Journal of Sport and Health Research 2022, 14(1):31-50

Gomis-Gomis, M. J.; Chacón-Borrego, F.; Pérez-Turpin, J. A. (2022). Effects of physical activity program based on technological progress: exer-games as health promoters. *Journal of Sport and Health Research. 14*(1): 31-50.

Original

EFECTOS DE UN PROGRAMA DE ACTIVIDAD FÍSICA BASADO EN LOS AVANCES TECNOLÓGICOS: LOS ENTORNOS VIRTUALES MOTRICES COMO PROMOTORES DE SALUD

EFFECTS OF PHYSICAL ACTIVITY PROGRAM BASED ON TECHNOLOGICAL PROGRESS: EXER-GAMES AS HEALTH PROMOTERS

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Edited by: D.A.A. Scientific Section Martos (Spain)

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Received: 10/05/2020
Accepted: 18/06/2020

RESUMEN

La finalidad de este trabajo es analizar la mejora en la salud y calidad de vida de los niños/as y jóvenes detectados con sedentarismo y/o sobrepeso, mediante la aplicación de un programa de entrenamiento basado en los entornos virtuales motrices. En el estudio participaron un total de 359 niños y niñas de entre 3 y 12 años pertenecientes a cuatro centros escolares, de los que se seleccionaron 20 niños de entre 5 y 12 años, para formar dos grupos de 10 niños/as cada uno. El grupo experimental llevó a cabo el programa de entrenamiento, junto a pautas nutricionales, mientras que el grupo control no tuvo ninguna intervención. Las variables analizadas fueron el IMC y perímetro de la cintura, mediante mediciones antropométricas, el tiempo de uso de pantalla, el tipo de desplazamiento al colegio y el nivel de adherencia a la dieta mediterránea, medidos mediante cuestionario, y la imagen corporal, evaluado a través de las siluetas. Para complementar la investigación, se efectuaron valoraciones nutricionales iniciales y finales al grupo experimental. Se analizaron los estadísticos descriptivos para todas las variables, calculando para las variables cuantitativas la media, mediana y desviación típica; porcentajes y frecuencias para las variables cualitativas. Los resultados obtenidos pueden indicar que un programa de intervención motriz basado en los entornos virtuales motrices contribuye a promover la salud de los escolares con rasgos de sedentarismo y/o sobrepeso.

Palabras clave: sedentarismo; sobrepeso; salud; entornos virtuales motrices; escolares.

ABSTRACT

The purpose of this work is to analyse the improvement in the health and quality of life of children and youth detected with sedentary lifestyle and/or overweight, through the application of a training program based on exer-games. A total of 359 boys and girls between the ages of 3 and 12 from four schools participated in the study, from which 20 children between the ages of 5 and 12 were selected, to form two groups of 10 children each. The experimental group carried out the training program, together with nutritional guidelines, while the control group had no intervention. The variables analysed were the BMI and waist circumference, through anthropometric measurements, screen time, the type of commute to school and the level of adherence to the Mediterranean diet, measured by questionnaire, and body image, evaluated at through the silhouettes. To complement the research, initial and final nutritional evaluations were carried out on the experimental group. Descriptive statistics for all variables were analysed, calculating the mean, median and standard deviation for the quantitative variables; percentages and frequencies for qualitative variables. The results obtained may indicate that a motor intervention program based on exer-games contributes to promoting the health of students with sedentary and/or overweight traits.

Keywords: sedentary lifestyle; overweight; health; exer-games; schoolchild.

INTRODUCTION

In today's developed societies, sedentary lifestyle and being overweight are a serious problem, especially among children and young people, since these stages are considered essential for acquiring healthy and active lifestyle habits that are far from the negative repercussions of inactivity. Physics (Sallis & Owen, 1999; Hernández, Varo & González, 2003). Numerous studies link overweight or obesity in the early ages with health problems and obesity in adulthood (World Health Organization, 2019; Dobashi, Takahshi, Nagahara, Tanaka & Itabashi, 2017), especially the relationship with diabetes and cardiovascular diseases, as well as with regard to mortality in adults (Ortega, Lavie & Blair, 2016; Bellisimo & Akhavan, 2015; De Ruiter, Olmedo-Requena, Sánchez-Cruz & Jiménez-Moleón, 2017; Fan, Song, Chen, Hui & Zhang, 2013; Eckel, Meidtner, Kalle-Uhlmann, Stefan & Schulze, 2016; Umer et al., 2017; Zapico, Blández & Fernández, 2010). According to the study carried out by NCD Risk Factor Collaboration (2017), the problem of excess weight in children worldwide, leads to health complications during the rest of life; it needs national and international measures for its treatment from comprehensive policies.

Sedentary lifestyle refers to all behaviour that occurs especially in a sitting or lying position, whose energy expenditure is at a level equal to or less than 1.5 METS, considering a MET the energy consumed during the resting state (The Sedentary Behaviour and Obesity Expert Working Group, 2010; Sedentary Behaviour Research Network, 2012; cit. in Solomon-Moore et al., 2017). The WHO (World Health Organization, 2019) defines overweight and obesity as an accumulation of abnormal or excess fat associated with health problems.

As fundamental causes of overweight and obesity, we find the change in world food towards foods composed mostly of fats and sugars, with a high calorie intake and with a minimal contribution of vitamins, minerals and healthy micronutrients; as well as the low physical activity and sedentary lifestyle associated with recreation that characterize current societies, together with the change in the type of transport (Santaliestra-Pasías et al.,2015; Sánchez-López et al., 2017; cit. in Sánchez-López, 2017; World Health Organization, 2019; Aguilar-Cordero et al., 2014; Ferrari et al., 2012). Active commuting to school is considered an important form of physical activity for children (Lubans, Boreham, Kelly & Foster, 2011; Chillón, Hales, Vaughn & Gizlice, 2014), investigations such as that carried out by Faulkner, Buliung , Flora & Fusco (2009) show that children who travel to school on foot, by bicycle or on a skateboard tend to be more physically active in general than children with a passive trip to school. We also highlight the increasing of screen time through television, video games, tablets ... along with the decrease in hours of sleep associated with these habits, increased in families with low levels of economic income and low educational level (AECOSAN, 2016; Varela-Moreiras et al., 2013; Ahrens et al., 2014). The International Obesity TaskForce (IOTF, 2019), also associates musculoskeletal problems, skin problems and infertility, respiratory difficulties, increased risk of premature death and certain types of cancer with obesity; in addition to hypertension and cholesterol. It also identifies the importance of the psychological consequences in obese people, such as low self-esteem, anxiety and depression. We emphasize in this sense the influence of overweight and obesity on body image and socialization (Varela-Moreiras et al., 2013). In this sense, Salvador, García-Gálvez & De la Fuente (2010) studied the relationship between the weight of young people with satisfaction or dissatisfaction with their body image and self-esteem, with body image being the vision that each person has about their body and parts of it, being decisive in the state of health of childhood and adolescence (Sánchez-Castillo, López-Sánchez, Ahmed & Díaz Suárez, 2019).

The WHO (World Health Organization, 2019) indicates a series of general recommendations on the consumption of fruits and vegetables, legumes, cereals and nuts, avoiding the consumption of saturated fats and sugars, in addition to carrying out a physical activity of at least 60 minutes at day. Aguilar-Cordero et al. (2014), in their objective of analysing the main studies on physical activity to reduce overweight and obesity, find that the best physical activity program is the one that combines aerobic and anaerobic activities, with better results on the reduction of overweight and obesity if it is accompanied by nutritional guidelines; a diet-only program also has minor effects than the sum of diet and physical activity; in accordance with the results of the studies by Solís et al. (2015) and Zapico et al. (2010) who carried out a joint program between diet and physical activity.

The Mediterranean lifestyle is considered the best pattern for the prevention and treatment of sedentary lifestyle, overweight and obesity (Varela-Moreiras el al., 2013; Zapico et al. 2010); considering it in its three pillars: diet, physical activity and socialization; through its gastronomic culture prioritizing fresh and seasonal food, the social aspect of meals, regular physical activity and rest.

Given this reality, one of the reasons for carrying out this study is the need to seek effective strategies to encourage voluntary participation in regular physical activities (Baranowski, Buday, Thompson & Baranoswski, 2008). The choice of activity is closely related to the level of enjoyment it brings (Mellecker & McManus, 2008; Epstein, Beecher, Graf & Roemmich, 2007), in fact, the reason that most often justifies participation in physical activities by of children is the extent of their "fun" character (Borra, Schwartz, Spain & Natchipolsky, 1995). Similarly, this motivation is what drives your interest in sedentary activities, such as video games.

In a society immersed in technologies and with high rates of sedentary lifestyle, active video games or virtual motor games represent a new social phenomenon that can have benefits for public health. Recent review papers on the role that video games can play in promoting healthy behaviours (Baranowski et al., 2008) or the possibilities offered by new technologies to deal with childhood obesity (Hillier, 2008), have already made reference to the potential of active video games as a tool to promote physical activity. With a proper approach, the perception of enjoyment does not decrease even when the level of physical demand increases as a consequence of the inclusion of active video games (Berkovsky, Coombe, Freyne, Bhandari & Baghaei, 2010). Virtual reality can promote overweight or obese children to have fun exercising (Baños et al., 2016). We know that active videogames involve higher Energy Expenditure (GE), Heart Rate (FC) and Maximum Oxygen Consumption (VO2max) than conventional videogames or other sedentary behaviours such as watching television (Lanningham-Foster et al., 2009; Graves, Stratton, Ridgers & Cable, 2007; Graves, Ridgers & Stratton, 2008; Maddison et al., 2007; Mellecker & McManus, 2008).

Given this reality, we propose as a general objective of this study to investigate the use of technological advances, to verify the improvement in the health of Spanish schoolchildren detected as sedentary and/or overweight, by applying a personalized training program, based on exer-games. As specific objectives, we intend to improve the health of detected schoolchildren who are treated with exer-games, assess the anthropometric changes produced in children, analyse the importance of the commuting to school for children in relation to the level of sedentary lifestyle and overweight, examine the influence of screen time as a determinant of sedentary lifestyle and overweight, assess the effect of nutritional guidelines on sedentary behaviour and excess weight, detect psychological factors related to physical inactivity and, of course , provide relevant information on the possibilities of evaluating sedentary lifestyle and overweight.

METHODS

Participants

The reference sample size for the study consists of a voluntary initial sample of a total of 359 boys and girls (192 boys and 167 girls) aged between 3 and 12 years, 13 boys and 14 girls from Early Childhood Education and 179 boys and 153 girls of Primary Education, belonging to four schools in the province of Alicante. Of the 359 boys and girls who initially make up the sample, for our research we have finally selected a total of 20 boys and girls (10 boys and 10 girls) aged between 5 and 12 years, diagnosed as having a level of Body Mass Index (BMI) equal to or above the level listed by the WHO (World Health Organization, 2019) as overweight, presenting symptoms of sedentary lifestyle and/or convenience according to their family, school, social, cultural and psychological situation reported by the school.

Considering BMI as an indicator of overweight or obesity, according to the WHO (World Health Organization, 2019), for adults, overweight corresponds to a BMI equal to or greater than 25; considering obesity a BMI equal to or greater than 30. For children, in addition to BMI, we must take into account age and gender when establishing levels of obesity or overweight. Up to the age of five, the weight for height that deviates from the median of the infant growth patterns established by the WHO by more than two standard deviations is considered overweight; obesity is due to more than three standard deviations.

From age five to nineteen, BMI is considered overweight for age that deviates from the median established by WHO child growth standards by more than one standard deviation; obesity corresponds to more than two standard deviations. As indicated by Varela-Moreiras et al. (2013), considering the BMI curves according to age and gender, obesity corresponds to a percentile equal to or greater than 95, overweight with a percentile equal to or greater than 85 to below 95.

Design

Depending on the nature of the objectives to be achieved, in this research a quasi-experimental design has been adopted, in which the subjects were chosen in accordance with certain criteria, taking measures before and after the intervention, in two groups, experimental group A and control group B.
The experimental group was made up of a total of 10 children (4 girls and 6 boys). The experimental group underwent a physical activity program through technological advances, using exer-games for this. The experimental group was divided into two subgroups of 5 children each, each subgroup carrying out a total of 3 sessions lasting 60 minutes each, establishing one session per week, for a total of three weeks of intervention. The experimental group, during the three weeks of intervention, also underwent a nutrition program based on initial and final evaluations, in addition to an individual session with each boy and girl with their families, in which they were offered guidelines and advice nutritional.

On the other hand, the control group made up of 10 children (6 girls and 4 boys) diagnosed in the initial evaluation with symptoms of sedentary lifestyle and overweight, did not participate in any of the programmed activities and only the initial and final measures were collected.

In the present study, six variables were analysed as indicators of the level of sedentary lifestyle and/or overweight for the entire sample. Anthropometric measurements, specifically, firstly, BMI, for the calculation of which weight and height were measured, since it results from dividing the weight expressed in kilos by the height squared expressed in meters (Kg/m2); and secondly, the waist circumference. Thirdly, screen time, the type of commuting to school as the fourth study variable, the level of adherence to the Mediterranean diet in fifth place and, finally, body image as the last study variable.

Regarding anthropometric measurements, we have followed the indications of the ALPHA project (Ruiz et al., 2011) for the choice of BMI and waist circumference as indicators of body composition in children from the six years, following their measurement criteria, using a Taurus model scale and a tape measure. We have based ourselves on the PREFIT battery of field tests (Ortega et al., 2015) for evaluation in pre-schoolers, that is, in boys and girls under the age of six (from three to five years), which is the continuation of the project ALPHA.

The variable of screen time has been used as an indicator of sedentary lifestyle in children and, therefore, as a possible factor contributing to the level of overweight. It is considered that there is a relationship between hours of screen time with a poorer quality of life and greater chances of being overweight, with an exposure greater than or equal to 2 hours of screen time per day (Stiglic & Viner, 2019). Following Stiglic & Viner (2019), in the present study, the screen time referred to the time dedicated to the use of the computer, mobile, tablet or television, in an item of the questionnaire provided to children, distinguishing between 1 hour, 2 hours, 3 hours or 4 hours, assigning the 4-hour response as a level 0 for considering it excessive, and the rest with a level 1 for being less harmful to children's health.

Following Rodríguez-Rodríguez, Cristi-Montero, Celis-Morales, Escobar-Gómez & Chillón (2017), to evaluate the type of displacement that each child goes to school, two categories belonging to an item of the questionnaire used were distinguished. in research, provided to children. Firstly, active displacement (riding or cycling) and passive displacement (car, motorcycle or bus).

The KIDMED test for adherence to the Mediterranean diet is made up of 16 questions whose total score can lead to an optimal diet (score greater than or equal to 8), need for improvement (from 4 to 7) or of very low quality (Serra-Majem et al., 2007; cit. in Solís, 2015). In our case, we used the KIDMED test adapted to Early Childhood Education and the first years of Primary Education, with drawings to represent the possible answers in 10 items. Each item was rated with a 1, if the answer was for a healthy diet, or 0, when the answer was for an unhealthy diet, adding up all the scores and obtaining an index. The higher the index, the greater adherence to the Mediterranean diet.

Specifically, only in the experimental group, at the nutritional level, those related to body composition using portable bioimpedance (TANITA BC-601) and child anthropometry (measurements of the rest of body perimeters, skin folds and diameters) have also been used as quantitative tools. arm and leg bones); testing at the beginning and end of the study. In order to study eating habits, the self-administered short consumption frequency questionnaire (CFC) was also administered to parents at the beginning of the program, validated for the Spanish population (Trinidad-Rodríguez & Fernández-Ballart, 2008) and the 24-hour reminder (R24), used by Serra-Majem et al. (2004), among other authors, through a personal interview in the presence of the parents/guardians of each child, before and after the program. For the development of the nutritional advice session with families, the Hardvard balanced plate was used with the instructions for use, the Mediterranean healthy eating wheel with explanation, a table with the recommended frequency of consumption of the different food groups and an example of weekly distribution.

The silhouettes of Stunkard, Sorensen and Schlusinger (1983) constitute an instrument for evaluating body image, consisting of nine silhouettes from the thinnest to the most obese, in which children must choose the image they think corresponds to their body and the image they would like to have (Stunkard et al., 1983; cit. in Sánchez-Miguel, González, Sánchez-Oliva, Alonso & Leo, 2018). In our case, the children rounded off the silhouette with which they felt most identified and were also asked to draw a tenth silhouette. Therefore, 10 figures formed the basis for evaluating the instrument. For each school, the lowest BMI in the sample and the highest BMI were chosen as references to form a segment, dividing this segment into 10 portions or sections and assigning to each section a minimum and maximum BMI value; in such a way that given the chosen figure rounded and considering the BMI assigned to that section, each section was subtracted 0.10 until reaching the section corresponding to its actual BMI. The children had a 1 point in the silhouettes as long as the value of their real BMI was within the section corresponding to that BMI.

To carry out the training program, we were able to count on the basic gym equipment of each school (mats, cones, Swedish benches, balloons, chairs and rings). In addition, we use the following technological material:

- Maxforce interactive dynamometer
- Samsung Galaxy TAB A 10.1 ”32 GB T580 Tablet
- Samsung Gear Fit 2 Pro Black Activity Tracker
- Xbox 360 game console
- Kinect Adventures action video game, with the Kinect sensor for Xbox 360
- Digital board and computer provided by each school

The Maxforce interactive dynamometer is considered a motivating scientific instrument for measuring force and training a variety of muscle groups, given its audio-visual support in tablet or mobile format in which children view interactive games in which they participate with their dynamometer, working the force in the upper and lower body, in a variety of exercises; dynamometer whose validity and reliability have been endorsed by Pérez-Turpin, Gomis-Gomis, Pérez-Suárez & Suárez-Llorca (2019).

Using the activity bracelet, we can record heart rate and heart zones and obtain statistics of the sessions carried out, in order to develop training sessions more appropriately and as a motivating element for children.

The Xbox 360 video game console with the action video game Kinect Adventures was used as a tool in the training of children, and could be used as a more motivating instrument than traditional exercise, as shown by the study of this exergame by McDonough, Pope, Zeng , Lee & Gao (2018) and even have application in training for the rehabilitation of certain pathologies (Arman, Tarakci, Tarackci & Kasapcopur, 2019).

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Procedures

Prior to the start of the study, the management of the centre was informed about the objectives and type of tasks to be carried out during the course of the investigation. In addition, informed consent was obtained in writing from all the fathers, mothers or guardians of the children included in the study, who also collaborated in the study.

The data collection in the initial phase was carried out at the facilities of the University of Alicante, where each school was invited one day to make an excursion in which they enjoyed a circuit of stations; anthropometric measurements constituted one of the stations and another station the silhouettes of Stunkard, Sorensen and Schlusinger (1983) together with the questionnaire. This questionnaire was made up of 10 nutritional items, 1 item related to screen time and a last item on the type of commute to school, with a total of 12 items that were answered directly by each child; with the help and explanation from professional collaborators.

The intervention phase for the Experimental Group was carried out for 3 weeks, between the months of May and June 2018, which consisted of the application of a training program using exer-games together with nutritional guidelines, as well as specific measurements of the nutrition program. The measurements of the nutrition program were carried out the week before and the week after with respect to the duration of the training program, taking place in a session in each school in the morning and with the families to indicate the nutritional guidelines.

The experimental phase was carried out by dividing into two groups of 5 children each, each subgroup carrying out a total of 3 sessions lasting 60 minutes each, one session a week for the 3 weeks duration, through games in five stations, in the afternoon after the end of the school day. In each session, the children had 4 coaches, with the sessions of the intervention phase being carried out in each school, in a classroom equipped for the program. The nutrition program and nutritional assessments were conducted by an experienced nutritionist, ISAK I anthropometrist.

After the program, a session was held in each centre to evaluate and measure again the same variables as in the initial evaluation.

Statistical Analysis

For the analysis of the data, the Statistical Package for Social Sciences (SPSS) v. 25.0 for Windows, a normality and variance homogeneity test were initially performed, applying the Student's t test for independent samples, without statistically significant differences in the sample data. The level of significance was determined as $p \leq 0.05$ for significant values.
Descriptive statistics for all variables were analysed, calculating the mean, median and standard deviation for the quantitative variables; percentages and frequencies for qualitative variables. The DIAL diet analysis program was used to analyse the results obtained in R24 for the experimental group.

RESULTS

This section shows the results obtained in the present investigation, with the graphic representation of the most relevant data. Firstly, the main descriptive statistics of the study variables are analysed, specifically, those referring to the anthropometric variables BMI and waist circumference, adherence to the Mediterranean diet as a factor related to nutritional intake and body image in Regarding the perception of health. Second, the frequencies and percentages of the categorical variables related to the screen time and the type of commuting to school are estimated.

The descriptive study begins with Table 1 and Table 2. In Table 1 we can see the statistics referring to the pre-test, both in the control group and in the experimental group; Table 2 shows the statistics for the post-test; In both cases, an attempt was made to establish the mean, median and standard deviation for each variable, in addition to including the data referring to weight and height.

Regarding the standard deviation in the experimental group, for each variable a decrease is observed from the results of the pre-test and the post-test, which seems to indicate more homogeneous results regarding the mean in this group after the intervention phase, especially in adherence to the Mediterranean diet and body image. Regarding the control group, less pronounced decreases in the standard deviation of the variables are observed, except for the case of the waist circumference.

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The median for the BMI case in the control group remains the same in the post-test, while in the experimental group it decreases. The median waist circumference for the experimental group decreased after the intervention, going from 80.5 to 78.5, contrary to what occurs in the control group, with an increase from 74.2 to 78. Regarding adherence to the Mediterranean diet, in the experimental group it remains in the highest score, that is, 10; in the control group it decreases from 9.5 to 9. Lastly, the median body image remains the same in the control group, increasing in the experimental group to its value 1, which is the maximum.

The graphical representation of the relationship of means between the pre-test and post-test for both groups is made from Table 3, with the comparison of means for each of the numerical variables of the study.

Table 1. Pre-test statistics

	Weight	Height	BMI	W cir.	M.D.	B imag.
CG, n=10						
Mean	41.992	1.3772	21.705	76.14	8.9	0.52
Median	44.45	1.4	22.35	74.2	9.5	0.5
S Dev.	9.28409	0.12503	1.5205	8.58943	1.37	0.09189
EG, n=10						
Mean	50,75	1.43	24.789	75.9	9.4	0.84
Median	50,8	1.445	26.1	80.5	10	0.85
S Dev	12.0920	0.12018	4.7457	14.3329	1.265	0.14298

Table 2. Post-test statistics

	Weight	Height	BMI	W cir.	M.D.	B imag.
CG, n=10						
Mean	44.79	1.393	22.72	76.3	9	0.53
Median	46.45	1.435	22.35	78	9	0.5
S Dev.	10.1018	0.12884	1.4987	7.14998	1.054	0.06749
EG, n=10						
Mean	50,26	1.43	24.215	74	9.8	0.99
Median	51.15	1.445	25.215	78.5	10	1
S Dev	11.9482	0.12018	4.5391	13.7436	10.44	0.03162

Table 3. Comparison of means according to the group in Pre-test and Post-test

	Pre-test	Post-test
Control Group, n=10		
Weight	41.992	44.79
Height	1.3772	1.393
BMI	21.705	22.72
Waist circumference	76.14	76.3
Mediterranean Diet Adher.	8.9	9
Body image	0.52	0.53
Experimental Group, n=10		
Weight	50.75	50.26
Height	1.43	1.43
BMI	24.789	24.215
Waist circumference	75.9	74
Mediterranean Diet Adher.	9.4	9.8
Body image	0.84	0.99

In Figure 1, we observe how the mean BMI in the experimental group decreases from 24,789 to 24,215 after the intervention phase, while the mean BMI for the experimental group increases, from 21,705 to 22.72. The same trend follows the waist circumference, whose average increases for the control group, from 76.14 to 76.3, being lower in the post-test for the experimental group, going from an initial average of 75.9 to a final average of 74. at the mean values of adherence to the Mediterranean diet, improvement in both groups in the post-test; however, in the experimental group there is a greater increase, from 9.4 to 9.8, than in the control group in which it only improves from 8.9 to 9. Finally, in body image, the mean values rise in the experimental group of 0.84 to 0.99; while in the control group they improve only slightly, from 0.52 to 0.53.

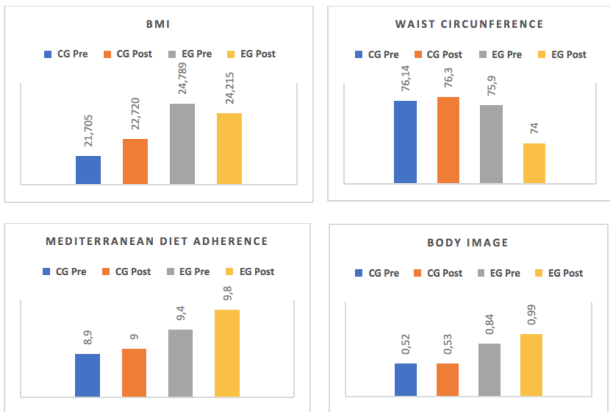

Figure 1. Representation of the means of the quantitative variables

The following tables show the frequencies and percentages related to screen time and type of commute to school, for the pre-test (Table 4) and the post-test (Table 5).

Regarding screen time, in the experimental group it remains the same both in the pre-test and in the post-test, in its maximum and most appropriate value, since 100% of the children who formed part of the intervention continues to be exposed to technological screens for a maximum of 3 hours a day.

In the control group, on the contrary, a worsening occurs, since in the pre-test 100% of the children used the new technologies for a time of up to 3 hours; In the post-test, one of the children increased their screen

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time to more than 3 hours, which corresponds to 10% of this control group.

Table 4. Pre-test frequencies

	Frequency	Percentage	Valid percentage	Accumulated percentage
CG, n=10				
Screen time				
Up to 3 h	10	100	100	100
More 3 h	0	0	0	0
Com. school				
Passive	10	100	100	100
Active	0	0	0	0
EG,n=10				
Screen time				
Up to 3 h	10	100	100	100
More 3 h	0	0	0	0
Com.school				
Passive	3	30	30	30
Active	7	70	70	100

Table 5. Post-test frequencies

	Frequency	Percentage	Valid percentage	Accumulated percentage
CG, n=10				
Screen time				
Up to 3 h	9	90	90	90
More 3 h	1	10	10	100
Com.school				
Passive	10	100	100	100
Active	0	0	0	0
EG,n=10				
Screen time				
Up to 3 h	10	100	100	100
More 3 h	0	0	0	0
Com. school				
Passive	1	10	10	10
Active	9	90	90	100

A more exhaustive analysis of the type of commuting to school can be done by looking at the following graphs that represent the percentage of active travel to school and the percentage of passive travel (Figure 2). It is alarming to verify that in the control group, the active displacement represents the value 0 for all children, therefore, 100% passively travels to school both in the pre-test and in the post-test. In contrast, the experimental group increased in terms of active displacement, going from 70% in the pre-test to 90% in the post-test; so, the passive displacement decreases from 30% to a final 10%.

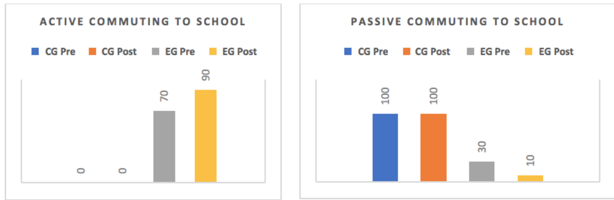

Figure 2. Percentage of active and passive commuting to school

To conclude, below, we highlight the main results derived from the nutritional program carried out only for the experimental group, made up of an anthropometric analysis together with a series of nutritional tips and guidelines.

To carry out the nutritional analysis, the experimental group was divided into two subgroups based on BMI, the first group with children with a BMI above the average, equivalent to 90% of the group, and the second group with a BMI below the average, which includes 10% of children. From the anthropometry performed in the pre-test, it is observed that the group with a BMI above the average, presents an average percentage of fat mass of 36.3 ± 6.8% and 40.4 ± 2.4% in terms of muscle mass; the group with the BMI below the average presented a fat percentage of 10% and a muscle mass of 42.8%. In the post-test, 100% of the children in the experimental group reduced the percentage of total fat by between 1% and 4%, in 30% the muscle mass decreased slightly (0.5-1%).

Regarding the consumption frequency questionnaire (CFC), in the subgroup with the BMI below the average, its average consumption is 1366 kcal, in which proteins represent 12.5%, carbohydrates a 36.6% and fat 49.6%. The average consumption of the subgroup with BMI above the average is 1951 ± 366 kcal, with 15.6 ± 3% protein, 47 ± 7.1% fat and 38.8 ± 7.9% carbohydrates.

As regards the results obtained from R24, comparing the results of R24 in pre-test and post-test, we observe that the distribution of macronutrients and fibre intake have not changed; although there has been a decrease in caloric intake of 630 kcal, reaching 1714 ± 247 kcal/day. Daily sodium and cholesterol intake have also been reduced in the post-test, with 1762 ± 599 mg for mean sodium values and 258 ± 88 mg for cholesterol. Intake of saturated fats has also decreased by 1.6%, with a lower intake of processed foods, rich in calories, cholesterol, salt and saturated fats, in accordance with the caloric decrease.

DISCUSSION

The primary objective of this study is to contribute to improving the health and quality of life of schoolchildren, specifically, in boys and girls who are overweight and/or sedentary; through a personalized training program and nutritional guidelines, using as a basis the exer-games, in such a way that technological advances can serve to fight sedentary lifestyle and overweight, instead of continuing to cause them.

In the results of our study, after statistical analysis, no statistically significant differences were found in the study variables, it can be assumed that a similar training program carried out in a sample with a greater number of children and of longer duration. could lead to significant differences. On the contrary, Solís et al. (2015) implemented a training program against overweight in 282 children from two Spanish schools, during two school years, considering BMI, abdominal circumference and eating habits through the KIDMED test. The experimental group decreased their BMI, improved their adherence to the Mediterranean diet and increased the percentage of students with a healthy diet; without obtaining statistically significant differences between the experimental and control groups.

In the present study we have used the BMI and the waist circumference as anthropometric indicators of the entire sample, despite its limitations; a more complete anthropometric analysis would have been possible, also using the fat mass index and the so-called waist/height index.

Regarding the results in BMI obtained in our sample, after the intervention phase, we have verified how the mean of BMI decreases in the experimental group, while in the control group it increases, both in relation to children and girls. This fact could be indicative of a decrease in overweight of children thanks to the intervention program carried out. Regarding the waist circumference, from the study results, we can determine that the mean increases for the control group after the intervention phase, decreasing for the experimental group; which could be indicative of a decrease in excess weight in children who have followed the intervention program.

According to Serra-Majem et al. (2003, cit. In Manonelles-Marqueta et al., 2008), although there are various tools to measure excess weight in children (such as skin folds, MRI, etc.), BMI is the most widely used. In any case, through BMI it is not possible to know if excess weight refers to increases in fat mass or fat-free mass (Freedman et al., 2009; Garemo et al., 206; cit. in Aristizabal, Barona, Hoyos, Ruiz & Marín, 2015), the thickness of the skin fold can be more precise with respect to body fat than the BMI (Watts et al., 2005; Acosta et al., cit. in Aristizabal et al., 2015); however, intra-abdominal fat is the most related to the risk of cardiovascular diseases, the thickness of the skin fold is more related to subcutaneous fat (Powell et al., 2007; The National Academic Press, 2001; cit. in Aristizabal et al., 2015).

BMI does not provide information on fat mass or fat-free mass (Wells et al, 2012; Nagy et al., 2014; Ahrens, 2014). In this sense, the fat mass index can be used as a body composition index, expressed in the same units as the BMI, calculated by dividing the body fat mass by the height in meters squared; the BMI, for its part, uses weight and height, that is, measures that are easier to obtain, and the BMI used worldwide allows comparisons to be made internationally (Aristizabal et al., 2015). A study carried out by Tomiyama, Hunger, Nguyen-Cuu & Wells (2016), indicates the importance of not depending solely on BMI when cataloguing people as unhealthy individuals at the cardiometabolic level, identified through this index as obese or overweight. In this sense, the cataloguing of overweight by the WHO is based on data from decades ago, by some authors the suitability of its review is suggested (World Health Organization, 2016; cit. in Afzal, Tybjærg-Hansen, Jensen & Nordestgaard, 2016). According to a study carried out by the *National Institute for Health Research* (NIHR, 2019), life expectancy is positively related to the pace when walking, not so much with the BMI.

Since the waist circumference or perimeter can be used as an indicator of overweight and obesity, specifically as a measurer of excess abdominal fat (Bacopoulou, Efthymiou, Landis, Rentourmis & Chrousos, 2015; Curilem-Gatica, Rodríguez-Rodríguez, Almagià -Flores, Yuing-Farías & Berral-de-la-Rosa, 2016, Dobashi et al., 2017); In our study, in addition to BMI as an anthropometric indicator, the waist circumference has been used. Although certain authors tell us about the suitability of the new waist/height index (Aristizabal et al., 2015; Curilem-Gatica et al., 2016).

The threshold used for the categorization of screen time in terms of 3 hours, is far above the main recommendations of national and international associations and organizations that usually indicate a maximum of 2 hours of exposure (Stiglic & Viner, 2019; Reid-Chassiakos et al., 2016); one would expect more exhaustive results using the increasingly restrictive 2-hour threshold. A more current study carried out among children from 4 to 13 years old indicates that staying in front of the television for more than 1.5 hours a day is already relevant for obesity (De Jong et al., 2013; cit. in Reid-Chassiakos et al., 2016), while an investigation with a sample close to 300,000 children and young people concluded that using screens for 1 to 3 hours can increase obesity from 10% to 27% (Braithwaite et al., 2013; cit. in Reid-Chassiakos et al., 2016). After the most current studies, Reid-Chassiakos et al. (2016) opens the possibility that the threshold of screen time should be between 1 and 1.5 hours a day to avoid excess weight in children and youth, more restrictive than the 2 hours a day currently proposed, as is the case of the *American Academy of Paediatrics*; which is a much more restrictive threshold than the 3-hour threshold used in our research.

Likewise, a more detailed analysis could have been carried out when considering the content viewed by children, according to the authors who defend the suitability of certain digital programs and tools as promoters of child development (Stiglic & Viner, 2019).

In the present study, after the intervention phase, only in the experimental group an increase in active displacement to school occurs, this increase could be a consequence of the application of the program that aims to enhance physical activity and decrease the level of excess weight of schoolchildren in the study. In our three-week study, there has been an increase in the active displacement of the experimental group together with a decrease in their BMI, in accordance with the results obtained by Rosenberg, Sallis, Conway, Canin & McKenzie (2006), those who affirm that children who move actively to school tend to have a lower BMI and if this behaviour continues for two years, a change in BMI or overweight is possible (Rosenberg et al., 2006). Active displacement to school promotes the level of physical activity, also associated with an increase in cardiovascular (Larouche et al., 2014) and cardiorespiratory fitness (Lubans et al., 2011). The time required for daily physical activity of 60 minutes can be met throughout the day, with the sum of each of the activities carried out, which may include walking or cycling to school (Manonelles-Marqueta et al., 2008).

The type of commuting to school has been classified as active (walking or cycling) and passive (motor vehicle), we could also have used a third category distinguishing between passive displacement (private vehicle) and semi-active displacement, that is to say , typical of buses or other public vehicles that involve a certain dose of physical activity (Rodríguez-Rodríguez et al., 2017).

More information would have been obtained by analysing the type of rural or urban context and its relationship with the prevalence of one type of displacement or another, as well as considering the distance from home to school and its influence on the choice of the form of displacement; the influence of infrastructure, characteristics of the environment, family influence and especially the fact of being accompanied to school or independently are interesting factors that have not been taken into account in this research (Chillón et al., 2014).

For body image measurement, a more standardized extraction of results from the silhouettes of Stunkard, Sorensen and Schlusinger (1983) would have allowed greater comparisons with the results of other studies; the use in addition to other instruments for body image or other psychological factors would have allowed obtaining more information about the sample (Sánchez-Miguel et al., 2018; Sánchez-Castillo et al., 2019; Maximova et al.,2008). In order to obtain data in the sample referring to the perception of the body image of each child, based on the results obtained using the silhouettes of Stunkard, Sorensen and Schlusinger (1983), we observed that after the intervention phase, in the experimental group, an increase in the index used, that is, children are perceived to be closer to their true BMI. In the control group it also increases but very little. As Cattelino, Bina, Skanjeti & Calandri (2015) indicates, overweight children tend to have a distorted perception of their body, underestimating their weight.

Although there are other instruments to measure body image (Cuervo, Cachón, Zagalaz & Mesa, 2018), body image silhouettes in relation to BMI are considered an adequate way to measure the level of excess weight (Pedro et al., 2016; Coelho et al., 2013; cit. In Sánchez-Castillo, 2019), various current investigations have used Stunkard's silhouettes, Sorensen y Schlusinger (1983) with this function (Sánchez-Castillo et al., 2019; López-Sánchez et al., 2017; Scagliusi et al., 2006).

The KIDMED test of adherence to the Mediterranean diet is an instrument used in various investigations as an indicator of the level of overweight, sometimes analysed in relation to body composition and level of physical activity (Alonso, Carranza, Rueda & Naranjo, 2014) , validated (Serra-Majem et al., 2004; cit. in Zapico et al., 2010).

As a result of the mean values in adherence to the Mediterranean diet, collected from the adaptation of the original KIDMED test, after the intervention phase both the control group and the experimental group show an improvement, although the rise has been greater in the experimental group. Results that do not directly agree with the BMI data of our sample in a direct and unidirectional way, but they do present better results in the experimental group after the program than in the control group.

In this sense, Alonso et al. (2014) in his research, he measured the BMI of the subjects in his sample and the KIDMED test every month, concluding that there is no correlation between the test data and the BMI. Zapico et al. (2010), on the other hand, in his study with 406 boys and 408 girls, he measured adherence to the Mediterranean diet using the KIDMED test, along with anthropometric measurements, including waist circumference and BMI, as in our research, concluding that nutritional results at the national level have worsened for a decade, the early detection of overweight being very important.

In the post-test, 100% of the children in the experimental group reduced the percentage of total fat by between 1% and 4%, in 30% the muscle mass decreased slightly (0.5-1%). Therefore, from these results, it seems that the combination of training and dietary guidelines can change the body composition of children in three weeks.

In the post-test, it has been observed that the distribution of macronutrients has not changed, nor has fibre consumption, since eating habits are not easy to change when they are based on foods rich in fat, sugars and low fibre intake. ; in accordance with Manonelles-Marqueta et al. (2008), eating patterns are the result of culture, tradition and geography. On the other hand, Varela-Moreira et al. (2013) that at present there are family and work limitations that do not allow adequate time to be spent buying, preparing and consuming food that favours the intake of cheaper and more prepared products; In this sense, it is important for administrations to improve this situation (NCD Risk Factor Collaboration (2017); Varela-Moreira et al., 2013). The decrease in caloric intake in the experimental group could be due to a slight decrease in the consumption of processed foods.

Therefore, with the analysis of nutritional results, based on the training program combined with healthy eating guidelines, we can verify a decrease in BMI with the reduction of fat mass, also decreasing the consumption of processed foods with a high level of cholesterol, salt and saturated fat; leading to improvements in children's health.

Nutritional evaluations only carried out on the experimental group regarding infant body composition and anthropometry, complementary to the BMI and waist circumference results, could have been extended to the entire sample for a more complete analysis.

In this research, a personalized training program of three weeks duration, with a 60-minute session per week, based on motor technological advances, along with nutritional guidelines for children and their families, has been carried out. in order to promote physical activity, the reduction of overweight and the improvement of children's health and quality of life. In this sense, López-Sánchez et al. (2019) indicates the suitability of programs that combine physical activity and diet, to reduce lean mass and BMI, and consider the importance of psychological aspects, as well as the role of the family. It is, therefore, necessary to consider this fact as support for our weekly session of the training program carried out, for 3 weeks; training program that combined aerobic and anaerobic activities, together with strength exercises, accompanied by nutritional guidelines, lasting more than two weeks, following Aguilar-Cordero et al. (2014). A personalized training program has been carried out for each child, given the importance of individualizing physical activity programs for overweight children, in accordance with Manonelles-Marqueta et al. (2008).

As Chacón et al. (2016; cit. In Cuervo et al., 2018), training programs against overweight in children can be developed with active video games. Through active video games, with regular practice, the minimum recommendations for daily physical activity proposed by certain medical organizations can be covered (Armstrong & Welsman, 2006; Tan, Aziz, Chua & Teh, 2002; Unnithan, Houser & Fernhall, 2006). Arman et al., 2019), They carried out an investigation in which they compared the results between a group of children who carried out training with active video games (Xbox 360 Kinect) with another group that trained with conventional material, both groups of children with juvenile idiopathic arthritis., with a program duration of 8 weeks, with 3 sessions per week. Although this study lasted longer than the present investigation, the results in the variables of physical condition studied were superior for the group that trained with active video games, so that said training turns out to be feasible. On the other hand, McDonough et al. (2018) evaluated the effects of exergaming on training using Xbox 360 Kinect Reflex Ridge and Xectic Kinect Just Dance, concluding that they do not match the intensity of the treadmill by walking fast, but it does increase the fun in motor activity. Bronner, Pinsker, Naik & Noah (2016) also agree in stating that virtual motor games are fun, although they need constant innovation so that the players remain motivated in the game. As for the Maxforce interactive dynamometer, it is an adequate motivational tool for isometric strength training; this type of force is beneficial at the bone level (Heinonen et al., 2013; Yousefi et al., 2012; cit. in Pérez-Turpin et al., 2019), to decrease cardiovascular risk (Carlson et al., 2014, Grøntved et al., 2015; Kamiya et al., 2015; cit. in Pérez-Turpin et al., 2019) and for the improvement of the quality of life (Pérez-Turpin et al., 2019)

The WHO (World Health Organization, 2019) in its objective to alleviate sedentary lifestyle and childhood overweight, pursues a global strategy at the dietary, physical activity and health levels. In our study, also based on the main authors and international organizations, a training-based intervention program for children has been carried out, together with nutritional guidelines, which in principle may make it difficult to know exactly what Measurement The improvements produced in the measured parameters may be due in large part to training or to a change in eating habits. In this sense, we can corroborate from the analysis of the results that in the 3 weeks of the program, there have been slight variations in eating habits, although improvements have been achieved in the six variables studied. Greater number of members in the sample, more training sessions per week and a longer total duration of the program would be adequate to corroborate and advance the results obtained, being able to measure the possible effects on bone, cardiovascular, respiratory health, etc.; as well as evaluating the possible relationship between the study variables.

CONCLUSIONS

The fight against sedentary lifestyle and childhood overweight has been the initial motivation for this research, the need for protection of the child population, immersed in a lifestyle that increasingly contributes to accelerating the current trend towards inactivity in the first ages, with possible negative repercussions throughout life. Through the present investigation, the aim has been to evaluate the use of exer-games as promoters of the health and quality of life of schoolchildren with signs of sedentary lifestyle and/or overweight, by measuring six factors related to sedentary lifestyle and/or overweight, rescued from the main studies on inactivity and excess weight in childhood, in which their measurement and evaluation has not yet been carried out jointly. It has been proposed to assess anthropometric changes, assess adherence to the Mediterranean diet and diet quality, detect psychological factors related to physical inactivity through body image, analyse the weight of the type of commuting to school at the level of sedentary and overweight, examine the influence of the time of use of technological screens and, ultimately, provide relevant information on the possibilities of assessment of sedentary lifestyle and childhood overweight.

In the present study, an attempt has been made to determine the influence and relationship of the six variables with a sedentary lifestyle and being overweight, in order to be able to point out a possible path towards the detection, improvement and prevention of childhood inactivity from this analysis. With all this, technological advances have been used as the basis of the training program, also using various technological instruments in order to provide the most complete training possible, as a way of transforming the detrimental effect that technology has had on inactivity. children, digital tools that can motivate and enhance their active entertainment, reaffirming that the current child population has been born in a digital world, with access to technology from its earliest days.

Despite the fact that after statistical treatment, no statistically significant differences were found in the study variables, the results in the variation of the six factors analysed seem to follow the expected line and are similar to most of the main studies, in relation to the sedentary lifestyle and overweight. Therefore, the results may indicate that it is possible to carry out a personalized training program through technological advances, based on exer-games, developed mainly through play, combining aerobic and anaerobic activities, together with exercises. Strength, with the support of nutritional guidelines for children and their families, lasting 3 weeks, with one session per week, and being able to obtain improvements in the main parameters related to sedentary lifestyle and childhood overweight, in order to open a new path towards improving the health and quality of life of children.

This research aims to be a participant in the use of new technologies and exer-games as promoters of health in childhood, helping to broaden their study in future research, being able to generalize their use in schools and sports centres, to contribute to a real change in the physical activity and health habits of the child population; integrating the study of the main factors related to excess weight in children and young people. In short, a new study methodology that we hope can open a path towards the elaboration of a guide of good practices in the use of technological advances, as well as the creation of a computer application or App for detecting overweight and sedentary lifestyle.

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