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Original research article

COMPARISON OF DURATION AND INTENSITY OF PHYSICAL ACTIVITY IN AMERICAN AND HUNGARIAN BOYS AND GIRLS 10 – 14 YEARS OLD

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Abstract. *Vital information can be obtained on the relationship between duration and intensity of physical activity and body composition. Knowing the intensity and duration of physical activity children are participating in during a typical day can potentially give insight to the increase of childhood obesity in both the United States and Hungary. The purpose of this study was to analyze the duration and intensity of physical activity of American (n=91) and Hungarian (n=119) 10 -14yearold healthy boys and girls. They received Actigraph GT3X+ accelerometers collecting data continuously for 3 days of a typical school week (Monday-Wednesday). Height and weight were measured and body mass index was calculated. Activity counts were separated into moderate (~3.5 Mets), vigorous (~5 Mets) and vigorous+ (~8 Mets) activity levels using the recommended cut off points provided by Actigraph. Independent t-tests were used to determine significant differences. The American children performed significantly more activity daily compared to Hungarian children but the American children had a significantly higher BMI. The results raise questions about American diet and amount of physical activity recommended daily).*

Key words: *accelerometer, children, physical activity, obesity*

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INTRODUCTION

Overweight and obesity can be defined as having abnormal fat accumulation above what is considered normal or desirable (Obesity, 2012). In developed countries there are several studies resulting in an increased prevalence of overweight and obesity among adults and children (Kern, 2007). This trend is emerging in developing countries also making this non-communicable disease the most frequent civilization disease according to the World Health Organization (WHO, 2000).

Childhood obesity is increasing in prevalence around the world. Childhood obesity increases the risk of obesity in adulthood, particularly during the second decade of life (Kern, 2007). The second decade of a child's life is becoming an increasingly strong predictor of adult obesity especially for overweight children of obese parents (Power et al., 1997; Whitaker et al., 1997; Serdula et al., 1993). Obese children ages 10 – 14 years who have at least one parent who is obese have a 79 percent greater chance of becoming an obese adult (Whitaker et al., 1997; Wolfe et al., 1994).

There is increasing evidence showing obesity has detrimental social, economic, and health consequences on children (Gortmaker et al., 1993). Childhood obesity is recognized as an important public health issue and has been further heightened by the increasing prevalence of adult obesity in both developed and developing countries (Popkin, & Doak, 1998). The effects of obesity as a child usually do not cause medical problems until adulthood but adults rarely achieve sustained weight loss (Goodrick et al., 1996). This presents a serious problem for children because they are affected directly through genes passed on by their parents and environmental factors within the family (Whitaker et al., 1997). "Such rapid changes in the number of obese children within a relatively stable population indicate that genetic factors are not the primary reason for change." (Alison et al., 2001). This means environmental factors are causing the biggest problem for the children.

According to Iowans Fit for Life (2007), the percentage of overweight and obese Iowan adults in 2007 was 64.7%; which is an increase from 62.9% in 2006. This trend reflects the increase in obesity over the last two decades in the United States. The percentage of overweight and obese children in the United States has tripled over the past two decades (Iowans Fit for Life, 2007). The prevalence of obesity in Hungary has also been increasing dramatically in not only adults but also children (Antal et al., 2009). In a study done by Antal et al. 2009, looking at obesity in Budapest school children, 25.5 percent of Hungarian boys and 25.9 percent of Hungarian girls were in the overweight and obese categories based off of (body mass index) BMI. This increase is troubling because overweight and obesity impact a child's current and future health including but not limiting blood pressure, cholesterol, insulin levels, heart disease, and psychological wellbeing (CDC, 2009).

Physical activity is one of the main components of energy expenditure and there is evidence of decreasing physical activity among children, which is contributing to the increase in childhood obesity (Steinbeck, 2001). Nearly all studies of children indicate that activity levels peak around 13-14 years of age and decrease from then on (Steinbeck, 2001; Riddoch, & Boreham, 1995). The largest decrease in physical activity occurs just before puberty, with a high risk of maintaining this decreased level of physical activity into adulthood (Raitakari et al., 1994).

There are many reasons for the decrease of physical activity during childhood and early adulthood. There is an increase in watching television, playing video and computer games, internet use, increased traffic, lack of safe places to play, parental work habits and

mandatory cut-backs in physical education in schools to name just a few (Strauss, & Pollack, 2001). More children are spending their leisure time taking part in these sedentary activities, which have impacted their physical activity levels in a negative way.

Prevention of obesity in childhood and effective treatment of overweight children are essential. There is data to support that lower physical activity levels and sedentary behaviors are associated with a higher prevalence of obesity in children. "Effective prevention of childhood obesity is the first step towards preventing obesity" (Doak et al., 2006). Physical activity is an accepted strategy in the prevention and treatment of obesity and is why physical activity needs to be monitored in children (Pate et al., 2002; Steinbeck, 2001).

This research is worthy of implementation because with increasing levels of childhood obesity in both American and Hungarian children, we can compare physical activity levels to find out if there are similarities in daily physical activity or if other environmental factors may be contributing to the increase in obesity.

The purpose of this study was to analyze the duration and intensity of physical activity of American and Hungarian 10 – 14-year-old boys and girls.

METHODS

The sample of participants

A letter including the purpose of the study, the instructions for accelerometer use, and consent was sent to Grundy Center Middle School in Grundy Center, Iowa USA and Gardonyi Primary School in Győr, Hungary. Out of the students who returned the letter of consent, the physical education teachers of each school picked the "more responsible" children for use in the trial. At the time of giving out the accelerometers, body height, body mass, and age were measured.

Two hundred ten healthy 10-14-year-old boys and girls from Grundy Center Middle School and Gardonyi Primary School were included in the research.

The measuring instruments and procedure

The children were instructed to wear the GT3X+ accelerometers on their non-dominant wrist at all times, only taking it off for bathing or risk of submerging the device in water. The accelerometers were handed out at 8:00am Monday and retrieved at 8am Thursday, recording three typical days of a school week. The Actigraph GT3X+ accelerometers were set up to record activity counts every 60 seconds. The activity counts were summed to determine how much time per day each child was physically active. The activity counts were separated into three categories based off the recommended cutoff points from ActiGraph. For each child we recorded how much time they spent in the moderate (~3.5 Mets), vigorous (~5 METs) and vigorous+ (~8 METs) categories (Troost et al., 2005).

Statistical analysis

Independent t-tests were run on the data to determine significant differences in body height, body mass, BMI, and average physical activity intensity between countries and genders. The significance level was set at $p \leq 0.05$. All the data were screened using SPSS version 20.0.

RESULTS

Table 1 Descriptive characteristics of the main sample

	Boys			Girls		
	American (n=53)	Hungarian (n=62)	tboys	American (n=38)	Hungarian (n=57)	tgirls
	Mean±SD	Mean±SD		Mean±SD	Mean±SD	
Age (in yrs)	11.33±0.94	12.19±0.81	2.03	12.05±1,36	12.00±0.96	1.86
Body Height (in cm)	147.32	158.50	6.11*	155.61	157.54	2.17
Body Mass (in kg)	44.70	48.63	3.39	56.45	44.77	7.52*
BMI (in kg/m ²)	20.52	19.15	2.18	22.76	18.00	6.13*
ΣBMI (boys, girls in kg/m ²)	22.04	18.64	5.25*			

* level of significance set on $p < 0.05$

Hungarian boys were significantly taller than American boys ($p=0.01$). There was no significant difference in height between Hungarian girls and American girls.

American girls weighed significantly more than Hungarian girls ($p=0.04$). There was no significant difference in body weight between American boys and Hungarian boys.

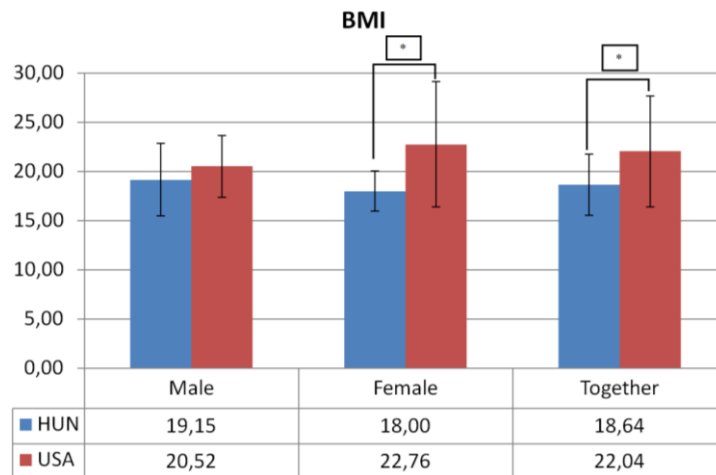


Fig. 1 Body Mass Index by country

Legend: * level of significance set on $p < 0.05$

American girls had a significantly higher BMI when compared to Hungarian girls ($p=0.01$). There was no significant difference in BMI between American boys and Hungarian boys. When comparing American children (both boys and girls combined) with Hungarian children there was a significant difference in BMI. American children had a significantly higher BMI when compared to Hungarian children ($p=0.01$).

The Hungarian children accumulated 39.02 minutes of moderate – vigorous+ physical activity daily on average. The American children (both boys and girls combined) accumulated 106.45 minutes of moderate to vigorous and vigorous+ physical activity, daily on average.

American children performed significantly more minutes of physical activity in each of the three intensity level categories when compared to the Hungarian children, (moderate

intensity level, $p=0.00$, vigorous intensity level, $p=0.00$, and vigorous+ intensity level, $p=0.00$).

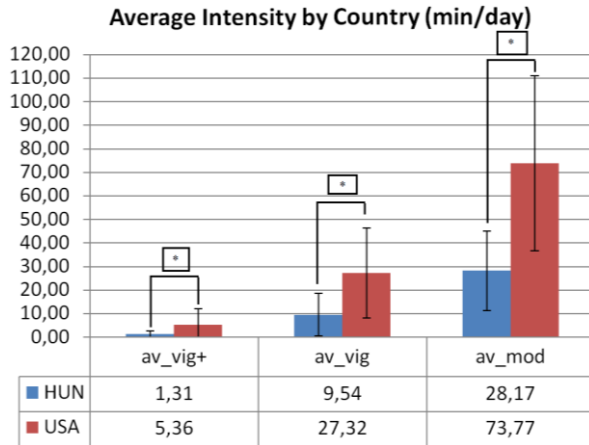


Fig. 2 Physical activity by country

Legend: av_vig+- average of vigorous+ intensity; av_vig - average of vigorous intensity; av_mod - average of moderate intensity; * level of significance set on $p<0.05$

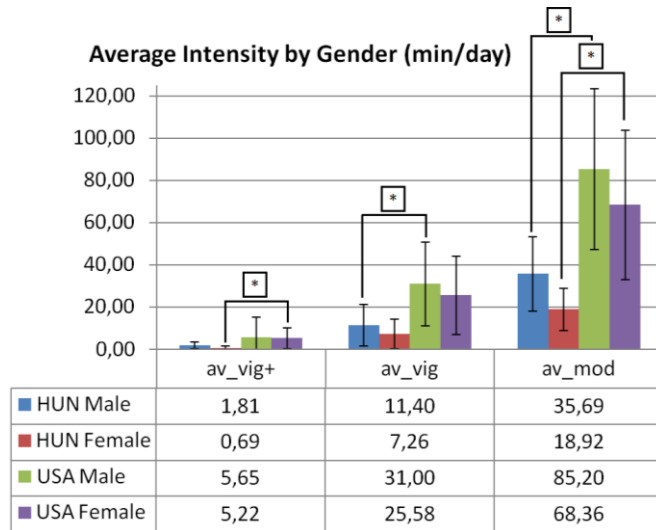


Fig. 3 Physical activity by gender

Legend: av_vig+- average of vigorous+ intensity; av_vig - average of vigorous intensity; av_mod - average of moderate intensity; * level of significance set on $p<0.05$

American boys accumulated 121.85 minutes of moderate to vigorous and vigorous+ physical activity, compared to 48.9 minutes of Hungarian boys. American girls accumulated 99.16 minutes of moderate to vigorous and vigorous+ daily on average, compared to 26.87 minutes of Hungarian girls.

In the vigorous+ category there was no significant difference between American boys and Hungarian boys. However, American girls performed significantly more physical activity in the vigorous+ category than Hungarian girls ($p=0.00$).

In the vigorous category American boys performed significantly more physical activity than Hungarian boys ($p=0.02$) and American girls performed significantly more physical activity than Hungarian girls ($p=0.00$).

In the moderate category American boys performed significantly more physical activity than Hungarian boys ($p=0.00$), and American girls performed significantly more activity than Hungarian girls ($p=0.00$).

DISCUSSION

The expectation was that boys will perform significantly more physical activity per day than girls can be held true when looking at both countries combined (American and Hungarian boys vs. American and Hungarian girls). The boys combined, performed on average 170.75 minutes of physical activity in the moderate to vigorous and vigorous+ categories, while the girls combined performed on average 126.03 minutes. But when looking at each country individually the hypothesis does not hold true, the American girls performed more physical activity than the Hungarian boys. The American girls averaged 99.16 minutes a day, while the Hungarian boys averaged 48.90 minutes. We cannot say for sure why this is, but it could be due to the greater opportunity for afterschool sports and safe places to play in the United States.

American children (males and females combined) had a significantly higher BMI compared to Hungarian children ($p=0.01$). The American boys did not have a significantly higher BMI than the Hungarian boys, but it was higher and the American boys average BMI was in the overweight category while the average Hungarian boys BMI was in the normal category. The American girls had a significantly higher BMI compared to Hungarian girls ($p=0.01$). The American girls average BMI was in the overweight category, while the average BMI for the Hungarian girls was in the normal category.

A result we did not expect to find was while the American children performed significantly more physical activity each day on average, their BMI's were significantly higher than the Hungarian children. We can only speculate why this is because it was beyond the scope of this study, but it could be due to the American's diet, portion size, intuitive eating, and family setting.

The accelerometers were wrist worn so this could potentially limit a child's physical activity that frequently rides their bike or a child that swims because we instructed them to not wear the device if there was a chance of submerging it in water for an extended period of time.

Another limitation to the study was collecting data for only 3 continuous days. If we would have collected data for 1-2 weeks, we could have been more confident in assuming our results for the daily average of physical activity represented a typical day for the children.

The small sample size used holds many limitations within itself. It is hard to say that the results we obtained can be representative of all children in the United States and Hungary. We can say that the results we found can be representative of Grundy Center Middle School and Gardonyi Primary School.

Further studies looking into the diet of American children including, caloric intake, meal size, intuitive eating, and family setting could be looked at. The American children

are meeting the daily physical activity recommendation set forth by the American College of Sports Medicine (2011), of at least an hour a day but on average they are all on the border of overweight according to their BMI's.

The amount of physical activity Hungarian children are taking part in daily is over 20 minutes less than the ACSM recommendation this could be an indication of having fewer places available to play compared to the American children.

Eating habits of Hungarian families could be looked at because they are taking part in significantly less physical activity daily but have a significantly lower BMI. This is most likely due to diet so it would be interesting to look into the meal size, family setting to find out more information about eating habits of Hungarian family compared to American families.

CONCLUSION

Obesity is a continuing problem worldwide in adults and children alike (WHO, 2000). It seems the best way to slow down the prevalence of obesity is with prevention of childhood obesity. For this reason monitoring childhood physical activity is a vital part of stopping this health epidemic. If we can get children to understand the importance of an active lifestyle at an early age through support of the school and family alike, children may be more likely to make it a normal part of their daily life. Knowing the importance of a healthy lifestyle incorporating both physical activity and a healthier diet, including smaller portion sizes and healthier foods, they may be able to learn to like this healthy lifestyle and continue it throughout their adulthood.

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POREĐENJE TRAJANJA I INTENZITETA FIZIČKE AKTIVNOSTI KOD AMERIČKE I MAĐARSKE DECE MUŠKOG I ŽENSKOG POLA UZRASTA 10-14 GODINA

Iz odnosa između trajanja i intenziteta fizičke aktivnosti i sastava tela se mogu izvući dragocene informacije. Ukoliko postoje podaci o intenzitetu i trajanju uobičajenih fizičkih aktivnosti u kojima učestvuju deca tokom dana, potencijalno može da se pruži uvid u sve češću pojavu gojaznosti dece u Sjedinjenim Američkim Državama i Mađarskoj. Svrha ove studije je analiziranje trajanja i intenziteta fizičke aktivnosti zdrave američke (n=91) i mađarske (n=119) dece muškog i ženskog pola, uzrasta 10-14 godina. Deca su koristila Actigraph GT3X+ akcelerometre neprekidno tokom 3 dana u okviru školske nedelje (ponedeljak-sreda) i prikupljali podatke o nivou aktivnosti. Merene su telesna visina i masa i izračunat je indeks telesne mase (BMI). Vrednosti intenziteta aktivnosti su podeljene na umerene (~3.5 Mets), energične (~5 Mets) i energične+ (~8 Mets) koristeći preporučene cut off vrednosti akcelerometra Actigraph. Za utvrđivanje značajnosti razlika između rezultata korišćeni su nezavisni t-testovi. Američka deca su svakodnevno bila znatno aktivnija u odnosu na mađarsku decu, ali je kod američke dece zabeležen znatno viši BMI. Dobijeni rezultati nameću pitanja u vezi sa američkim načinom ishrane i obimom fizičke aktivnosti koja se preporučuje na dnevnom nivou.

Ključne reči: akcelerometar, deca, fizička aktivnost, gojaznost