

## Physical activity and health-related quality of life in schoolchildren: structural equations analysis

Félix Zurita-Ortega<sup>1</sup>, Federico Salvador-Pérez<sup>2</sup>, Emily Knox<sup>3</sup>, Vanesa M. Gámiz-Sánchez<sup>2</sup>, Ramón Chacón-Cuberos<sup>4</sup>,  
Sonia Rodríguez-Fernández<sup>5</sup>, and José J. Muros<sup>6\*</sup>

*1 Department of Didactics of Musical, Plastic and Corporal Expression. University of Granada (Spain).*

*2 Department of Didactics and Scholar Organization. University of Granada (Spain).*

*3 School of Health Sciences. University of Nottingham (England).*

*4 Research Group HUM-238. University of Granada (Spain).*

*5 Department of Research Methods and Diagnosis in Education. University of Granada (Spain).*

*6 Department of Nutrition and Food Sciences. University of Granada (Spain).*

**Título:** Actividad física y calidad de vida relacionada con la salud en escolares: análisis mediante ecuaciones estructurales.

**Resumen:** El objetivo de este estudio es contrastar un modelo exploratorio del índice de masa corporal (IMC), calidad de vida relacionada con la salud y actividad física, y analizar los efectos de las variables físicas en los niveles de actividad física, autoestima y calidad de vida. Se realizó un estudio transversal en una muestra de 631 escolares españoles ( $12.5 \pm 1.4$  años). Estos cumplimentaron los cuestionarios de autoestima (test de Rosenberg), actividad física (PAC-C), dieta mediterránea, (KIDMED), calidad de vida (KIDSCREEN-27), además de medir su IMC y consumo máximo de oxígeno. Se emplearon ecuaciones estructurales para realizar los análisis estadísticos. Se observó que la correlación entre un bajo IMC y pocas horas de pantalla se asoció a buenos niveles cardio-respiratorios y a un aumento de los niveles de actividad física. Realizar más actividad física y seguir buenos patrones alimentarios se asoció a un aumento generalizado de la calidad de vida, lo cual se traducía en un aumento de la autoestima. Los resultados indicaron un buen ajuste y fiabilidad del modelo. Como conclusiones, la relación entre un bajo IMC y un menor tiempo de pantalla generó una mayor capacidad aeróbica y un incremento de los niveles de actividad física. Cuando la actividad física aumenta hay un incremento generalizado de la calidad de vida asociada a la salud y la autoestima.

**Palabras clave:** Calidad de vida relacionada con la salud; Actividad física; Autoestima; IMC; Dieta mediterránea; Escolares.

**Abstract:** The aim of this research was to develop an explanatory model of body mass index (BMI), health-related quality of life, and physical activity, and to analyse the effects of the physical variables on the levels of physical activity, self-esteem and health-related quality of life. A cross-sectional study was conducted on a sample of 631 Spanish schoolchildren ( $12.5 \pm 1.4$  years old). They completed questionnaires on self-esteem (Rosemberg test), physical activity (PAQ-C), Mediterranean diet (KIDMED), quality of life (KIDSCREEN-27) and had their BMI and maximum oxygen uptake measured. Structural equations constituted the statistical analyses. A correlation was found between lower BMI and fewer hours of self-reported screen time which was also conducive to higher cardio-respiratory levels and greater engagement in physical activity. More physical activity and better dietary care were related generally with higher health-related quality of life and self-esteem. The model demonstrated acceptable goodness of fit. Findings of the study suggest physical activity and positive dietary behaviours should be promoted in Spanish schools as incremental improvements have the potential to concordantly improve a large range of healthful outcomes including health-related quality of life, self-esteem and BMI.

**Keywords:** Health-related quality of life; Physical activity; Self-esteem; BMI; Mediterranean diet; Schoolchildren.

### Introduction

For a number of years, research in the fields of education and health has promoted the improvement of personal environments, habits and lifestyles. These lines of research are crucial given the level of concern shown by national and international authorities to reduce the risk factors associated with obesity (Buttitta, Iliescu, Rousseau, & Guerrien, 2014), consumption of noxious substances (Cava, Murgui, & Musitu, 2008; Ellickson, Tucker, & Klein, 2008), and/or maladaptive psychosocial outcomes (Naranjo & González, 2012). A number of these studies have identified the costs associated with modern diseases and the resultant savings to public finance should they be averted (Finkelstein, Fiebelkorn, & Wang, 2003). Early intervention at an early age to decrease risk factors associated with disease such as obesity have therefore been described (Blunt-Vinti, Wheldon, McFarlane, Brogan, & Walsh-Buhi, 2016; López, Nicolás, & Díaz, 2016; Machado-Rodrigues et al., 2016).

Leading public health agencies have established basic guidelines regarding minimal requirements for the type, amount and intensity of physical activity necessary to ensure adequate health (Haskell et al., 2007; WHO, 2010). Full or partial fulfilment of these guidelines can result in health benefits. Aerobic capacity is one of the most important factors related to the state of physical health (Minasian, Marandi, Kelishadi, & Abolhassani, 2014) with increases in aerobic capacity being related with improvements to specific health parameters in youth (Ortega, Ruiz, Castillo, & Sjöström, 2008).

Self-esteem is a critical factor affecting psychological and social adjustment. Low levels of self-esteem in young people have been associated with a number of psychopathological symptoms such as anxiety reactions (Naranjo & González, 2012), depressive symptoms, hopelessness and suicidal tendencies (Rodríguez-Naranjo & Caño, 2010), unnecessary delays in performing tasks, aggressive behaviour (Undheim & Sund, 2010), antisocial behaviour (Donnellan, Trzesniewski, Robins, Moffitt, & Caspi, 2005), and school violence (Martínez-Maldonado, Pedrão, Alonso-Castillo, López-García, & Oliva-Rodríguez, 2008). It is essential to examine youth populations suffering from low self-esteem. Trzesniewsky et al. (2006) describe such individuals as being

**\* Correspondence address [Dirección para correspondencia]:**

José Joaquín Muros. Department of Nutrition and Food Sciences. Faculty of Pharmacy, University of Granada 18071. Granada (Spain).  
E-mail: [jimuros@ugr.es](mailto:jimuros@ugr.es)

characterised by poor physical health, and having a higher risk of poor physical and mental health in adulthood.

In Spain and in Europe in general, there is growing concern about engagement of citizens in deleterious lifestyle behaviours (Kavas, 2009; Kokkevi, Richardson, Florescu, Kuzman, & Stergar, 2007), however, eating habits and children's body weight have emerged as the primary triggers of negative factors. However, it is not known whether the socio-cultural environment affecting the nutritional status of the population modifies the aforementioned behavioural aspects. This question is not insignificant, considering that cultural factors and behavioural eating models seem to be relevant to the prevention and treatment of overweight and obesity (Davis, Northington, & Kolar, 2000). Thus, the question at the heart of this research is how physical and athletic capacities affect obesity, self-esteem and health-related quality of life.

To answer this question, the present research was designed with the general aim of identifying and analysing the relationships between a number of physical and psychosocial variables. In this respect the objectives of the present research are: a) to develop and compare an explanatory model of the obesity level, health-related quality of life and physical activity of Spanish children, controlling for confounding variables, and b) on the basis of this explanatory model, to analyse the potential effects of some physical variables and of BMI on the levels of physical activity, self-esteem and health-related quality of life.

## Methods

### Subjects

Six hundred and thirty one Spanish children aged between 11 and 15 years old ( $12.5 \pm 1.4$  years), of which 328 were female and 303 male, participated in this descriptive, exploratory and transversal research. Participants were recruited from schools across Granada. In order to establish a representative model (*error*: 0.04; *C.I.* = 95.5%), stratification, proportionality and randomization techniques were used according to educational level and gender.

### Instruments

The following instruments were used to analyse the aforementioned variables:

- a) Physical activity engagement was assessed by means of a questionnaire (Physical Activity Questionnaire for older Children, PAQ-C). The questionnaire assesses engagement in moderate-to-vigorous activity over the previous 7 days through 10 questions which ask about the type and frequency of physical activities engaged in during the previous week. The first 9 questions are used to calculate a final score, whilst the final question determines whether the child was sick or unable to engage in their usual physical activity routine during the week of measurement.
- b) Maximal oxygen uptake ( $VO_2\text{max}$ ) was assessed using the Course Navette Test. Participants run between two lines set 20 meters apart. Speed is indicated by a sound signal, which gradually increases in frequency. The test ends when the child reaches fatigue or is unable to reach one of the lines before the signal sounds on two consecutive occasions. The test was carried out in a gym and the final stage reached by each student was recorded. On the basis of these data we calculated the  $VO_2\text{max}$  in relation to body mass using the formulas established by Léger, Mercier, Gadoury, & Lambert (1988).
- c) The Rosenberg test (Rosenberg, 1965) was used to determine self-esteem. The questionnaire consists of 10 questions rated on a scale from 1 (strongly disagree) to 4 (strongly agree), allowing for a minimum score of 10 points (lowest self-esteem) and a maximum of 40 points (highest self-esteem). Items 1, 3, 4, 7 and 10 are worded positively (eg. Overall, I am satisfied with myself), and items 2, 5, 6, 8 and 9 are worded negatively (eg. Sometimes I think I am not good at all). The questionnaire demonstrated excellent internal consistency with a Cronbach's alpha of .911.
- d) Adherence to the Mediterranean diet was determined by the KIDMED questionnaire proposed by Serra-Majem et al. (2004). KIDMED consists of 16 items with dichotomous response options, four of which are negatively framed, meaning that a positive answer results in -1 point, whereas the remaining 14 items are positively framed. Negative responses are not scored, and so are given the value 0. The final score can therefore range from -4 to 12 points. This instrument demonstrated acceptable reliability which a Cronbach's alpha coefficient of .837.
- e) Health-related quality of life was measured by the KIDSCREEN-27 questionnaire (Ravens-Sieberer et al., 2007) recommended for school children aged 8-18 years of age. KIDSCREEN-27 evaluates quality of life from a multi-dimensional perspective and allows comparisons across countries. It consists of 27 questions responded to on a Likert scale. Analysis is based on the overall score of the questionnaire. The questionnaire demonstrated excellent internal consistency with a Cronbach's alpha of .929.
- f) The anthropometric measurements were taken following the protocol established by the International Society for the Advancement of Cineanthropometry (Stewart, Marfell-Jones, Olds, & De Ridder, 2011). Weight was determined using a SECA balance (713, Hamburg, Germany), with an accuracy of 0.1 kg. For height measurements a Holtain stadiometer (Holtain Ltd., Dyfed, UK) was used with an accuracy of 1 mm. The data obtained were used to calculate the body mass index (BMI) as weight divided by height squared ( $\text{kg}/\text{m}^2$ ).

- g) To calculate screen time children were asked to report the number of hours per day they spent watching TV/DVD, computer, PDA, tablets or other different devices.

### Procedure

Permission was obtained from the University of Granada Ethics Committee for Research in Spain. In all cases signed consent from parents and/or legal guardians was requested and obtained, and participants' confidentiality was safeguarded. Six hundred and forty-five children completed the questionnaires and tests; 28 students were excluded for not completing the questionnaires correctly, refusing to undertake the study or failing to attend class on their testing day. All participants were informed of the complete confidentiality of the data and were notified of the subsequent handling of the data following analysis. Researchers were present during the conduct of all tests.

### Data analysis

A structural relations model of the relationships between the different constructs was developed using AMOS 21 software. The Statistical Package for Social Sciences (IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.) was used to analyse the data with  $\alpha$  set at 0.05.

As recommended by Bentler (1990) and McDonald & Marsh (1990) evaluation of goodness of fit must take into account various indices: a) Chi-Square values producing a non-significant  $p$  indicate good model fit (Jöreskog, 1977); comparative fit index (CFI) values higher than .90 indicate acceptable model fit (Hu, Bentler, & Peter, 1998); normalised fit index (NFI) values above .90 indicate good fit (Bentler & Bonnet, 1980); values of incremental fit index (IFI) above .90 indicate acceptable fit (Bollen, 1989); values of the root mean square error of approximation (RMSEA) below 0.1 indicate good model fit (Browne & Cudeck, 1993).

### Results

A structural model was designed to estimate the relationships between the measured constructs. The theoretical model specifications, as shown in figure 1, allow us to propose relational structures between variables, whereby some variables may influence other variables. Using this method we can conduct a path analysis to describe direct and mediated relationships.

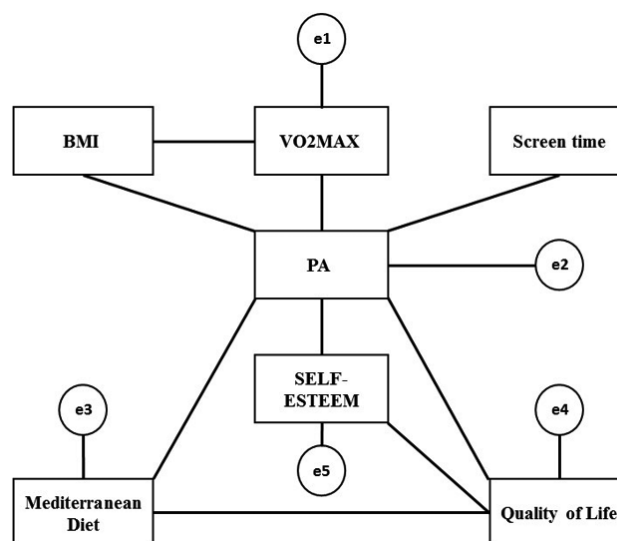


Figure 1. Routes Model.

In our model, the exogenous variables are the predictor variables, namely: BMI and screen time (hours per day). The endogenous variables are aerobic capacity ( $VO_2\max$ ) measured by the multi-stage fitness test; engagement in moderate-to-vigorous exercise (PA; measured by the Physical Activity Questionnaire for Children older); self-esteem (established through the Rosenberg test); Mediterranean diet (assessed through the questionnaire KIDMED) and health-related quality of life (measured by the KIDSCREEN questionnaire).

The model contains observable variables, and latent variables which describe error terms. The error terms associated to the endogenous variables represent the prediction error. The purpose of this particular model is to predict the magnitude of the direct and indirect effects of BMI and engagement with PA based on a number of variables.

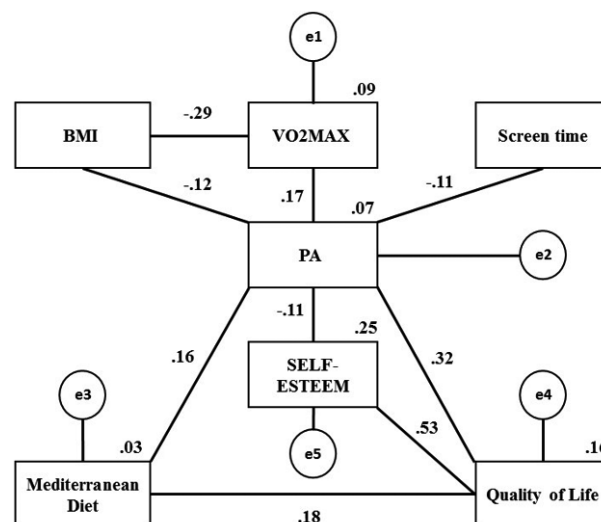


Figure 2. Model of structural relationships.

As can be seen, the proposed model is more complex than a regression model as some variables play the role of predictor variables and the dependent variable simultaneously. Interpretation of the magnitude and sign of the estimated parameters (figure 2) shows that the results confirm that the predictor variable (BMI) exhibits a significant negative relationship with aerobic capacity (VO<sub>2</sub>max), so that low BMI is related with a higher level of aerobic capacity (-.29). In addition, the BMI and screen time predictor variables also maintain a significant negative relationship with the level of PA. In this regard, a lower BMI and less screen time associate with higher levels of PA (-.12 and -.11, respectively).

The second level of the model describes the direct negative relationship of the referred variable on engagement with

PA and self-esteem of the present sample. Conversely, the level of PA regresses positively onto variables describing adherence to a Mediterranean diet and, more significantly (.32) better health-related quality of life. In this sense, an increase in physical activity implies better health-related quality of life and better adherence to the Mediterranean diet.

The third level describes the direct positive relationship between consuming a Mediterranean diet and improved health-related quality of life (.19). In turn, better health-related quality of life and positive self-esteem demonstrated one of the strongest relationships in the model (.53). The relationships between variables are shown in table 1.

**Table 1.** Relationship between variables

Relation between variables			R.W				S.R.W
			Estimations	E.S	C.R.	<i>p</i>	Estimations
VO2Max	<---	BMI	-.830	.110	-7.571	*	-.294
PA	<---	Screen time	-.171	.029	-5.896	*	-.111
PA	<---	VO2Max	.011	.003	4.129	*	.170
PA	<---	BMI	-.021	.007	-3.024	*	-.120
Mediterranean Diet	<---	PA	.133	.033	4.031	*	.162
HRQoL	<---	PA	7.355	.973	7.560	*	.320
HRQoL	<---	Mediterranean Diet	5.186	1.174	4.417	*	.186
Self-Esteem	<---	HRQoL	.187	.014	12.967	*	.533
Self-Esteem	<---	PA	-.903	.216	-4.180	*	-.112

Note<sup>1</sup>: R.W.: Regression weights; S.R.W.: Standardise regression weights; E.S.: Error Estimation; C.R.: Critical Ratio; BMI: body mass index; VO2max: maximum oxygen uptake; PA: physical activity; HRQoL: health-related quality of life

Note<sup>2</sup>: \* *p* < .001

Having determined the model parameters model fit was examined. Chi-square analysis produced a non-significant *p* value ( $\chi^2 = 49.007$ , *df* = 12; *p* = .001), though limitations of this index have been previously highlighted (Jöreskog, 1977) and so further indices were examined. The model obtained a comparative fit index (CFI) value of .905, IFI value of .900 normalised fit index (NFI) of .891 and RMSEA of 0.061 (i.e. below .08). All values could be described as acceptable or better (Hu et al., 1998; Bollen, 1989), suggesting that the model presents good fit to the empirical data.

## Discussion

The data obtained from the present sample of 631 Spanish children are similar to the data obtained by Riazi, Shakoor, Dudas, Eiser, and McKenzie (2010) in the United Kingdom, by Buttitta et al. (2014) in Chile, and by Kovacs et al. (2015) in a study conducted across Europe (Estonia, Sweden, Italy, Belgium, Germany, Hungary, Cyprus and Spain). The study was carried out using structural equation modelling that demonstrated good fit to the empirical data, although as previously discussed, the proposed model was more complex than alternative regression analysis since some of the variables acted as both predictor and dependent variables.

The results confirm that a low BMI predicts a higher level of aerobic capacity, as previously observed by Winsley, Armstrong, Middlebrooke, Ramos-Ibanez, and Williams

(2006). If we also consider children who watch few hours of screen devices per day, physical activity is likely to concomitantly increase (Elsenbung, Corpeleijn, Van Sluijs, & Atkin, 2014; Gopinath et al., 2014).

Another finding relating to the level of physical activity is that it was associated with better health-related quality of life, which in turn leads was related to better self-esteem (López, López, & Díaz, 2015). In this regard, Trost, Kerr, Ward, and Pate (2001), Orgilés, Sanz, Piqueras, and Espada (2014), and Zurita et al. (2015) have shown that physical activity is positively related to health, especially with mental, social and physical aspects.

Physical education classes offer teachers the opportunity to assess the fitness of their students and monitor their development over the school period. Smith, Morgan, Plotnikoff, Stodden, and Lubans (2016) has previously called for fitness records in school as a measure to combat the high prevalence of obesity in all age groups. The present findings are in accordance with those of several previous studies, which suggest that physical activity can play a leading role in the prevention of obesity in children and adolescents (Butin, Yin, Humphries, & Barbeau, 2005; López, González, & Díaz, 2016), and lead to a general improvement in an individual's perception of his or herself.

One limitation of the present research is the cross-sectional design which inhibits causal relationships from being investigated. Furthermore, the use of self-report to assess

various variables introduces the possibility of measurement error. However, as both the IPAQ-C and KIDMED have previously demonstrated high validity and reliability in this population, we believe this should have little impact on the conclusions made. Our findings conclude that the correlation between a lower BMI and less screen time relates to higher aerobic capacity and higher levels of physical activity. When physical activity is higher, health-related quality of life,

Mediterranean diet adherence, and subsequently self-esteem are generally also higher.

The practical implications of this study are far-reaching, relating to the reduction of obesity rates and BMI indices to improve sporting, psychosocial, and physical parameters. In line with the findings of this study, physical education activities should be prioritised to improve physical habits and health habits, aimed primarily at increasing school children's perceptions of quality of life.

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