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The relationship between the quality of life and cardiorespiratory fitness

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Abstract: *Low levels of cardiorespiratory fitness and physical fitness have a negative impact on the health of children and adolescents. The aim of the study is to determine the relationship between the quality of life and cardiorespiratory fitness in elementary school students. The study involved 651 4th grade elementary school students in the Republic of Croatia. The average age of the students was 10.38 ± 0.50 years. Their body height was measured with a height metre (Seca® 213, Hamburg, Germany) and body mass, body mass index (BMI), and adipose tissue (%) with a dual-frequency body composition analyser (TANITA DC -360P). Cardiorespiratory fitness was determined by a multistage 20-metre run test (20MSRT Shuttle Run Test). The quality of life was assessed by a questionnaire for children and adolescents aged 8 to 18 years (KIDSCREEN-10). The results show that students perceived their quality of life as relatively high (4.33) and that the values of maximal oxygen uptake (VO2max) were 45.16 mL/kg/min. The results of a simple regression analysis show that there is a statistically significant relationship (p=0.00) between the quality of life and cardiorespiratory fitness in elementary school students. The results obtained in this research should serve as a stimulus for future researches concerning the relationship of cardiorespiratory fitness, physical activity and quality of life. Raising the level of cardiorespiratory fitness together with a healthy diet should encourage the development of intervention school programs which would considerably improve the overall health of children and adolescents.*

Keywords: *quality of life, cardiorespiratory fitness, health, elementary education, children, ill-being.*

INTRODUCTION

Quality of life is described as part of holistic health and takes into account one's perception Health Related Quality of Life (HRQoL) provides information about a person's feelings about their well-being and provides information about current and future health (Pastor et al., 2022). Inadequate physical activity among children and adolescents is increasingly prominent and is becoming a growing public health problem, particularly among elementary school-aged children (Roca & Badrić, 2019). Quality of life is described as part of holistic health that takes into account the individual's perception of physical, mental, and social functioning (Centres for Disease Control, 2011). The World Health Organization defines health-related quality of life as a multidimensional and integrative construct consisting of physical, psychological, and social well-being and functioning (WHOQOL, 1993). Quality of life is a set of different conditions and needs such as biological needs, safety, love and belonging, respect, self-actualization, desire for knowledge and understanding, and aesthetic needs. (Jurko, Čular, Badrić, & Sporiš 2015). Health-related quality of life measures the impact of health or illness on daily life and is highly influenced by a person's concerns, conditions, and desires, as well as self-perceived health and well-being (Haraldstad et al., 2019).

Physical activity, health, and quality of life are closely linked. The human body is designed for movement and therefore requires regular physical activity to function optimally and prevent diseases (Heimer & Sporiš, 2016). Health-related quality of life is most commonly included in quality of life assessments because it covers a wide range of health issues, including subjective perceptions and thoughts, as well as an individual's functioning and ability to thrive in different areas of life (Wallander & Koot 2016). Cardiorespiratory fitness is a direct indicator of the overall capacity of an person's cardiovascular and respiratory systems to perform physical activities (Zhan et al., 2020). Cardiorespiratory fitness refers to the overall capacity of the cardiovascular and respiratory systems, as well as the ability to perform long-term rhythmic and dynamic exercises involving the large muscles of the body, and its direct measure is aerobic capacity (Lang et al., 2018). Maximum oxygen uptake (VO2max) is the only objective measure of

cardiorespiratory fitness and is exclusively used in exercise, fitness or cardiovascular health research. Cardiovascular capacity also determines aerobic capacity (Jurko et al., 2015). Cardiorespiratory fitness can be measured directly, expressed as maximal oxygen consumption (VO2max), or it can be estimated from the peak speed achieved on a treadmill or cycloergometer, or from non-exercise algorithms (Ross, et al., 2016). Cardiorespiratory fitness, which declines with age, is one of the greater problems of today's population. Insufficient physical activity and sedentary lifestyle undoubtedly contribute to poor cardiorespiratory fitness. (Badrić & Roca, 2020). Evaristo and colleagues (2019) emphasize the importance of developing a system for cardiorespiratory fitness in adolescents and that further research is needed in the future to assess the causal connection between cardiorespiratory fitness and quality of life in adolescents. From a clinical and public health perspective, monitoring children's physical fitness and aerobic skills development provides fundamental information that can be used to maintain and improve children's health. (Kolimechkov, 2017). A higher value of cardiorespiratory fitness in childhood and adolescence is closely related to current health status, but also to a good prediction for the future (Ortega et al., 2011). Therefore, it would be of great benefit to schools to conduct physical fitness tests that are tailored to the age of the participants and would provide the most relevant results on the relationship between physical fitness and health. Information on predictors related to quality of life in children and adolescents is important for public health (Magiera & Pac 2022). Some studies have confirmed a positive association between cardiorespiratory fitness and quality of life (Andersen et al., 2017; Pires-Júnior et al.., 2018; Riiser et al., 2014). These associations suggest that people who are physically active and fit also feel competent, have a positive self-image, and are perceived as competent by others. All these areas can affect social and emotional development and integration into peer groups, which consequently have a great impact on quality of life (Marković, Trbojević Jocić, Horvatin, Pekas, & Trajković, 2022). The aim of this study is to determine the relationship between quality of life and cardiorespiratory fitness in elementary school students.

METHODS

Sample of respondents

In the implementation of this research, a sample of 651 4th grade elementary school students from the Republic of Croatia was used. The average age of the students was 10.38 ± 0.50 years, and the sample was divided into two subsamples according to gender, which consisted of 316 girls (10.30 ± 0.47 years) and 335 boys (10.34 ± 0.49 years). The research was conducted during the second semester of the 2021/2022 school year. All examined students were completely healthy at the time of the research. The research was conducted in accordance with the ethical principles prescribed by the Code of Ethics of the University of Zagreb and the Code of Ethics for Research with Children (Ajduković & Keresteš, 2020).

Variables

Anthropometric measurements were performed according to the International Biological Program (IBP). Body height was measured with a height meter (Seca® 213, Hamburg, Germany), and body mass, body mass index (BMI), and adipose tissue (%) were measured with a dual-frequency body composition analyser (TANITA DC -360P). Cardiorespiratory fitness was determined using the 20MSRT shuttle run test, in which running speed starts at 8.5 km/h−1 and increases by 0.5 km/h−1 every minute. Each stage lasts approximately 60 seconds, with the duration of each interval indicated to the subject by beeps (Leger and Lambert, 1982). Maximal oxygen consumption (VO2max, mL/kg/min) was calculated using the equation: VO2max = 31.025 + 3.238 (S) 2 3.248 (A) + 0.1536 (A 3 S), where S = speed in kilometers per hour at the end of the test and A = age in years (Leger et al., 1988) which is suitable for boys and girls aged 8 to 19 using an online calculator (Wood, 2019). Participants' quality of life was assessed using a questionnaire for children and adolescents aged 8 to 18 years (The KIDSCREEN Group Europe, 2006). To assess adolescents' subjective health and well-being, the Croatian version of the KIDSCREEN-10 quality of life questionnaire was used, which is a short form of the KIDSCREEN-52 questionnaire. The questionnaire assesses the dimensions of physical and psychological well-being, autonomy and parental relationships, peer support and social support, and school environment. The questionnaire consists of 10 questions in which the participants tick on a five-point Likert scale the extent to which they agree with the content of a particular statement in order to obtain an overall rating at the end.The metric properties of the KIDSCREEN-10 questionnaire are satisfactory. The values of Cronbach's alpha are

0.82 and the test-retest coefficient is 0.70, which is a satisfactory result for the internal consistency of the questionnaire (Ravens-Sieberer et al., 2010).

Statistical Analyses

In processing the data for all variables in the study, the basic descriptive parameters were calculated: arithmetic mean, standard deviation, minimum and maximum values, and Skewness and Kurtosis. A simple linear regression analysis was performed to determine the connection between student quality of life as predictors and cardiorespiratory fitness as a criterion. Statistical significance of differences was tested with significance level $p < 0.05$. Data processing was performed using STATISTICA version 14.0.0.15, TIBCO Software Inc.

RESULTS

Table 1. *Descriptive indicators of quality of life assessment, anthropometric characteristics, and cardiorespiratory fitness for the entire sample (N = 651)*

Variables	Mean±Std.Dev	Median	Min	Max	Skewness	Kurtosis
Health assessment	4.30 ± 0.74	4.00	2.00	5.00	-0.80	0.08
Physical form	4.26 ± 0.84	4.00	1.00	5.00	-1.16	1.31
Energy level	4.38 ± 0.75	5.00	1.00	5.00	-1.22	1.61
Mood	1.88 ± 0.92	2.00	1.00	5.00	1.26	1.63
Loneliness	1.47 ± 0.89	1.00	1.00	5.00	2.25	4.80
Personal time	4.15 ± 0.98	4.00	1.00	5.00	-1.14	0.76
Free time	4.22 ± 0.94	4,00	1.00	5.00	-1.12	0.52
Relationship with parents	4.68 ± 0.65	5.00	2.00	5.00	-2.13	4.24
Fun with friends	4.53 ± 0.79	5.00	1.00	5.00	-1.88	3.36
Academic achievement	4.12 ± 0.85	4.00	1.00	5.00	-0.66	-0.14
Learning indicator	4.41 ± 0.86	5.00	1.00	5.00	-1.59	2.34
Overall estimate of quality of life	4.33 ± 0.48	4.40	2.20	5.00	-1.17	1.62
Body height (cm)	147.92 ± 7.23	147.60	124.60	174.00	0.24	0.17
Body weight (kg)	41.03 ± 9.93	39.50	21.90	82.60	0.89	0.77
Body fat (percent %)	19.21 ± 7.57	18.20	4.50	44.40	0.55	-0.29
Body mass index (BMI)	18.57 ± 3.45	17.90	12.70	31.40	0.95	0.68
Maximal oxygen uptake VO2max (mL/kg/min)	45.16 ± 3.78	44.60	37.90	58.30	0.76	0.20

MEAN=arithmetic mean; SD = standard deviation; MIN = minimum result; MAX = maximum result; Skewness =asymmetrical distribution; Kurtosis = tailedness of distribution;

Table 1 shows the descriptive values of the participants' assessment in the dimensions of the KIDSCREEN-10 questionnaire. Students experience their quality of life as relatively high (4.33). The highest assessments of quality of life are related to relationships with parents and family and fun with friends. The lowest scores are found in the dimensions of academic achievement, free time, and loneliness. Self-assessment of health is at a high level. The results of Table 1 also show that the students have an average height of 147.92±7.23 centimeters and a body weight of 41.03±9.93 kilograms. The result for fat percentage (%fat) is 19.21% and body mass index (BMI) is 18.57, indicating that the students had a balanced diet. The results for the values used to estimate maximal oxygen uptake (VO2max) are 45.16 ml/kg/min. The values of the asymmetry of the distribution are in an acceptable range, and the elongation of the distribution shows slightly higher values for individual variables. The values of asymmetry and distributional curvature were taken for samples with more than 300 participants, for those whose values met the threshold: (Kim, 2013) greater than 2 and greater than 7, and parametric statistical analyses were used for the variables in the study.

Table 2. *Results of the regression analysis used to determine the correlation between quality of life and cardiorespiratory fitness in fourth-grade students*

Model	R	R2	Adjusted R	SE	Durbin-Watson	F	p
1	.24	.06	.06	3.67	1.64	39.83	0.00*

*R = multiple correlation coefficient; R2 = coefficient of determination; Adjusted R = corrected coefficient of determination SE = standard error; p = p-value *at the error level p < 0.05*

Table 2 shows the results of the regression analysis, where the statistical significance of the regression model is found in the F-test value (F = 39.83; p = 0.00). Accordingly, this model can be considered as predictively valid. The value of the coefficient of determination (R = 0.24) between quality of life and cardiorespiratory fitness is low but statistically significant. The significant association between predictor and criterion variables explains the 6% of joint variability. The value of the standard error (SE = 3.67), as an indicator of the standard deviation of the dispersion of the measured results around the direction of regression, shows a relatively large imprecision of the regression model. The results of the Durbin-Watson test show that there is no autocorrelation in the residual.

Table 3. *Results of the analysis of variance - ANOVE in the regression model*

	Sums of Squares	df	Mean Squares	F	p
Regression	535.88	1	535.88	39.83	0.00*
Residual	8731.19	649	13.45		
Total	9267.06				

*Df- degrees of freedom; F coefficient of mean squared for regression and residual; p significance level; *at error level p < 0.05*

The results of the analysis of variance in Table 3 based on the results of the F-test (F = 39.83) show the statistical significance (p = 0.00) of the regression model and indicate the suitability of the predictor model for regression analysis.

Table 4. *Test results for determining the significance of the regression coefficient of the predictor variables*

	Standardized coefficient		Unstandardized coefficient			
N = 651	β	Std.Err.	B	Std.Err.	t(649)	p-value
Intercept			36.90	1.32	27.99	0.00*
Quality of life	0.24	0.04	1.91	0.30	6.31	0.00*

*B = beta standardized regression coefficient; B = beta nonstandardized regression coefficient; Std.Err= standard error; t = t-value; p-level of significance; *at error level p < 0.05*

Table 4 shows that the regression coefficient (p = 0.00) of the predictor variables for quality of life is significant. The regression coefficient (b = 0.24) for the predictor variable shows the magnitude or direction of the slope in the sample. An increase of 1 standard deviation in the predictor variable will result in an increase of 0.24 standard deviation.

DISCUSSION

Based on the objective of the study, it can be concluded that there is a statistically significant relationship between quality of life and cardiorespiratory fitness in elementary school students in the Republic of Croatia. A positive correlation between quality of life and cardiorespiratory fitness was found in the participants of this study. The 20mSRT Shuttle running test showed that the maximum oxygen uptake (VO2max) of the students was 45.16 mL/kg/min. This value was higher than the results of the studies by (Bustos-Barahona, Delgado-Floody, &Martínez-Sa-

lazar, 2020; Langer, de Fatima Guimarães, Gonçalves, Guerra-Junior & de Moraes, 2020; Caamaño-Navarrete, Latorre-Román, Párraga-Montilla, Álvarez, & Delgado-Floody, 2021; Tanaka, Tremblay, Okuda, & Tanaka, 2020). The study by Álvarez et al. (2020) showed the same results as this study, while the study by Nqweniso et al. (2020) showed lower values. The participants experience their quality of life as very high. Results from the overall study sample showed a high mean score on the composite variable for assessing overall quality of life (4.33). Quality of life scored high among children living in countries with higher living standards (Dumuid et al., 2017). The dimensions such as relationship with parents and family and fun with friends showed high scores. On the other hand, the dimensions of academic achievement and leisure had the lowest scores. These results are due to school overload and lack of free time to spend on activities of their choice. The study participants rated their health status as high. The coefficient of determination between quality of life and cardiorespiratory fitness is low but statistically significant. Increasing quality of life can significantly influence cardiorespiratory fitness, but the reverse is also true, as increasing cardiorespiratory fitness may well increase quality of life. This fact refers to the feeling of satisfaction, as they create positive values by combining various activities with physical exercise.

In the study by Marković et al. (2022), similar results were obtained. They find that better aerobic capacity contributes to better health and quality of life, while age has the opposite effect. With age, health and thus quality of life decreases. A significant connection between cardiorespiratory fitness and quality of life was also found in the studies by (Andersen et al., 2017; Evaristo et al., 2019; Bottolfs et al., 2020). In addition, a growing number of studies show that cardiorespiratory fitness is associated with better quality of life in children and adolescents (Gu, Chang, & Solmon, 2016; Marques, Mota, Gaspar, & de Matos, 2017; Pires-Júnior et al., 2018). No significant connections were found between aerobic capacity and quality of life in the studies (Basterfield et al., 2021 and Salvini et al., 2018). Lifestyle factors have different effects on physical activity status, so it is important to examine all unifying elements such as physical fitness, sedentary lifestyle, and obesity status (Tambalis, Panagiotakos, Psarra, & Sidossis, 2019). Our study participants have not yet officially entered puberty and at this age it is possible to take preventive measures and improve cardiorespiratory fitness and thus quality of life. As the number of physically active students decreases during adolescence and people become less active over time, it is not surprising that quality of life decreases with age (Marković et al., 2022).

CONCLUSION

The results obtained in this study should stimulate further research on the relationship between cardiorespiratory fitness, physical activity, and quality of life in order to improve the overall health of children and adolescents. Assessing and identifying the level of cardiorespiratory fitness and quality of life of elementary school students should play the key role in monitoring the health of this population. Improving cardiorespiratory fitness together with good nutritional habits should form the basis for school-based intervention programs. In this way, we could have a direct impact on the health of elementary school students. Changing lifestyle habits will impact quality of life and benefit health as we age. The use of exercises that promote the development of cardiorespiratory fitness in children and adolescents could prevent obesity, which is one of the negative components of health status in modern times.

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