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ORIGINAL ARTICLE

Ambulatory physical activity, triglycerides and atheromatic index in preschool children

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Abstract

In the recent years it has been highlighted that health conditions associated with lack of physical activity (such as cardiovascular diseases, obesity, etc.) can appear already from childhood. Therefore, health organizations worldwide have issued directives to organize physical activity (PA) at this age. The current study is focused in the relationship between the number of steps of pre-school children and their level of triglycerides and Atheromatic Index (AI) which is the ratio of total cholesterol over high-density cholesterol (HDL). The study sample was 30 children in the age of 4-6 years old without any diagnosed health issues. To evaluate the ambulatory activity of the children, pedometers Omron HJ-720IT-E2 were used. Morning blood samples were received, after the children were fasting for at least 12 hours. The statistical relationship between the number of steps per day, and the values of triglycerides concentration and AI was evaluated using Pearson correlation. The results showed a negative correlation between the number of steps and both triglycerides ($p<.005$) and AI ($p<.001$). It is therefore demonstrated that children without sufficient PA have a higher risk of serious health issues in their future life. In conclusion, the significance of PA from an early age needs to be emphasized and actions to organize the PA of pre-school children should be taken.

Keywords: *pre-school, physical activity, pedometer, triglycerides, atheromatic index*

Introduction

Obesity is considered an epidemic of the 21st century and it is related with insulin resistance that cause diabetes and high levels of cholesterol and systolic and diastolic blood pressure, which are indicators of cardiovascular risk (Tchernof & Despres, 2013). Cardiac risk factors are associated with extensive lesions in the aorta and coronary arteries caused by atherosclerosis, the underlying cause of coronary heart disease. Although the symptoms of coronary disease usually appear in late adulthood, there are many indications that the process of atherosclerosis begins early in a person's life (Tuzcu et al., 2001). Li and his colleagues (2003) showed that the levels of low-density cholesterol (LDL) and body-mass index (BMI) in childhood can lead to changes in the thickness of the intima and media of the carotid and to the occurrence and progression of atherosclerosis.

Furthermore, it has been observed that obese children have higher levels of LDL and lower levels of HDL compared to children of normal weight (Reinehr et al., 2006). Low levels of HDL, among others, are associated with obesity and physical inactivity. (Jellinger et al., 2012).

Another recent study has shown that low levels of PA are related to several factors of cardiovascular risk in children (Chaput et al., 2013). However there are limited studies on the relationship between PA and cardiovascular risk factors in non-obese children (Tremblay et al., 2011) and especially considering children younger than 6 years old (Jiménez-Pavón et al., 2013). The current work is aimed to study the relationship between the number of steps of young children within a typical week and the concentration of triglycerides in blood and the AI. The AI is an indicator for the appearance of the coronary disease.

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Method

Participants

The study sample was consisted of 30 children (13 boys and 17 girls, aged between 4-6 years) with normal weight status (BMI=16.60±2.6). The participants for this study were recruited from kindergartens of the Rodopi area in Greece. A written consent was obtained from the parents, after they were informed about the purpose of the study. The children participation was voluntary and all examinations and measurements followed the same protocols.

The participating children were selected based on the BMI (Body Mass Index). Obese and overweight children, as determined by the BMI using a defined cut-off point and adjusting for sex and age, were excluded from our study sample. The BMI cut-off limits were specified using instructions from the US Centre for Disease Control (CDC) (Kuczmarski et al., 2002) and the International Obesity Task Force (IOTF) (Cole at al., 2000). Additional criteria for exclusion were considered such as medication of any type, chronic diseases (any diagnosed health issues), participation in organized PA, or following a diet.

Measurements

The ambulatory PA of the children was evaluated using pedometers Omron HJ-720IT-E2, which record with great accuracy the total number of steps, the walking time, and the number of aerobic steps (*i.e.* steps made at a constant walking intensity, with a frequency greater than 60 steps per minute for 10 consecutive minutes). Additional features include connectivity to computer and data storage. The pedometers do not record the PA carried on wheels (cycling, inline skating etc.) or water.

Procedure

The children were wearing the pedometers continuously for one week except when sleeping or having any activity in water. Morning blood samples were taken, following a fasting period of at least 12 hours. The lipid profile (total cholesterol, triglycerides, HDL, and LDL) for every child was extracted and the AI was calculated as the total cholesterol to HDL ratio.

Statistical analysis

To evaluate the statistical relationship between the number of steps, and the triglycerides concentration and AI, Pearson correlation has been used. A graphical illustration of the triglycerides and AI was made considering three categories of PA that derived from percent spacing using the visual binning technique.

Results

The results of the study showed a variation range for the triglycerides concentration between 26 and 102 mg/dl (mean 62) and for the AI between 1.9 and 4 (mean 2.6). Correlation analysis showed a negative correlation between the number of steps and triglycerides concentration ($r=.445$; $p<.005$) as well as with AI ($r=.432$; $p<.005$). A visual binning procedure was performed and three groups of children were formed based on their PA (defined as number of steps per day). By considering in each group of children the average value for triglycerides concentration and AI, the results of the correlation analysis are confirmed. The triglycerides values for each group of PA are illustrated in Figure 1. The corresponding Atheromatic Index (AI) values are shown in Figure 2.

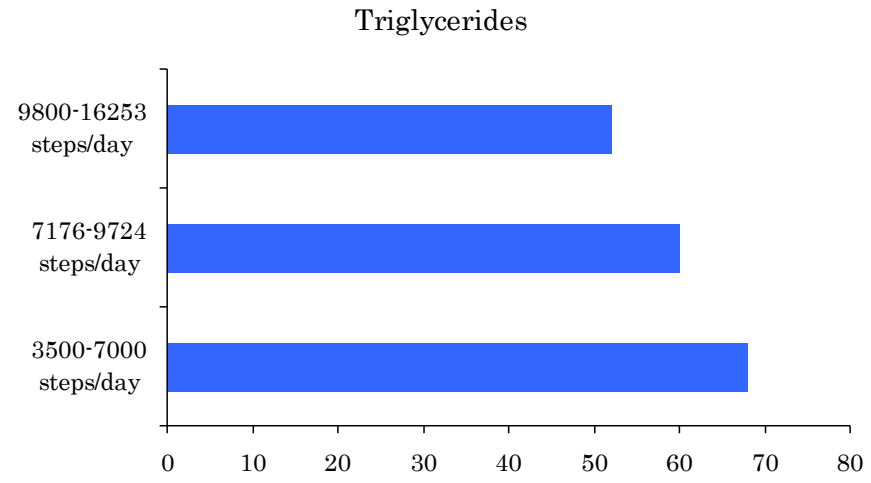

Figure 1. Distribution of triglycerides values among the three children groups based on ambulatory activity.

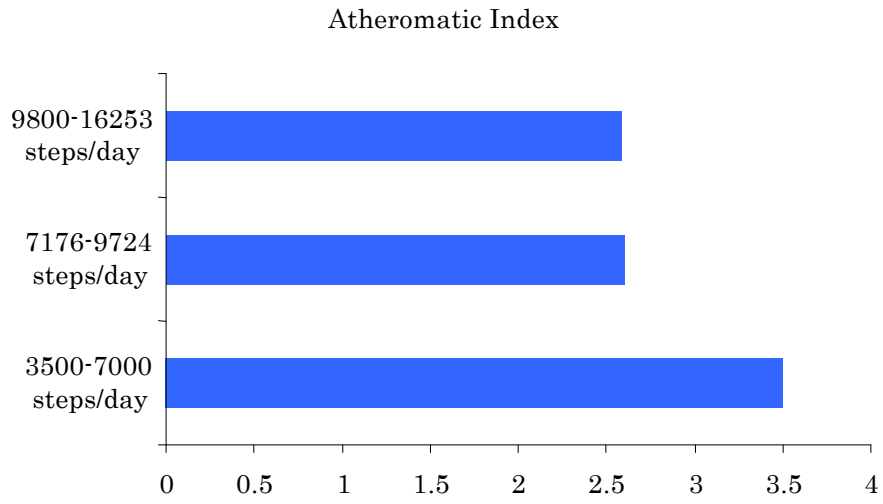

Figure 2. Distribution of AI among the three children groups based on ambulatory activity.

Discussion

The aim of our study is to investigate the correlation between the PA of normal-weight children 4-6 years old and certain cardiovascular risk indexes (triglycerides and AI). Currently there are few studies that propose objective measures of PA in young age (Expert Panel Pediatrics, 2011) and there are no international standards about the nature and the amount of PA that preschool children should follow for optimum cardiovascular health. The PA of children in this age might be described more appropriately as “play” (Timmons et al.,

2007), or in other words considered as any time that the child is not asleep or completely sedentary (Steinbeck, 2001). In our study, counting the number of steps for a typical week during the same school season provided a common baseline for assessing the PA of the children in the sample. They all had the same conditions and opportunities for PA (same location, same school schedule, same climate and weather conditions, etc).
The concentration values for triglycerides and AI measured in our study are within the normal range for children of the particular age. (Expert Panel Pediatrics, 2011, Daniels et al., 2008). However, the negative correlation between the number of steps and these values shows that even for normal-weight children, higher levels of PA have lower levels of triglycerides and AI. In another study considering children from 2 to 9 years old (Jiménez-Pavón et al., 2013), no consistent correlation between PA and CV factors was shown for ages younger than 6 years old. Our study shows that this correlation can still be observed for children between 4 to 6 years old.

Physical inactivity has been identified as an independent risk that leads to a disadvantageous lipid profile (Expert Panel Pediatrics, 2011). In a review of 14 studies between 1998 and 2009 (Ekelund et al., 2012) concerning children 4-18 years old, it was concluded that lack of PA was associated with increased cardio metabolic risk factors (including triglycerides and HDL cholesterol). Furthermore, in a research study on children 6-8 years of age it is found that the total PA was inversely associated with triglycerides and LDL cholesterol and directly related to HDL cholesterol (Vaisto et al., 2014). In another study (Martinez-Gomez et al., 2010), low PA levels (characterized as high levels of sedentary behavior in adolescents 13-17 years old) were associated with increased cardiovascular risk factors. These conclusions are in agreement with the results of our research.
The BMI of young children, starts to increase rapidly between the ages of 4 to 6 years old (Batch et al., 2005). Lack of PA in this age can lead to overweight children and the risk of persistent obesity in adult life with its complications (hypertension, diabetes, hypercholesterolemia and cardiovascular diseases) (Dietz, 1994; Trost et al., 2003). It is therefore very important to understand and assess the amount and type of PA during this critical growth period of preschool children (Timmons et al., 2007).

PA in children, as has been shown by research, reduces the risk of heart disease and provides beneficial effects on cardiovascular risk factors such as obesity, blood pressure and lipids (Froberg et al., 2005; Monzavi et al., 2006). Programs that increase PA may reduce the risk of developing cardiovascular risks associated with obesity, while they improve the existing condition of the blood vessels (Meyer et al., 2006). Targeted school and healthcare policies can play a significant role in promoting PA (Pate et al., 2004). Children teach themselves lifestyle behaviors from early age and may be more flexible in their ability to change behaviors than adults (Steinbeck, 2001). The inability of the child's family to understand the potential threat of CVD risk factors for the future health, can serve as a barrier to prevent adult CV disease (Wilson et al., 2015). Therefore we believe that a family-based lifestyle intervention to increase PA in combination with a healthy diet can have long-term benefits not only to the children but for the whole family.

Conclusions

The results of our study showed a correlation between the PA and the decreased levels of CV factors in children of normal weight between the ages of 4 to 6 years old. This is the first study to observe such a correlation in children of this age. The amount of PA is measured by the number of steps during the daily activity of children within the period of a week. Our results highlight the significance of PA even from a young age for the management of specific risk factors (triglycerides and atheromatic index).

References

Batch, J., Baur, L. (2005). Management and prevention of obesity and its complications in children and adolescents. *Medical Journal of Australia*, *183*(3), 130–134.

Chaput J.P., Saunders, T.J., Mathieu, M.E., Henderson, M., Tremblay, M.S., O'Loughlin, J., & Tremblay, A. (2013). Combined associations between moderate to vigorous physical activity and sedentary behavior with cardiometabolic risk factors in children. *Applied Physiology Nutrition & Metabolism,* 38, 477–483.

Cole, T.J., Bellizzi, M.C., Flegal, K.M., & Dietz, W.H. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. *The BMJ, 320,* 1240-1243.

Daniels, S.R., Greer F.R., and the Committee on Nutrition (2008). Lipid Screening and Cardiovascular Health in Childhood, *American Academy of Pediatrics, 122*,198-208.

Dietz, W.H. (1994). Critical periods in childhood for the development of obesity. *American Journal of Clinical Nutrition*, 59, 955-959.

Ekelund, U., Luan, J., Sherar, L.B., Esliger, D.W., Griew, P., & Cooper,, A. (2012). Moderate to Vigorous Physical Activity and Sedentary Time and Cardiometabolic Risk Factors in Children and Adolescents. *Journal of the American Medical Association*, *307*(7), 704-712.

Expert Panel Pediatrics (2011). National heart, Lung and Blood Institute. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report. *Pediatrics*, *128*(5), 213-256.

Froberg, K. & Andersen, L.B. (2005). Mini review: Physical activity and fitness and its relations to cardiovascular disease risk factors in children. *International Journal of Obesity*, 29, 34-39.

Jellinger, P., Smith, D., Mehta, A., Ganda, O., Handelsman, Y., Rodbard, H., Shepherd, M., & Seibel, J. (2012). American Association of Clinical Endocrinologists' Guidelines for Management of Dyslipidemia and Prevention of Atherosclerosis. *Endocrine Practice, 18*(1), 1-78.

Jiménez-Pavón, D., Konstabel, K., Bergman, P., Ahrens, W., Pohlabeln, H., Hadjigeorgiou, Ch., Siani, A., Iacoviello, L., Molnár, D., De Henauw, S., Pitsiladis, Y., Moreno, L.A. (2013). Physical activity and clustered cardiovascular disease risk factors in young children: a cross-sectional study (the IDEFICS study) *BMC Medicine*, 11, 172.

Kuczmarski, R.J., Ogden, C.L., Guo, S.S., Grummer-Strawn, L.M., Flegal, K.M., Mei, Z., Wei, R., Curtin, L.R., Roche, A.F., & Johnson, C.L. (2002). 2000 CDC Growth Charts for the United States: Methods and development. *Vital Health Statistics*, 11, 1-190.

Li, S., Chen, W., Srinivasan, S., Bond, M.G., Tang, R., Urbina, E., & Berenson, G. (2003). Childhood cardiovascular risk factors and carotid vascular changes in adulthood. The Bogalusa Heart Study. *Journal of the American Medical Association*, *290*(17), 2271-2276.

Martinez-Gomez, D., Eisenmann, J.C., Gomez-Martinez, S., Veses, A., Marcos, A., Veiga, O.L. (2010) Sedentary behavior, adiposity and cardiovascular risk factors in adolescents. The AFINOS study. *Revista Española de Cardiología,* 63(3), 277-85.

Meyer, A.A., Kundt, G., Lenschow, U., Schuff-Werner, P., & Kienast, W. (2006). Improvement of early vascular changes and cardiovascular risk factors in obese children after a six-month exercise program. *Journal of the American College of Cardiology, 48*(9), 1865-1870.

Monzavi, R., Dreimane, D., Geffner, M.E., Braun, S., Conrad, B., Klier, M., & Kaufman, F.R. (2006). *Pediatrics*, *117*(6), 1111-1118

Pate, R.R., Pfeiffer, K.A., Trost, S.G., Ziegler P., & Dowda, M. (2004) Physical Activity Among Children Attending Preschools. *Pediatrics*, 114,1258-1263.

Reinehr, T., De Sousa, G., Toschke, A.M., & Andler, W. (2006). Long-term follow-up of cardiovascular disease risk factors in children after an obesity intervention. *American Journal of Clinical Nutrition*, *84*(3), 490–496.

Steinbeck, K.S. (2001). The importance of physical activity in the prevention of overweight and obesity in childhood: a review and an opinion. *Obesity Reviews*, 2, 117-130.

Tchernof, A. & Després, J.P. (2013). Pathophysiology of human visceral obesity: an update. *Physiological Reviews*, 93(1), 359–404.

Timmons, B.W., Naylor, P.J., & Pfeiffer, K.A. (2007). Physical activity for preschool children-how much and how?. *Applied Physiology, Nutrition, and Metabolism,* 32, 122-134

Tremblay, M.S., Leblanc, A.G., Kho, M.E., Saunders, T.J., Larouche, R., Colley, R.C., Goldfield, G., & Connor Gorber, S. (2011) Systematic review of sedentary behavior and health indicators in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity*, 8, 98.

Trost, S.G., Sirard, J.R., Dowda, M., Pfeiffer, K.A., & Pate, R.R. (2003). Physical activity in overweight and nonoverweight preschool children. *International Journal of Obesity*, 27,834-839.

Tuzcu, E.M., Kapadia, S., Tutar, E., Ziada, K., Hobbs, R., McCarthy, P., Young, J., & Nissen, S. (2001). High prevalence of coronary atherosclerosis in asymptomatic teenagers and young adults: evidence from intravascular ultrasound. *Circulation,* 103, 2705-2710.

Vaisto , J., Eloranta, A.M., Vitasalo, A., Tompuri, T., Lintu, N., Karjalainen, P., Lampinen, E.K., Agren, Y., Laaksonen, D.E., Lakka, H.M., Lindi, V., & Lakka, T.A. (2014). Physical activity and sedentary behaviour in relation to cardiometabolic rsik in children:cross-sectional findings from the Physical Activity and Nutrition in Children (PANIC) Study. *International Journal of Behavioral Nutrition and Physical Activity,* 11, 55.

Wilson, D.P., McNeal, C., & Blackett, P. (2015). Pediatric Dyslipidemia: Reccomendations for Clinical Management, *Southern Medical Journal*, *108*(1), 7-14.