

THE CONNECTION BETWEEN DIGITAL APPLICATIONS FOR PHYSICAL EXERCISE AND THE LEVEL OF KINESIOLOGICAL ACTIVITY OF ADOLESCENTS

SUMMARY OF DOCTORAL THESES

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Physical inactivity is the fourth-largest behavioral factor contributing to poor health and mortality (NCD, 2021). The number of adults who are physically inactive is increasing in many countries, affecting the prevalence of non-communicable diseases and the general health of the global population. Participation in regular physical activities reduces the risk of non-communicable diseases by improving muscular and cardiorespiratory fitness (NCD, 2021). However, currently 25% of adults in the world do not meet recommendations for physical activity (WHO, 2021). Physical activity is essential for healthy aging. The advantage of digital exercise apps over traditional approaches, especially among a younger, technologically advanced population, is that they provide an interactive, social, and personalized platform that helps users modify their own activity with minimal professional contact. Because mobile devices track users at almost all hours of the day, adolescents can seamlessly integrate health monitoring into their daily schedule. Therefore, teenagers can find a digital application for physical exercise that stimulates their kinesiological activity and thus has a positive effect on their health. Mobile health apps are very popular today and provide new opportunities for changing health-related behaviors and managing chronic conditions. Typical fitness apps provide immediate access to health information, provide reminders, or help track progress in an exercise regimen. Health and fitness apps have gained popularity in interventions to improve nutrition (Schoeppe, Alley, Van Lippevelde, Bray, Williams, Duncan, & Vandelanottev, 2016), physical activity, and reduce sedentary behavior. Systematic literature searches conducted by Schoeppe et al. (2016) were based on five databases to identify papers published between 2006 and 2016. Studies included in the analysis referred to those that investigated the use of smartphone applications to improve nutrition, increase physical

activity, and reduce sedentary behavior. The final outcomes were changes in health behaviors and related health outcomes (i.e., fitness, body mass, blood pressure, glucose, cholesterol, and quality of life). This review provided modest evidence that app-based interventions to improve diet and physical activity and reduce sedentary behavior can be effective. It is necessary to state that there are not many papers that dealt with this area, which on the one hand was a difficulty in collecting sources, while on the other hand was a challenge regarding its scientific contribution. According to a number of definitions (Findak, 1995; Klavora, 2008; Momirović, 1969; Mraković, 1971, 1992, 1997), kinesiology as a science “studies the effectiveness of human movement, the controlled process of exercise, its laws, and its consequences on the human organism in the broadest sense” (Prskalo and Sporiš, 2016, p. 12) and strives to fulfill its futuristic role in securing the future of humanity, and above all in its most sensitive and vulnerable part. This role is fulfilled through all its applied areas or branches, and especially through kinesiological education, which is the only one that implies complete inclusion of the population with the mandatory subject called Physical and Health Culture throughout the entire duration of compulsory education. By the term kinesiological activity, we mean the total set of conventional and unconventional activities with the primary function of acquiring motor skills in the former or developing abilities in the latter, divided according to the complexity of the structure into monostructural, polystructural, aesthetic, and complex activities (Mraković, 1997; Findak, Prskalo, 2004).

Smartphone applications are recognized as a potential and promising approach to increasing adherence to physical activity guidelines (Laranjo, Ding, Heleno, Kocaballi, Quiroz, Tong, Chahwan, Gabarron, Dao, Rodrigues, Neves, Antunes, Coiera, & Bates, 2021). By using modern technology, not only the educational school system but also students and teachers get faster and more motivated access to scientific and professional data needed for teaching and learning and achieve the set learning outcomes faster and better (Jandrić, 2015).

At the beginning of 2020, the world was affected by a coronavirus pandemic, and many countries around the world, including the Republic of Croatia, had to come up with various strategies to prevent the spread of the virus. Due to the outbreak of this virus, many countries had to impose various rules and regulations to limit social life and education in order to reduce the spread of the virus. This referred to various types of isolation, including a ban on traveling and meeting in public places, sports activities, holding concerts, and even going to work and school. This pandemic had a very negative impact on people’s lives, as it stopped life as it had been known. Education was also stopped during the pandemic, and schools were closed in almost 200 countries around the world, including the Republic of Croatia. It was during

this period that distance learning began using modern technology. Information and communication technology is a generic term, defined as a diverse set of technological tools and resources used to communicate, create, disseminate, and manage information (Blurton, 1999). In Physical and Health Culture classes, this includes all communication devices or applications, including heart rate monitors, speedometers, cameras, radio, television, smartphones, computers, network hardware and software, satellite systems, and the like, as well as various services and applications related to them. More frequent use of information and communication technology in teaching Physical and Health Culture could contribute to an increase in the quality of teaching Physical and Health Culture by using its many advantages, such as easy access to images, videos, and other resources, the ability to easily explain complex information and motor skills, having more interactive classes, and expanding communication between students even after Physical and Health Culture classes. It has become increasingly difficult to protect children from exposure to technology and its negative impact on their development, rest, physical activity, and mental health. On the other hand, mobile devices are also recognized as a potentially useful tool in monitoring health and promoting an active lifestyle (Khan, Marvel, Wang, and Martin, 2017) and can potentially be used for diagnostic purposes in the detection of acute coronary syndrome (Rathi, Kalantri, Kalantri, and Rathi, 2016), arrhythmias (Sardana, Saczynski, Esa, Floyd, Chon, Chong, and Mcmanus, 2016), or blood pressure (Plante, Urrea, MacFarlane, Blumenthal, Miller III., Appel, and Martin, 2016) and can help patients reach their health and physical goals more easily (Higgins, 2016). Today, there are numerous mobile applications created for sports activities such as running, cycling, and sports training, followed by those for healthy nutrition and water intake, body weight control, and the promotion of a healthy lifestyle. It is important to emphasize that mobile applications intended for physical exercise and sports training should also be implemented in other areas under the supervision of trained experts. Bardus, van Beurden, Smith, and Abraham (2016) mention that the content of the mentioned applications must be based on scientific knowledge and professional information in order for their impact on users' perceptions, habits, and actions to be positive.

Smartphones are inexpensive today and allow users to engage with health information technologies in any environment and at any time. They are equipped with advanced technological features, most notably Internet connectivity, a global positioning system, and built-in accelerometers, and offer the ability to create individualized and interactive applications for real-time data collection. These features, as well as the widespread use and convenience of smartphones, make them an attractive tool for researchers providing physical activity interventions. A part of information and

communication technology are also modern digital watches that have appeared on a larger scale in the last five years, which are connected to smartphones and contain very serious applications that can not only monitor numerous student activities, but also directly provide them with important information, such as the amount of calories burned, time spent standing and exercising, heart rate, types of activities they engaged in during the day, to warn them if they did not sleep enough considering their age, but also to warn them about nutritional activities that should be performed during the day, including the need to occasionally stop activities and briefly concentrate and relax, breathing calmly. The good thing about such classes is that a student can either determine the amount of daily movement himself or accept one of the proposed programs with regard to age, height, and body weight. Such programs encourage many people to be physically active because it is in human nature to reach what they have chosen or set as a goal. Using a smart watch connected to a smartphone, students can also receive messages from teachers about the need to perform various physical activities, which was very useful during online classes. Information and communication technology (ICT) is becoming an increasingly important part of teaching and kinesiology activities. Adolescents are responsible for starting to learn how to take care of themselves, and digital applications for physical exercise provide them with an opportunity to put their health in their own hands (Chan and Cheng, 2017; Vojtisek, 2019; Karuc, Mišigoj-Duraković, Marković, Hadžić, Duncan, Podnar and Sorić, 2020; Wiseman and Weir, 2017; Strong, Malina, Blimkie, Daniels, Dishman, Gutin, Hergenroeder, Must, Nixon, Pivarnik, Rowland, Trost and Trudeau, 2005).

The main goal of this doctoral dissertation is to determine to what extent kinesiological activity among adolescents is related to the use of digital applications for physical exercise and to knowledge of the possibility of using applications for physical exercise. Additionally, we wanted to determine whether kinesiological activity is conditioned by a positive attitude towards the use of digital applications for physical exercise and whether adolescents' kinesiological activity is related to regional affiliation. Ultimately, the intention is to determine whether the social status of the family conditions better material support for the use of digital technology and whether it causes greater kinesiological activity in adolescents.

The research hypotheses are listed below:

1. There is a statistically significant positive correlation between the kinesiological activity of adolescents and the level of use of digital applications for physical exercise.

2. There is a statistically significant positive correlation between the kinesiological activity of adolescents and the possibility of using digital applications for physical exercise.
3. There is a statistically significant positive correlation between the kinesiological activity of adolescents and their attitude towards the use of digital applications for physical exercise.
4. There is a statistically significant positive correlation between the social status of the family and the use of digital technologies for physical exercise and kinesiology activity among adolescents.
5. The kinesiological activity of adolescents differs statistically significantly depending on the students' regional affiliation.

Two questionnaires were used to collect data: the Croatian version of the *Questionnaire* (Vidaković-Samaržija and Mišigoj-Duraković, 2013) for assessing the overall level of physical activity of younger school-aged children (PAQ-C) (Kowalski, Crocker, and Donen, 2004), as well as the *Questionnaire for assessing students' attitudes in relation to the use of mobile applications intended for physical exercise*, with a total of 12 variables. The research covered two regions in the Republic of Croatia: the coastal region with islands (the island of Krk) and the continental region (the towns of Petrinja and Velika Gorica). We wanted to see if there is a difference in the use of digital applications for physical exercise depending on the region and how much and if their use affects the kinesiological activity of adolescents. The cluster sample consisted of eighth-grade elementary school students. The total sample consisted of 349 students, with an average age of 14 years and an equal gender ratio, and is presented in detail in the research results chapter.

Data were analyzed with descriptive statistics (mean values, dispersions, the curve, and flatness of the distribution) and normality of distributions (Kolmogorov-Smirnov test), and hypotheses were tested with inferential statistics.

In the area of the correlation plot, bivariate correlations (zero order) were tested with the Pearson correlation coefficient. A one-way ANOVA was used in the area of differential design for the fifth hypothesis. In the case of an inability to use ANOVA, the robust Welch test was used. The tests used were tested at a level of statistical significance $p < 0.05$.

In conclusion, it was established that the kinesiological activity of adolescents is significantly and positively correlated with the use of digital applications for physical exercise, with knowledge of the possibility of using applications for physical exercise, as well as with a positive attitude towards the use of digital applications for physical exercise. The correlation is small but statistically significant. Also, it was shown that there is a statistically significant difference in kinesiological activity

depending on regional affiliation and that it is statistically significantly lower in Velika Gorica compared to Petrinja and coastal Croatia with islands. And finally, the hypothesis that the social status of the family is related to the kinesiological activity of the students was not confirmed. The original scientific contribution is reflected in the creation of a new conceptual methodological framework for measuring the use of digital applications for physical exercise and the connection with the kinesiological activity of adolescents, which can be used in the long term and contribute to research on the same population and in other countries that have socio-demographic characteristics of adolescents similar to Croatia's. The obtained data are significant in theoretical space, which, considering relatively little research on modern digital applications, expects a more modern paradigmatic framework.