

Article

Strength Training Habits and Awareness of Its Recommendations among 18–63-Year-Old Adults

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Abstract: In addition to aerobic physical activity, adults of all ages should engage in muscle-strengthening activities (i.e., strength training). The main aim of this study was to identify the strength training habits and awareness of its recommendations among the study group of 18–64-year-old residents of Pärnu County. The sample consisted of 18–63-year-old residents of Pärnu County, who completed a questionnaire ($n = 250$) including sociodemographic and lifestyle-related information, strength training habits, and awareness of the World Health Organization (WHO) recommendations on physical activity about muscle strengthening activities (i.e., strength training). The results showed that 42% of the participants engaged in regular strength training on a weekly basis and 36.4% were aware of the WHO recommendations to engage in strength training on a weekly basis. The participants who were younger, at a normal weight, rated their daily physical activity higher and health better, were significantly associated with a higher likelihood of engaging in regular strength training on a weekly basis. The participants of the study who were aware that the WHO recommends engaging in strength training at least twice a week, were more likely to engage in regular strength training on a weekly basis, the majority of them at least twice a week.

Keywords: strength training; physical activity recommendations; adults



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1. Introduction

According to the World Health Organization’s (WHO) recommendations, 18–64-year-old adults should engage in aerobic and muscle strengthening activities on a weekly basis. Worldwide, 25% of adults do not meet the global recommended physical activity levels. Insufficiently physically active people have a 20–30% higher risk of different illnesses and death [1]. Noncommunicable diseases account for the majority of global causes of death and physical inactivity is one of the main risk factors for mortality from noncommunicable diseases [1,2].

According to the WHO recommendations, all 18–64-year-old adults should be regularly physically active, doing at least 150–300 min of moderate-intensity or at least 75–150 min of high-intensity aerobic physical activity a week, or a combination of them. In addition, it is recommended to do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups at least twice a week [1]. Muscle-strengthening activity, also known as strength/weight/resistance training or exercise, is a form of physical activity that increases skeletal muscle strength, power, endurance, and mass [3,4]. These activities involve lifting heavy weights multiple times. Strength training can also be done using elastic bands or body weight [3]. Strength training is usually performed in gyms or fitness centers or at home during a person’s leisure time. Engaging in strength training could be done for numerous purposes, for instance for strength-related sports, aesthetic purposes, conditioning for sports performance, general fitness and health, or physical therapy [4].

Several studies have found that strength training has a positive effect on health independent of aerobic exercise and, in some cases, it is even considered more effective

than aerobic exercise. Strength training has been found to reduce all-cause mortality by 21%, independent of aerobic exercise, and is associated with lower cardiovascular disease mortality [5]. Strength training is the most effective method to increase bone density [6], muscle mass, and strength [7], it improves physical performance [8], movement control [9], walking speed [10], and functional independence [11]. Strength training lowers resting blood pressure [12,13], increases high-density lipoprotein (HDL), decreases low-density lipoprotein (LDL) in the blood [14], improves vascular health [15], reduces low back pain [16,17], arthritic discomfort [18,19], and pain associated with fibromyalgia [20,21]. It also has a positive effect on mental health [22] and cognitive abilities [23]. Strength training has been found to reduce brain white matter lesion volumes and atrophy and increase gray matter volume [24], reduce symptoms of fatigue, anxiety, and depression, increase self-esteem, and improve sleep quality in adults of all ages [25].

Based on previous studies, the level of physical activity—including the practice of muscle-strengthening activities (i.e., strength training)—is low worldwide [26–29]. The popularity of strength training varies widely across European countries. It has been found that only 17.3% of all participants from 28 European countries engaged in strength training at least twice a week. Adults from Iceland (51.6%), Sweden (38.4%), and Denmark (34.3%) reported the highest prevalence of sufficient strength training (≥ 2 days/week). Adults from Malta (6.7%), Poland (5.5%), and Romania (0.7%) reported the lowest prevalence of sufficient strength training. In Estonia's neighboring countries, Finland and Latvia, 34.1% and 16.8% of adults, respectively, engaged in strength training at least twice a week. To the best of our knowledge, this is the only study to investigate strength training habits among Estonian adults and only 11.3% of participants from Estonia engaged in strength training at least two days a week [28].

Several studies have found that strength training has become more popular in the United States during the past years [29]. Findings show that 29.1% of adults engaged in strength training at least twice a week in 2011, 29.4% in 2013 [29], 30.2% in 2015 [30], and 30.3% in 2017 [29]. Research shows that the prevalence of strength training in Australia has increased over time [26,27]. In the years 2001–2010, 10.4% of the study participants engaged in strength training that involved all major muscle groups at least twice a week in the last two weeks and 9.3% in the last year [26]. In 2011–2012, 18.6% of the study participants had done strength training at least twice in the last week [27] and 23% of adults engaged in strength training at least twice a week in 2017–2018 [31]. In the previous studies, it was mainly found that being male, younger age, being a student, normal weight, higher self-rated health, higher income and education, and living in a more densely-populated area were significantly associated with a higher likelihood of reporting sufficient strength training (≥ 2 days/week) [26–30,32,33].

Previous studies have found that 18–69% of the participants were aware of strength training recommendations [34–38]. Some 18% of participants in the United States in 2017 [34], 25% of the participants in Finland in 2015 [35], and 32% of participants in United Kingdom in 2016 [18] knew that engaging in strength training is recommended at least twice a week. Cunningham and O'Sullivan found that 51.6% of participants in Ireland and Northern Ireland in 2020 knew that adults should engage in strength, balance, and flexibility activities at least two days a week [37]. In 2014, 69% of participants in the United States knew that engaging in strength training was recommended at least twice a week [38].

The main aim of this study was to identify the strength training habits and awareness of its recommendations among the study group of 18–64-year-old residents of Pärnu County. Based on the main aim of the study, four sub-goals were set:

- (1) Examining the strength training habits among the study group of 18–64-year-old residents of Pärnu County.
- (2) Examining the awareness of strength training recommendations among the study group of 18–64-year-old residents of Pärnu County.

- (3) Examining the possible associations between strength training habits and sociodemographic and lifestyle-related information among the study group of 18–64-year-old residents of Pärnu County.
- (4) Examining the possible associations between strength training habits and awareness of strength training recommendations among the study group of 18–64-year-old residents of Pärnu County.

2. Materials and Methods

2.1. Participants and Study Design

Participants were recruited in April 2021 via the web-based environment Facebook, where the questionnaire was shared publicly on the researcher's personal user's timeline, in various groups, and via private messages. A public post was created on the researcher's personal user's timeline and in various groups. A message was created by the researcher to share the questionnaire via private messages. The public post and the message consisted of an invitation to the study and a hyperlink to the questionnaire (Appendix A). The invitation to the study included a request to share the post or message if possible. The questionnaire was administered in Estonian. Participation in the study was voluntary. The participants of the present research were 18–63-year-old residents of Pärnu County. The minimum number of participants was 100 and the maximum number was 500. The participants completed a questionnaire in the web-based environment Connect.ee, which included questions about sociodemographic and lifestyle-related information, strength training habits, and awareness of the WHO physical activity recommendations on muscle-strengthening activities (i.e., strength training). The survey data was collected from 5 April 2021 to 19 April 2021.

2.2. Measures

The questions were designed specifically for the present survey and were similar to questions used in previous studies [26–38]. Following a pilot (38 Tartu Health Care College's physiotherapy students and lecturers), a small number of minor changes were made to the questions.

The following sociodemographic and lifestyle-related information were assessed by the questionnaire: gender, age, nationality, height, body mass, residence, highest level of education completed, occupational status, marital status, gross monthly income, self-rated daily physical activity, and self-rated health.

Strength training habits were assessed with the following question: "Do you engage in regular strength training ON A WEEKLY BASIS? By this we mean training, for example, with your own body weight, with free weights (dumbbells, barbells, kettlebells, medicine balls, etc.), weight machines, rubber bands, etc. Do not count aerobic activities like walking, running, cycling, swimming, etc." Response categories were (1) "yes" (question 20 will be skipped) and (2) "no" (questions 14–19 will be skipped). The participants who answered that they do engage in regular strength training on a weekly basis (answer option "yes") were also asked about the frequency, duration, intensity, the muscle groups being targeted, training place, and purpose(s) for engaging in regular strength training. The participants who answered that they do not engage in regular strength training on a weekly basis (answer option "no") were also asked about reason(s) for not engaging in regular strength training.

Awareness of the WHO physical activity recommendations on muscle-strengthening activities (i.e., strength training) were assessed with the following questions: "Does the World Health Organization (WHO) recommend doing muscle-strengthening activities (i.e., strength training) on a weekly basis?" and "According to the World Health Organization (WHO), how often is it recommended to do muscle-strengthening activities (i.e., strength training)?" The survey questionnaire is presented in Appendix A.

2.3. Statistical Analysis

Data obtained from the questionnaire were entered into the spreadsheet program MS Excel (Microsoft Office Excel 2019), where the primary analysis was performed. More detailed statistical data processing was performed using SPSS Statistics (Version 23.0; IBM Corp., Armonk, NY, USA). The sample was divided into different groups based on strength training habits: participants who engaged in regular strength training (≥ 1 time/week) and participants who did not engage in regular strength training (< 1 time/week). The distributions of numerical characteristics (age, height, body mass, BMI) were analyzed using the Shapiro–Wilk test, and none of them were normally distributed. Descriptive statistics (median and quartiles) were used for data presentation. Mann–Whitney test was used to compare the numerical values (i.e., age, height, body mass, BMI) between the two groups (participants who engaged in regular strength training and participants who did not engage in regular strength training). Cramer’s V test was used to measure association between non-numerical values (i.e., gender, nationality, residence, highest level of education completed, occupational status, marital status, gross monthly income, self-rated daily physical activity, self-rated health, and awareness of the WHO physical activity recommendations on muscle-strengthening activities) between the two groups (participants who engaged in regular strength training and participants who did not engage in regular strength training). Statistical significance was set at $p < 0.05$ for all the tests.

2.4. Research Ethics

The study protocol was approved by the Research Ethics Committee of the University of Tartu (337/T-31). Participation in the study was voluntary, and the participants could withdraw from filling out the questionnaire at any time, without giving the reason. The questionnaire did not ask for the participants’ names. The web-based environment Connect.ee did not allow the IP address of the participants to be identified. The participants’ data were stored on the researcher’s personal computer, which was password protected. Access to the electronic documents was allowed only to the members of the study group.

3. Results

3.1. Sociodemographic and Lifestyle-Related Information

A total of 253 individuals completed the questionnaire on a voluntary basis, 3 of whom were not in the 18–64 age group. Thus, the study group consisted of 250 residents of Pärnu County aged 18–63. Of these participants, 67.2% were women. The youngest participant was 18 years old and the oldest was 63 years old. The majority of participants were 18–24 years old, and the fewest participants were in the age group 55–63 (Table 1). In total, 99.2% of all participants were Estonians and 52.4% were employed. Most participants were at a normal weight, had a second level of education, reported their marital status as married, cohabitation, or living with a partner, earned 500–999 euros a month, and lived in a city (Table 2). Body mass (kg) was divided by the square of height (m^2) to determine the body mass index (BMI) of the participants. Most of the participants considered themselves moderately active and rated their health as “good”. None of the participants rated their health as “very poor”. Statistically significant difference was not found in age, height, body mass, and BMI between participants who did and did not engage in regular strength training on a weekly basis (Table 2).

Table 1. Age, BMI, education level, marital status, residence, and gross monthly income of total sample and participants who engaged in regular strength training.

		Total Sample	Engaging in Regular Strength Training (≥1 Time/Week)	
		<i>n</i> (%)	<i>n</i> (%)	<i>p</i>
Age (years)	18–24	121 (48.4)	57 (47.1)	0.046
	25–34	52 (20.8)	23 (44.2)	
	35–44	26 (10.4)	13 (50.0)	
	45–54	38 (15.2)	10 (26.3)	
	55–63	13 (5.2)	2 (15.4)	
BMI (kg/m ²)	Underweight (<18.5)	5 (2.0)	0 (0.0)	0.010
	Normal weight (18.5–24.9)	156 (62.4)	77 (49.4)	
	Overweight (25–29.9)	64 (25.6)	21 (32.8)	
	Obese (>30)	25 (10.0)	7 (28.0)	
Education level	First level	35 (14.0)	11 (31.4)	0.327
	Second level	142 (56.8)	60 (42.3)	
	Third level	73 (29.2)	34 (46.6)	
Marital status	Married/cohabitation/living with a partner	145 (58.0)	55 (37.9)	0.126
	Single/divorced/living apart from spouse/widow	105 (42.0)	50 (47.6)	
Residence	City	164 (65.6)	74 (45.1)	0.300
	Town	8 (3.2)	3 (37.5)	
	Township	33 (13.2)	9 (27.3)	
	Village	45 (18.0)	19 (42.2)	
Gross monthly income (euros)	<500	60 (24.0)	25 (41.7)	0.670
	500–999	70 (28.0)	28 (40.0)	
	1000–1499	48 (19.2)	21 (43.8)	
	1500–1999	19 (7.6)	5 (26.3)	
	≥2000	24 (9.6)	12 (50.0)	
	Would not like to answer	29 (11.6)	14 (48.3)	

Table 2. Age, height, body mass, and BMI of participants who engaged and who did not engage in regular strength training.

Median (Quartiles)	Not Engaging in Regular Strength Training (<1 Time/Week)	Engaging in Regular Strength Training (≥1 Time/Week)	<i>p</i>
Age (years)	28 (20–45.5)	23 (20–34)	ns
Height (cm)	172 (167–180)	173 (170–180)	ns
Body mass (kg)	71 (62–84)	72 (61–80)	ns
BMI (kg/m ²)	23.9 (21.4–27.2)	23.1 (21.0–25.4)	ns

Note. ns = statistically not significant difference.

3.2. Strength Training Habits and Sociodemographic and Lifestyle-Related Information

Overall, 105 study participants (42%), of whom 61.9% were women, engaged in regular strength training on a weekly basis. The majority of participants who engaged in regular strength training (94.3%) did it at least twice a week (39.6% of all participants). While 33.3% of participants who engaged in regular strength training usually did it three times a week. There were more participants who engaged in regular strength training among men than among women (48.8% vs. 38.7%; $p = 0.129$), but no statistically significant difference was found in gender groups between participants who did and did not engage in regular strength training on a weekly basis. As age increased, engaging in strength training decreased among all participants. Participants who were at a normal weight were

more likely to engage in regular strength training compared to underweight, overweight, and obese adults. More detailed data on engaging in regular strength training in different age groups and according to BMI are presented in Table 2. Among the participants with a higher level of education, the proportion of engaging in strength training was higher, but no statistically significant difference was found in education level groups between participants who did and did not engage in regular strength training on a weekly basis (Table 2). Among all participants, no statistically significant difference was found in marital status, residence, and gross monthly income groups between participants who did and did not engage in regular strength training on a weekly basis (Table 2).

Overall, 36.6% of employed participants and 45.6% of students engaged in regular strength training. Meanwhile, 56.1% of the participants who both worked and studied engaged in regular strength training, compared with 33.3% of those who did neither work nor study. No statistically significant difference was found in occupational status groups between participants who did and did not engage in regular strength training on a weekly basis ($p = 0.207$). Participants who rated their daily physical activity higher were more likely to engage in regular strength training ($p < 0.001$), with 78.6% of the participants rating their daily physical activity as “extremely active”, 72.7% of the participants who reported “very active”, 41% of the participants who reported “moderately active”, 20.7% of the participants who reported “lightly active”, and 16.7% of participants who reported “inactive” engaged in regular strength training. Participants who rated their health better were more likely to engage in regular strength training ($p < 0.001$). Some 60% of participants who rated their health as “very good” engaged in regular strength training, compared with 45.9% of participants with good health and 27.5% of participants with average health assessment. None of the participants who chose the answer option “bad” engaged in regular strength training.

Some 50.5% of participants who engaged in regular strength training reported that the duration of one training session is usually 31–60 min, whereas 10.5% usually engaged in strength training for up to 30 min and 39% for more than 60 min. Furthermore, 75.2% of participants who engaged in regular strength training mostly reported the intensity of their strength training to be at the level of “moderate”, 17.1% at the level of “high”, and 7.6% at the level of “low”. All major muscle groups were targeted by 73.3% of participants who engaged in regular strength training (30.8% of all participants), with 61.9% of participants (26% of all participants) who engaged in regular strength training targeting all major muscle groups with moderate or high intensity at least twice a week. Overall, 68.6% of participants who engaged in regular strength training did it at home, 61.9% in the gym, 40% outdoors, and 21.9% in group training. It was possible for the participants to choose multiple answer options. The answer option “other” was chosen by two participants and they added “at the athletics hall (sports hall)” and “at work”.

Most of the participants engaged in regular strength training to improve their well-being, develop physical abilities, and because of good appearance; the least mentioned was “increasing bone density”. One participant chose the answer option “other” and added that engaging in regular strength training is a source of income for him/her. The detailed answers are shown in Figure 1.

Most of the participants chose the answer “lack of motivation” for the question “Give a reason/reasons for why you do not engage in regular strength training on a weekly basis. You can choose several answer options.” Almost half of the participants reported that they did not engage in regular strength training because of a lack of time. Six participants who chose the answer option “other” reported that they did not engage in regular strength training because of closure of gyms due to COVID-19 restrictions, two participants reported pregnancy, and one added “lack of equipment”. Out of the available options, the least chosen answers were “the health condition does not allow to engage in strength training” and “poor health condition”. None of the participants chose the answer option “there is no transport to get to the training place”. A more detailed overview of reasons for not engaging in regular strength training is presented in Figure 2.

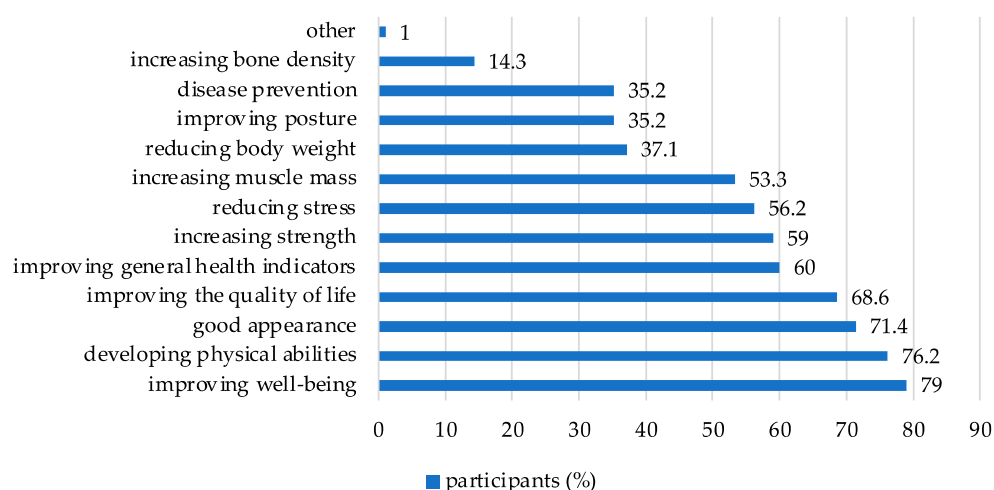


Figure 1. Purposes for engaging in regular strength training.

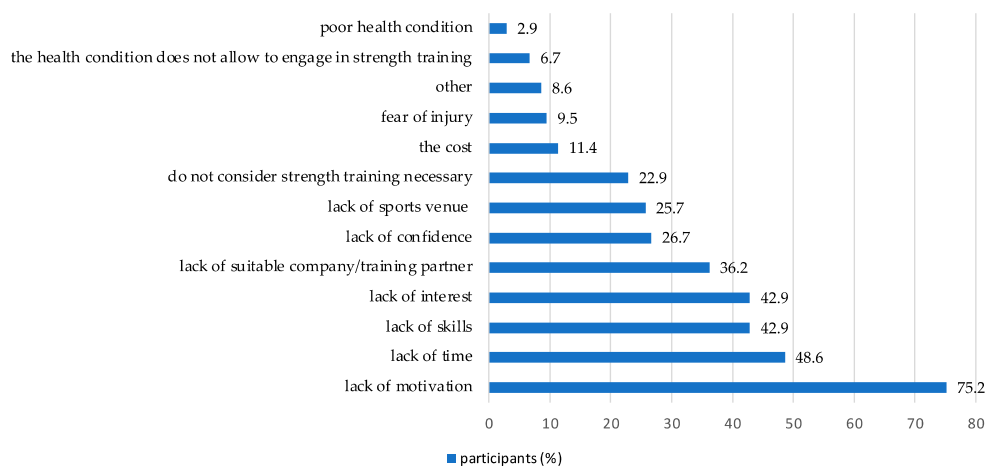


Figure 2. Reasons for not engaging in regular strength training.

3.3. Strength Training Habits and Awareness of Strength Training Recommendations

In total, 36.4% of the participants answered “yes” and 3.2% of the participants answered “no” to the question “Does the World Health Organization (WHO) recommend doing muscle-strengthening activities (i.e., strength training) on a weekly basis?”. The majority (60.4%) of participants chose the answer option “do not know”. Additionally, 49.5% of those who were aware (answer option “yes”) and 37.7% of those who were not aware (answer options “no” and “do not know”) of the strength training recommendations engaged in regular strength training. There was no statistically significant difference in engaging in regular strength training between participants who were aware that the WHO recommends engaging in muscle-strengthening activities, i.e., strength training, on a weekly basis, and those who were not aware of the recommendations ($p = 0.071$).

Participants who were aware that the WHO recommends engaging in strength training were more likely to be aware that the WHO recommends engaging in strength training at least twice a week ($p < 0.001$). To the question “According to the World Health Organization (WHO), how often is it recommended to engage in muscle-strengthening activities (i.e., strength training)?”, 0.8% of the participants reported that it is not recommended to engage in strength training, and 72% chose the answer option “do not know”. Only 10.8% of the participants knew that it is recommended to engage in strength training at least twice a week. Furthermore, 2.4% of the participants reported that it is recommended to engage in strength training once a week, 13.6% of the participants reported that strength training should be done three times a week. One participant reported that 150 min of strength training a week is recommended. Participants who were aware that the WHO recommends

engaging in strength training at least twice a week were more likely to engage in strength training compared to the participants who did not know how often it is recommended to engage in strength training (63% vs. 39.5%; $p = 0.019$). Participants who knew that engaging in strength training is recommended at least twice a week were more likely to engage in strength training at least twice a week compared to participants who did not know how often it is recommended to engage in strength training (59.3% vs. 37.2%; $p = 0.027$).

4. Discussion

4.1. Strength Training Habits and Sociodemographic and Lifestyle-Related Information

The study group consisted of 250 residents of Pärnu County aged 18–63, 168 (67.2%) of whom were women. According to Statistics Estonia database [39], there were 52,574 residents aged 15–64 in Pärnu County in 2021, 25,705 (48.9%) of whom were women. Therefore, the total present study group accounted for approximately 0.5% of the total population of Pärnu County. This could differ from the actual result as participants of the present study were aged 18–63, but the statistical database presents information about 15–64-year-old residents of Pärnu County. Accordingly, the study sample is not comparable to the target population, so the present study results infer about the sample itself.

Present study results show that 42% of the participants engaged in regular strength training on a weekly basis, 39.6% at least twice a week. In a previous study, it was found that engagement in strength training among Estonian adults is low, as Bennie and co-authors found that, in 2013–2014, only 11.3% of Estonians aged at least 18 engaged in strength training at least twice a week—17.3% of all participants. Previous to this study, engagement in strength training was higher in Iceland, where 51.6% of the participants of a study engaged in strength training [28]. As a result of all other previous studies [26–31], it has been found that a smaller proportion of the participants engaged in strength training than in the present study. The higher percentage of participants engaging in strength training compared to the results of previous studies in Estonia and other parts of the world could be due to the fact that the largest group of participants in this study were aged 18–34, who also were more likely to engage in strength training compared to older participants. This could also be due to the fact that the questionnaire was shared only via the web-based environment Facebook, where it is more likely for young people to respond to such a questionnaire.

The present study showed that as age increased, engaging in strength training decreased among all participants, which corroborates the results of previous studies [26–28,30], which have also found that the probability of engaging in strength training decreases with increasing age. This was likely due to the fact that younger people are generally more physically active. In addition, it could be assumed that older people are not aware that strength training is recommended for adults of all ages. Awareness in different age groups was not studied. In the future, it could be investigated whether awareness of strength training recommendations differs between age groups. Similar to previous studies [27,28,30,33], it was found that participants who were at a normal weight were more likely to engage in strength training compared to underweight, overweight, and obese adults. Therefore, it can be concluded that people engaging in regular strength training are better at maintaining a normal weight. Meanwhile, individuals who are not at a normal weight may lack the courage to start exercising or training among more fit people.

Participants who rated their health better were more likely to engage in regular strength training. Similar results were found in previous studies [28,30,32], which could show that strength training has a positive effect on health. It can be assumed that adults who engage in strength training are aware that strength training has a positive effect on health, and do it regularly for this purpose. However, participants' poor health could also prevent them from engaging in regular strength training. As only self-rated health status was investigated, it is not known if those who rated their health as bad or very bad or reported that the health condition does not allow to engage in strength training could actually engage in strength training to any extent. In the future, health status could be

assessed more objectively to make more accurate conclusions between strength training and health condition. Participants who rated their daily physical activity level higher were more likely to engage in strength training. Participants' self-rated daily physical activity may have been higher especially due to greater participation in strength training, but it may also be because participants who are generally more physically active could be more interested and aware of different physical activity forms, such as strength training. Previous studies have not investigated associations between daily physical activity and strength training habits. Future research could consider investigating associations between daily physical activity and strength training habits.

Among the participants with a higher level of education, the percentage of engaging in strength training was higher, however, no statistically significant difference was found in education level groups between participants who did and did not engage in regular strength training on a weekly basis. In the present study, no statistically significant difference was found in gender, residence, and gross monthly income groups between participants who did and did not engage in regular strength training on a weekly basis. This result differs from previous studies, where it was mainly found that being male [27–30,33], having a higher level of education [28,29], living in a more densely populated area [26,28], and having a higher income [28–30] were significantly associated with a higher likelihood of engaging in regular strength training. Students and participants who worked and studied were more likely to engage in strength training compared to participants who worked or neither studied nor worked. No statistically significant difference was found in occupational status groups between participants who did and did not engage in regular strength training on a weekly basis. Previous studies have found that students from various groups with different occupational status were more likely to engage in strength training [28,30].

Half of the participants who engaged in regular strength training usually did it for 31–60 min, a tenth for less than 30 min, and the rest for more than 60 min. Since the WHO recommendations do not specify which training session duration would provide optimal health benefits, it can be concluded that one training session should last long enough to target all major muscle groups at a moderate or high intensity. A third of participants who engaged in regular strength training did not target all major muscle groups as recommended by the WHO [1]. It is possible that they were not aware that all major muscle groups should be targeted when doing strength training. Almost a tenth of participants who engaged in regular strength training rated their training intensity as mostly low, while the rest usually trained at moderate or high intensity. The WHO recommends that all adults engage in strength training and target all major muscle groups at a moderate or high intensity at least twice a week [1]. More than half of the participants who engaged in regular strength training (almost a third of all participants) did it according to these recommendations, but engaging in strength training to a lesser extent than recommended also has a positive effect on health. Further research is needed to provide evidence of dose-response relationships of strength training.

Strength training was mostly done at home. This is probably due to the distribution of the questionnaire at a time when strict COVID-19 restrictions were in force in Estonia and gyms were closed and group trainings were not organized. More than half of the participants who engaged in regular strength training trained in a gym, less than half outdoors, in group training, and elsewhere. The answers could be based on which places were usually used for training before the restrictions.

More than half of the participants who engaged in regular strength training did it to improve their well-being, develop physical abilities, because of good appearance, improve the quality of life, improve general health indicators, increase strength, reduce stress, and increase muscle mass. "Increasing bone density" was the least chosen answer out of the available options. It could be argued that the participants were not aware that strength training increases bone mineral density. Participants who did not engage in regular strength training reported lack of motivation, time, skills, and interest as the most common reasons. It could be assumed that they were not aware of the benefits of strength training and could

not motivate themselves enough to engage in strength training. Six participants mentioned under the answer option “other” that it is not possible to use gyms due to COVID-19 restrictions. In addition, pregnancy and lack of equipment were mentioned. It is possible that they were not aware that strength training is recommended even during pregnancy and that strength training can also be done with your own body weight or with equipment at home. A fifth of the participants did not consider strength training necessary. Most likely, they were not aware that strength training has been recommended for adults of all ages and what benefits it has on their health. Less than a tenth of the participants did not engage in strength training due to poor health condition and/or their health condition did not allow them to engage in strength training. Only self-rated health status was investigated in the questionnaire. Therefore, it is not known whether their health status would have enabled them to engage in strength training to any extent. Further research is needed to determine the reasons among a larger population for not engaging in regular strength training. It could help develop strategies for higher engagement in strength training, for example, raising awareness of benefits and importance of strength training in different age groups.

4.2. Awareness of Strength Training Recommendations

Overall, 36.4% of all participants were aware that the WHO recommends engaging in regular strength training. Half of the participants who were aware and about a third of the participants who were not aware of the recommendations engaged in strength training. However, there was no statistically significant difference in engaging in regular strength training between participants who were aware and who were not aware of the strength training recommendations. Previously, as far as is known, the awareness of adults about strength training recommendations had not been studied in Estonia. Also, to the best of our knowledge, in other countries research participants have not been asked whether the WHO recommends doing strength training, but it has been investigated how many times a week the WHO recommends engaging in strength training. In the present study, only 10.8% of the participants knew that strength training is recommended to be done at least twice a week. Participants who knew that the WHO recommended engaging in strength training were also more likely to know that engaging in strength training was recommended at least twice a week. It can be concluded that the participants who were generally more aware of the WHO recommendations also knew the substantive side of the recommendations. The awareness of the participants was lower compared to the results previously found in other countries. It has been found that 18% [34] and 69% [38] of the participants in the United States, 25% in Finland [35], 32% in the United Kingdom [36], and 51.6% in Ireland and Northern Ireland [37] knew how many times a week it is recommended to engage in strength training. Thus, it can be concluded that the current measures used in Estonia are not sufficient for people to be aware of the recommendations, and the awareness of the WHO recommendations regarding strength training should be increased among all adults.

4.3. Strength Training Habits and Awareness of Strength Training Recommendations

Participants who were aware that the WHO recommends engaging in strength training at least twice a week were more likely to engage in strength training compared to those who were not aware. Participants who knew that engaging in strength training was recommended at least twice a week were also more likely to do it at least twice a week compared to participants who did not know how many times a week engaging in strength training was recommended. More than half of the participants who were aware that engaging in strength training was recommended at least twice a week did engage in regular strength training, most of them at least twice a week. In the past, as far as is known, there has been no research in Estonia or anywhere else in the world examining associations between strength training habits and awareness of strength training recommendations. In the future, it is necessary to investigate associations between awareness of strength training recommendations and strength training habits to make more general conclusions whether higher knowledge would result in higher engagement in strength training.

4.4. Strengths and Limitations

Since there is no data on strength training habits among Estonians in recent years, we can still get a partial overview of them with the help of the data of the study group of 18–63-year-old residents of Pärnu County studied in this research. As the first study to assess awareness of strength training recommendations in Estonia we believe the results can still provide useful insights into this targeted population. The present study results show the importance of this topic, therefore strength training habits and awareness of strength training recommendations could be further investigated in Estonia.

A main limitation of this study is the use of self-report assessments as the results reflect only the subjective opinion of the participants and it could differ from the actual result. Another limitation of the present study can be considered to be that the study of strength training habits and awareness of strength training recommendations was only conducted in Pärnu County, which does not reflect the results across the entire country of Estonia. This topic could be studied in different counties across Estonia. The presence of more participants would have resulted in statistically more accurate results. In addition, the questionnaire was shared only via the web-based environment Facebook. Therefore, younger people could be more likely to respond to such a questionnaire. Using a valid and reliable questionnaire would have allowed us to have more accurate results, although to the best of our knowledge, such a questionnaire did not exist when conducting the present survey. Validation of the questionnaire used in the present study is necessary for future research. In the future, participants' awareness of strength training recommendations could also be compared with various sociodemographic and lifestyle-related information. Further studies with less methodical limitations and more participants are necessary to make more generalized conclusions.

5. Conclusions

To sum up, 42% of the study group of 18–64-year-old residents of Pärnu County engaged in regular strength training on a weekly basis, 39.6% of all participants engaged in strength training at least twice a week. Furthermore, 36.4% of the study group of 18–64-year-old residents of Pärnu County were aware that the WHO recommends engaging in regular strength training on a weekly basis, and 10.8% of the participants knew that the WHO recommends engaging in strength training at least twice a week. The participants who were younger, were at a normal weight, who rated their daily physical activity higher and their health better, were more likely to engage in regular strength training on a weekly basis. The 18–63-year-old residents of Pärnu County participating in the study, who were aware that the WHO recommends engaging in strength training at least twice a week, were more likely to engage in regular strength training on a weekly basis, most of them at least twice a week.

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Appendix A. The Questionnaire Used in the Study

Dear resident of Pärnu County!

I am Andra Muhu (andramuhu@gmail.com), a third-year student of the physiotherapist curriculum at the Tartu Health Care College, and I am writing a thesis on the topic “Strength training habits and awareness of its recommendations among 18–64-year-old residents of Pärnu County”. I invite you to participate in a study aimed at identifying the strength training habits and awareness of its recommendations among 18–64-year-old residents of Pärnu County.

The questionnaire takes approximately 10 min to complete and is voluntary. The questionnaire does not ask for your name. The Connect.ee environment does not allow researchers to see the IP addresses of participants. The collected data is stored on the researcher’s password-protected computer, which can only be accessed by members of the study group. The data will be deleted from the computer in June 2021.

By completing the questionnaire, you agree that your answers will be analyzed and used in a generalized form in the thesis.

1. Your gender
 - ☐ Female
 - ☐ Male
2. Your age (years) ____
3. Your nationality
 - ☐ Estonian
 - ☐ Russian
 - ☐ Other ____
4. Your height (cm) ____
5. Your body mass (kg) ____
6. Your residence
 - ☐ City (>1000 permanent residents)
 - ☐ Town (>1000 permanent residents)
 - ☐ Township (>300 permanent residents)
 - ☐ Village (<300 permanent residents)
7. What is your highest level of education completed?
 - ☐ First-level education (basic education or education equivalent to it, vocational education without basic education requirements, vocational education based on basic education)
 - ☐ Second-level education (secondary education, vocational secondary education (including secondary specialized or technical school education) based on basic education, vocational secondary education based on secondary education)
 - ☐ Third-level education (higher education, secondary specialized education based on secondary education)
8. What is your occupational status?
 - ☐ I work
 - ☐ I do not work
 - ☐ I study
 - ☐ I study and work
 - ☐ I do not study nor work
 - ☐ I am retired
 - ☐ I am retired and working
9. What is your marital status?
 - ☐ Married/cohabitation/living with a partner
 - ☐ Single/divorced/living apart from spouse/widow
10. What is your gross monthly income?
 - ☐ <500 euros
 - ☐ 500–999 euros
 - ☐ 1000–1499 euros
 - ☐ 1500–1999 euros

- ☐ ≥ 2000 euros
- ☐ Would not like to answer

11. How do you rate your daily physical activity?

- ☐ Extremely active
- ☐ Very active
- ☐ Moderately active
- ☐ Lightly active
- ☐ Inactive

12. How do you rate your health status?

- ☐ Very good
- ☐ Good
- ☐ Average
- ☐ Bad
- ☐ Very bad

13. Do you engage in regular strength training ON A WEEKLY BASIS? By this we mean training, for example, with your own body weight, with free weights (dumbbells, barbells, kettlebells, medicine balls, etc.), weight machines, rubber bands, etc. Do not count aerobic activities like walking, running, cycling, swimming, etc.

- ☐ Yes (question 20 will be skipped)
- ☐ No (questions 14–19 will be skipped)

14. How many times a week do you usually engage in strength training?

- ☐ 1 time a week
- ☐ 2 times a week
- ☐ 3 times a week
- ☐ 4 times a week
- ☐ 5 times a week
- ☐ 6 times a week
- ☐ 7 times a week
- ☐ More than 7 times a week

15. How long does one strength training session usually last?

- ☐ Up to 30 min
- ☐ 31–60 min
- ☐ 61–90 min
- ☐ 91–120 min
- ☐ More than 120 min

16. How do you usually rate the intensity of your strength training?

- ☐ Low (no shortness of breath, no sweating, pulse rate increases slightly)
- ☐ Moderate (short of breath and sweating somewhat, heart rate increases noticeably)
- ☐ High (panting and sweating profusely, heart rate increases significantly)

17. Which muscle groups do you target when engaging in strength training? You can choose several answer options.

- ☐ Upper limb muscles
- ☐ Chest muscles
- ☐ Back muscles
- ☐ Abdominal muscles
- ☐ Lower limb muscles

18. Where do you engage in strength training? You can choose several answer options.

- ☐ In the gym
- ☐ At home
- ☐ In group training sessions
- ☐ Outdoors
- ☐ Other ____

19. For what purpose(s) do you engage in strength training? You can choose several answer options.

- ☐ Increasing strength
- ☐ Reducing body weight
- ☐ Improving general health indicators
- ☐ Developing physical abilities
- ☐ Good appearance
- ☐ Increasing muscle mass
- ☐ Increasing bone density
- ☐ Improving posture
- ☐ Reducing stress
- ☐ Improving the quality of life
- ☐ Disease prevention
- ☐ Improving well-being
- ☐ Other ____

20. Give a reason/reasons for why you do not engage in regular strength training on a weekly basis. You can choose several answer options.

- ☐ Lack of time
- ☐ Lack of motivation
- ☐ Lack of skills
- ☐ Lack of suitable company/training partner
- ☐ Do not consider strength training necessary
- ☐ The cost
- ☐ Lack of interest
- ☐ Lack of sports venue
- ☐ Lack of confidence
- ☐ Fear of injury
- ☐ There is no transport to get to the training place
- ☐ Poor health condition
- ☐ The health condition does not allow to engage in strength training
- ☐ Other ____

21. Does the World Health Organization (WHO) recommend doing muscle-strengthening activities (i.e., strength training) on a weekly basis?

- ☐ Yes
- ☐ No
- ☐ Do not know

22. According to the World Health Organization (WHO), how often is it recommended to do muscle-strengthening activities (i.e., strength training)?

- ☐ At least ____ time/times a week
- ☐ Muscle-strengthening activities (i.e., strength training) are not recommended
- ☐ Do not know

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