to being physically active as perceived by inactive survey respondents in 2013 and 2015 (%; $n=840$).

***significant at level $p<0.01$; *significant at level $p<0.1$.

Next, when looking at the differences in perceived barriers of inactive adults by gender, age, and education level, only 2015 data was used. As for gender, there were no statistically significant differences present in any of the perceived barriers (Figure 3a). As for age groups, a similarity in most frequently

reported barriers were detected for the 15–34 and 35–49 age groups (Figure 3b). The main reported barriers for these age groups were the absence of interest or unwillingness to make an effort, tiredness at work, and lack of time. Among 50–74-year-olds, the main barriers to inactivity were absence of interest or unwillingness to make an effort, poor health, and tiredness after work. A significant difference between age groups was present for tiredness at work, poor health, and lack of time ($p=0.004$, $p=0.000$, and $p=0.000$, respectively). About two-fifths of younger respondents (15–34-year-olds) stated that they did not exercise because sports are too expensive, whereas in the older age groups this is mentioned as a barrier by one-third or less ($p=0.023$). In addition, approximately 20% of respondents from the younger age groups (15–34 and 35–49) claimed a lack of sports venues as one of the barriers to physical activity, while in older age groups this is problematic for about one-tenth of respondents ($p=0.012$). As for educational level (Figure 3c), we identified two barriers which were differently perceived as a barrier depending on the educational level. More than 18% of adults with primary or basic and secondary education reported lack of sports venues as a barrier to physical activity, while only 6% with a higher education reported this ($p=0.042$). There was a tendency for those with primary or basic education and secondary education to admit poor health as a barrier to physical activity more frequently (more than 40% of respondents), whereas among those with higher education, about one-quarter felt the same ($p=0.052$).

a)



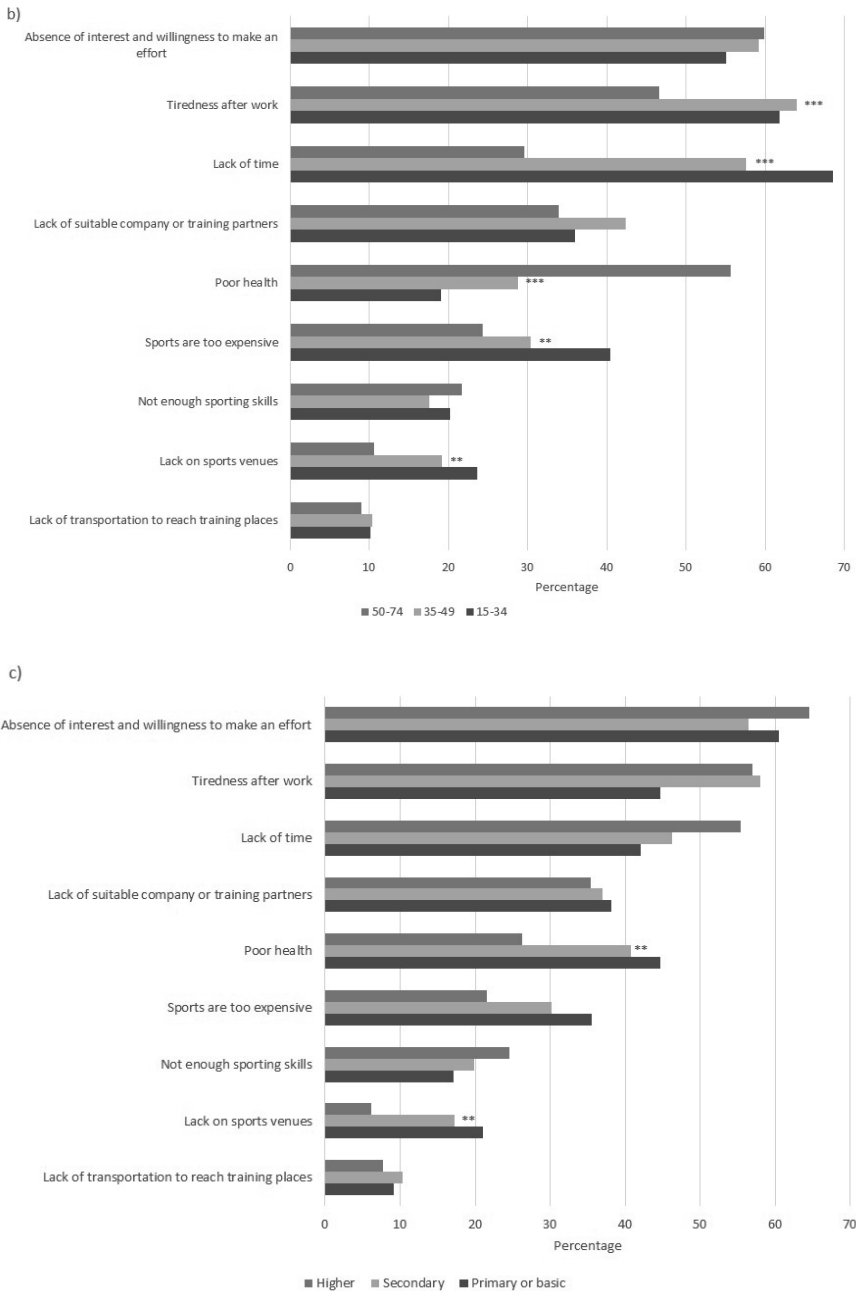


Figure 3. Barriers to being physically active perceived by inactive by gender (a), age group, (b) and educational level (c) in 2015 (%; n=403).

***significant at level $p < 0.01$; **significant at level $p < 0.05$.

DISCUSSION

The aim of the current study was to describe the physical activity of Estonian adults, examine the determinants of physical activity, and also the perceived barriers. The novelty of the current study is that it is the first to identify the perceived barriers of LTPA according to sex, education, and age among Estonian inactive adults.

The overall LTPA levels of the Estonian adult population have increased modestly over the two-year period – the prevalence of adults exercising regularly at least four times per week increased from 19% in 2013 to 21% in 2015, and those who exercise 2–3 times per week increased from 20% in 2013 to 24% in 2015. An increase in the LTPA of adults over time has also been observed in other countries. For example, in Finland the high level of LTPA increased from 1982 to 2012 by more than 12 percentage points [6], whereas in Australia the prevalence of adults acquiring at least 150 min of PA a week increased from 2002 to 2012 by more than 5 percentage points, resulting in a prevalence of 61% of adults being sufficiently physically active [13], which is three times greater than the current study. The systematic review by Knuth and Hallal [28] also confirmed an increasing trend in the leisure time physical activity of adults. However, there are still populations where a decline in LTPA [28, 30] or relatively stable LTPA levels has been observed [8]. At the same time, it has been highlighted that despite the slight increase in LTPA, due to declining work-related activity, declining transportation activity, declining activity in the home, and increasing sedentary activity, the total physical activity levels are declining [8]. It should be pointed out that despite the modest increase in LTPA of Estonian adults in the current study, the physical activity levels are worrying as less than half of the adults exercise more than once per week during their leisure time, which is below the average of the 28 EU member states [19].

Physical activity is a dynamic process throughout a person's lifespan. Trost et al. [52] have concluded in their review that age and gender are the two most consistent demographic correlates of physical activity in adults. As for age, our results are in accordance with previous studies as the odds of being physically inactive increased with age [5, 43, 52, 53]. This indicates that there is a need to pay special attention to supporting the physical activity levels of the older age group. Public health and sport policy documents should include actions related to physical activity opportunities for older adults, especially when the general trend in the population demographic situation is an ageing population. However, up to now there has not been any health promotion campaigns in Estonia targeted at older adults [15].

Therefore, our results highlight a need to create additional interventions and solutions supporting physical activity in people from the older age group.

When considering the physical activity levels from the perspective of gender, several studies have found that men are more physically active than women [5, 29, 52, 22]. Surprisingly, this trend was not supported in the current study where no gender differences were present between active and inactive adults. What is even more important is the fact that among inactive adults, there were no gender differences present in perceived barriers. We can hypothesise that existing sports facilities, available forms of LTPA, and existing gender roles in Estonian society support physical behaviour regardless of gender. Another possible explanation for why this study does not support the results of previous studies can arise from how physical activity is measured and what criteria are used to defining people as physically active or inactive. For example, Hamrik et al. [21] divided adults into three activity groups (high-, moderate-, and low-active) based on their weekly MET-min and showed that while there were no gender differences in the probability of being low-active, gender differences were present for high-active adults.

Another demographic factor related to the physical activity of adults is educational level. There is a consensus that a higher educational level is associated with higher levels of physical activity [5, 43, 52] and our results are in line with previous studies. As for perceived barriers, we identified only two barriers that were differently perceived by adults depending on their educational level. One of these barriers was the lack of sports venues: only 6% of inactive adults with a higher education reported it as a barrier to physical activity compared to 18% of adults with a secondary, primary, or basic educational level. It could be hypothesised that persons with a higher education have better access to sporting venues as their presumably better economic status enables a wider range of choices. At the same time, as a considerable number of adults with basic or primary education are young people, it also could be that there are not enough sporting facilities available for playing the sports that they enjoy (e.g. extreme sports). Another barrier where differences based on educational level were present, was poor health: those with a higher education reported it less often as a barrier than adults with lower educational levels. The better health of adults with a higher education could be related to their presumably better knowledge and health behaviour and is also supported by the overall tendency that higher educational level is associated with lower rates of incidence and morbidity [20, 57].

It has been concluded that health status is one of the determinants of physical activity [5]. This tendency is also supported by the current study where those who were not satisfied with their health had 2.5 times greater

odds of being physically inactive. At the same time, it is well-known that physical activity is an important factor for preventing and controlling several diseases [36]. We can argue that for those who are not satisfied with their health, a family physician can play an important role in supporting and motivating them to do health-enhancing physical activity. As people with more health problems tend to visit the family physician more often, this puts the physician in a favourable position to give exercise-related advice. It has been shown that getting physical activity-related advice from a physician significantly increases the physical activity levels of older adults [26]. Also, according to a meta-analysis, the promotion of physical activity among sedentary adults by a primary care physician leads to a small to medium improvement in self-reported physical activity after twelve months [34]. In Estonia, according to the physicians' reports, the most important topic in counselling for health promotion was physical activity [48]. However, the effect of the counselling and how the current system should be supported and improved warrants further research.

The most prevalent barriers to physical activity reported by inactive adults were 1) the absence of interest or unwillingness to make an effort, 2) tiredness at work, and 3) lack of time, which are common barriers reported by other studies [7, 24, 30, 52]. However, the proportion of adults reporting these barriers is more than two times higher in the current study than in the study conducted in Poland [30]. When comparing the two measurement periods in the current study, it is alarming that work-related tiredness as a barrier to physical activity has increased by seven percentage points. According to the previous study, high work stress and work demand have a negative impact on LTPA [27]. Thus, it is important to raise the knowledge of employers concerning the positive influence of physical activity on health. A meta-analysis by Conn et al. [12] suggested that workplace physical activity interventions not only increase overall physical activity but also improve work attendance, job satisfaction, and reduce job stress. Of course, supporting the physical activity of employees is not only a task for employers, but can also be supported by the state through legislation supporting physical activity among both employers and employees.

One important and positive finding of the current study was that during the two-year period, significant changes were present for several environmental factors – there were significantly fewer inactive adults reporting lack of sports venues, lack of transportation to training places, and the expense of sporting as a barrier to being physically active. In addition, among inactive adults, no differences could be noted between men and women regarding

environmental determinants of physical activity which is in line with previous findings [55].

One limitation of the study is the self-reported measurements of physical activity, which did not allow for a precise quantification of the intensity and duration of physical activity. Moreover, a recall bias could have affected the reported physical activity levels. However, using more precise objective methods in a similar sample size is rarely used and would need significantly greater resources. Another limitation is that perceived barriers were only asked from inactive adults which did not enable a comparison between barriers in active and inactive adults. However, this is the first study in Estonia examining the gender, educational, and age differences in perceived barriers of inactive adults, thus providing important input into public health strategies.

In conclusion, over the two-year period positive changes in the LTPA of adults can be noticed. However, the physical activity levels are still rather low and the odds of being inactive are greater in the older age group. As the perceived barriers among inactive adults are different depending on the age group, public health strategies should consider age-specific solutions. Also, the high prevalence of adults reporting lack of time and tiredness after work as a barrier to physical activity indicates that all sectors outside the health sector should be involved in supporting the physical activity levels of adults.

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