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Physical Fitness, Anthropometric and Sedentary Behavior Characteristics of 7-to-11 Year-old Boys in Different Physical Activity Levels

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Abstract: The aim of this study was to compare anthropometric variables, sedentary behaviours and various physical fitness components of three different physical activity levels in 7-to-11year-old Ardabilian boys. 766 healthy boys underwent standard anthropometry and twelve fitness tests. Child's TV watching and video playing daily time (TVVPT) was taken for sedentary behavior evaluation. Physical activity (PA) for children was measured using the PA Questionnaire. Considering the mean of PA scores children were categorized in three no active, some active and active groups. Except Hand grip strength and Balance test, the active boys attained better results in all fitness tests than the no active boys ($P \leq 0.01$). Also except cardiorespiratory fitness, Hand grip strength and Balance test the active boys attained better results in all fitness tests than the some active boys ($P \leq 0.01$). The some active and the no active boys had significantly higher TVVPT than the active boys ($P \leq 0.01$). The mean values of Weight, BMI, Fat mass were significantly higher in the no active boys than both the some active and the active boys ($P \leq 0.01$). Regarding the active boy's higher fitness level, high PA is recommended, although it should be stated that any PA in children is better than none at all.

Key words: Balance test · BMI · Cardiorespiratory fitness · Hand grip strength · TV and video playing

INTRODUCTION

Regular exercise training may contribute to the improvement of several components of psychological such as depression, anxiety, aggression and hopeless [1-4] and physical aspects such as strength, muscular and cardiorespiratory fitness, flexibility and body composition [5, 6]. These changes of physical aspects may especially favor the control of body adiposity as well as the maintenance or improvement of functional and neuromotor capacity, improving hence performance in several daily chores. Consequently, they provide better health conditions and more suitable quality of life to their practitioners [5, 6].

Health-related physical fitness refers to those components of fitness that have a relationship with the ability to perform daily activities with vigour and by traits and capacities that are associated with a lower risk for the development of chronic diseases and premature death: cardiorespiratory fitness, musculoskeletal fitness, motor fitness and body composition [7-9]. There is growing evidence that fitness at childhood and adolescence is negatively associated with total and central body fat later in life; [10, 11] and similar findings were observed in cross-sectional studies [12-15]. On the other hand, decrease in the usual PA levels seems to favor gradual development of countless degenerative-chronic dysfunctions such as obesity, dyslipidemias, diabetes, cardiovascular diseases, hypertension among others, in escalating early ages [16-20].

Although a large part of the variability in physical fitness is genetically determined, environmental factors and particularly physical exercise, also influence physical fitness. In children, the relationship between PA and physical fitness is less clear [21].

In this regard, additional studies are essential for better understanding the association between physical fitness and PA. However, simultaneous assessment of anthropometric parameters, sedentary behavior time (such as: TV watching and video playing daily time), PA and health related physical fitness will provide much information about children's health. The aim of the present investigation was to evaluate the possible relationships among activity levels and selected Anthropometric parameters, TV watching and video playing daily time and health related physical fitness in 7-to-11year-old boys in Ardabil, Iran.

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MATERIAL AND METHODS

Participants: This cross-sectional study was carried out on 766 normal, healthy school going boys of age range 7-11 years. The selection of the subject was made on the basis of random sampling from student populations of different schools in urban areas of Ardabil, Iran. All children and their parents were thoroughly informed about the purposes and contents of the study and written informed consent was obtained from one parent. The age of the subject was determined from their date of birth in their school register. The age was rounded off to the nearest whole number. The measurements and the tests that the children underwent were carried out during regularly scheduled physical education classes.

Measurement of Physical Activity: Physical activity for children was measured using the Physical Activity Questionnaire - Children (PAQ-C) [22]. The PAQ-C is used to assess the physical activity behaviors of the participants at different times and places (i.e. during school, after school, recess, weekend, etc.) during the previous seven days. Scoring is based on a 5-point Likert type scale, with an overall physical activity score derived from the mean of each scored item. Considering the mean of physical activity scores children were categorized in three no active (0-2), some active (2-3.5) and active groups (3-5). The PAQ-C has been tested and re-tested and results have shown that the instrument is reliable and valid measure of physical activity for children during the school year. Kowalski, Crocker and Faulkner [22] reported moderately high validity coefficients for the PAQ-C when compared to a variety of criterion measures, including activity ratings, recall questionnaires and activity monitors (r = .39 to .63,). The test retest reliability for the PAQ-C ranged from r=0.75 to 0.82 and internal consistency reliability values (coefficient alpha) ranged from 0.81 to 0.86 [23]. This instrument is widely used in research in order to assess physical activity of large and small populations at low cost [24].

TV Watching and Video Playing Daily Time (TVVPT): Children and their parent (s) were given a written questionnaire, which was filled out by the parent (s) only if the child was aged less than 8 years and both parent and child together if the child was between the ages of 8 and 11 years. If completed by parent and child together, they were instructed to agree on and record a single estimate of average daily time spent watching TV (time spent watching TV, videotapes, or DVDs) and playing video game (time spent on a home computer or video game). Parent estimates of child viewing and playing time have been shown to be reliable predictors of child screen time [25]. In order to further ensure the validity of TVVPT estimates, the physician verbally reviewed and confirmed the time estimate obtained from the questionnaire during the clinical interview with the parent(s) and, if aged over 8 years, the child.

Anthropometric Measurements: To estimate body weight and height the participants were barefoot and wore only underwear. Body weight (kg) was measured using a standard balance beam (Seca 220). Body height (cm) was measured using a precision stadiometer (Seca 220), attached to the balance beam. The subjects stood upright, with feet together, knees straight, heels, buttocks and back touching the back part of the stadiometer and the head held so that the Frankfurt line was horizontal. To compute BMI (kg/m2), data were converted into metric units of kilograms (mass) and meters (height). Cut-off points for BMI defining, underweight, normal weight, overweight and obesity were identified by using the International Obesity Task Force (IOTF) BMI cut-off points [26, 27].

Tricipital skin folds (TSF) and subscapular skin folds (SESF) were measured three times on the right side of the body using an adipometer (Lange, Beta Technology Incorporated, Cambridge, USA) and the mean of all three measurements was used for analysis (TSF measured on the right upper arm, midway between the acromion and the olecranon and the SESF is measured two fingers below the low point of the right scapula). Body adiposity was then estimated using the equation and sex-specific reference values proposed by Lohman, [28, 29] based on summing the two skinfold measurements. Then Fat mass evaluated by the below equation:

$$\text{Fat mass (FM)} = \text{weight} \times \text{fat percentage}/100$$

Physical Fitness Measurements: Physical fitness was determined using twelve physical fitness tests which were completed during regularly scheduled physical education classes. At the beginning of taking each test, the examiner explained the testing procedures to the participants in details.

Cardiorespiratory Fitness (VO_2Max): The 1-mile run was used to assess VO_2max. The objective of the mile run was to cover a mile in the shortest time possible. Students were encouraged to run throughout the test and to take

walking breaks only as needed. Physical education instructor also reminded children to avoid starting too fast to avoid premature fatigue. This test has shown to be valid and reliable for the prediction of the VO2max in children [30].

Sit ups, Modified pull ups, Pushups, Sit and reach, Flamingo balance, Standing broad jump, Hand grip, Vertical jump, 4×10m shuttle run test, 30-meter sprint (from standing position) and Simple finger reaction time tests were measured by the standard valid and reliable methods [30-33].

Statistical Analysis: Descriptive statistics were run on all variables. One-way analyses of variances (ANOVA) were carried out to assess differences among PA levels. The Scheffe correction was used for multiple comparisons. All calculations were performed using SPSS V.18.0 software for Windows. The significance level was set at $p \leq 0.05$.

RESULTS

Based on international BMI cut off points, figure 1 shows weight status in Ardabilian 7-11 year old boys. Prevalence of underweight, overweight and obesity in Ardabilian 7-11 year boys was 10.7%, 14.1 % and 4.2 %, respectively.

Anthropometric comparison among activity levels is given in table 1. ANOVA revealed that the no active group had significantly higher weight, FM and BMI than both the some active and the active group (P=0.01).Height values were not significantly difference among activity groups. TVVPT was significantly higher in both the no active and the some active group than the active group ($P \leq 0.01$).

Table 2 summarizes physical fitness results for the physically active, some active and the no active 7-11 year old boys. With a comparison among activity levels, ANOVA showed that apart from the Flamingo balance and Hand grip strength test values, the active boys' attained significantly better results than the no active boys in all the other fitness tests ($P \leq 0.01$). Also except Flamingo balance, Hand grip strength and cardiorespiratory fitness, the active boys significantly attained better results than the some active boys in all the other fitness tests ($P \leq 0.01$). Apart from the Flamingo balance, Hand grip strength, Reaction time, Sit and reach and Speed test values, the some active boys significantly attained better results in the other physical fitness tests than no active boys ($P \leq 0.01$). The no active boys had significantly lower cardiorespiratory fitness than both the active and the some active groups ($P \leq 0.01$). The mean values for Hand grip strength and Balance tests were not different among three activity level groups.

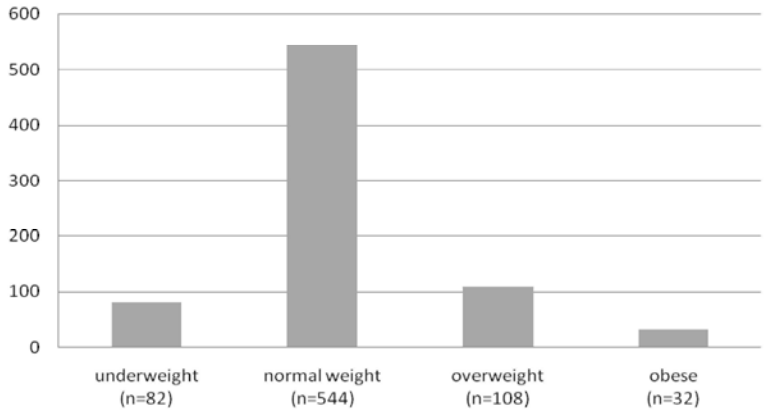

Fig. 1: Weight status in Ardabilian 7-to-11 year- old boys

Table 1: Anthropometric comparison among the three activity levels of 7-to-11year- old boys

Variables	No active (n=187)	Some active (n=404)	Active (n=175)	F values	P
Height(cm)	134.6±9.3	133.1±9.1	134.2±8.6	4.7	P=0.156
Weight(kg)	33.6±10	29.95±8.7	30.7±7.4	7.5	P≤0.01
BMI(kg/m^2)	18.3±3.6	16.8±3	16.8±2.4	11.2	P≤0.01
Fat Mass(kg)	9.9±6.9	7.8±6.3	7.6±4.1	7.2	P≤0.01
TVVPT (min/d)	211±110.4	198±84	168±78	9.4	P≤0.01

Table 2: Physical fitness comparison among the three activity levels of 7-to-11year- old boys

Variables	No active (n=187)	Some active (n=404)	Active (n=175)	F values	P values
One-mile(s)	729±128	652±105	610±86	41	p≤0.01
VO_2max(ml/kg/min)	44.97±3.2	46.5±2.9	47.1±3.1	13.9	p≤0.01
Sit and reach(cm)	26.4±6.3	27.5±6.2	28.9±6.3	7.5	p≤0.01
Flamingo Balance(s)	60±39	56.2±32	59.5±38	0.2	P≤0.816
Vertical jump(cm)	19±4.3	21.4±4.4	23.4±5.3	34.7	p≤0.01
Standing broad jump(cm)	107.8±20.5	116±22.8	127.6±24.2	34.7	p≤0.01
Hand grip(kg)	19.6±6.7	19.3±6.1	19.8±5.6	0.5	P=0.606
Speed(s)	7±0.7	6.8±0.8	6.3±0.6	48.9	p≤0.01
4×10m shuttle run(s)	13.5±1.2	12.9±1	12.4±1	46.1	p≤0.01
Sit ups(n)	13±8.9	16.9±10.5	23.1±10.3	46.6	p≤0.01
Pull ups(n)	6.5±4.8	8.8±5.8	10.7±7.2	17.9	p≤0.01
Pushups(n)	7.7±7.6	11.4±8.8	14.7±10.1	23.5	p≤0.01
Simple reaction time(cm)	32.5±11	33.1±9.3	28.1±7.9	24	p≤0.01

DISCUSSION

Obesity prevalence among the 7-11 year Ardabilian boys of this study was 4.2%. In comparison to this study the similar (4.3% and 4 %), lower (1% and 2%) and higher (6.3%) prevalence of obesity (in 6-12 year boys) were reported at difference cities in Iran [34-38].

Regarding PA levels in 7-11 years old boys in Ardabil, the findings of this study (Table 2) revealed that the no active boys performed worse in all fitness tests (except Balance and Hand grip tests) in comparison to the active boys (P≤0.01) and also performed worse in One mile time, 4×10m shuttle run, Vertical jump, Standing broad jump, Pull ups and Pushups in comparison to the some active boys (P≤0.01). Except Balance, Hand grip strength and cardiorespiratory fitness tests the active boys attained better results in all the other fitness tests than the some active boys (P≤0.01). Sallis *et al.* (1993) showed PA index (six measures of PA) in fourth-grade children(274 boys and 254 girls) was significantly associated with five measures fitness components (the mile run, Skin-fold tests, Pull-ups, Sit-ups and the Sit-and-reach test) [39]. Pate *et al.* (1990) showed that PA and physical fitness (1.6-km Run/Walk performance and sum of three skinfold thicknesses) in a nationally representative sample of third- and fourth-grade students (1150 boys, 1202 girls) were significantly, although moderately, associated in young children and suggest that interventions directed toward enhancement of PA in children are worthy of investigation [40]. Ara *et al.* (2007) in their study showed that apart from the Plate tapping, the Flexibility and the Bent arm hang tests, active boys (7-12 y) attained better results in all physical fitness test (Time in run speed test, Time in shuttle run test, VO2max, Jump performance, Handgrip, Sit-ups) than their sedentary counterparts [41]. Raudsepp *et al.* (2006) studied the time spent in outside-school PA and fundamental motor skills in primary school children with a mean age of 8 years. Through qualitative assessment they examined the developmental level of overhand Throw and Standing broad jump and the correlation with two categories of physical activity - skill specific activity and overall PA. Results revealed that levels of Throwing and Jumping were related with skill-specific PA but not with general levels of PA [42].

By referring to table 2 of this study the mean values of cardiorespiratory fitness in the active and the some active group were significantly higher than the no active group (P≤0.01). Also the results of this study (Table 1) showed that the no active group had significantly higher Weight, FM and BMI than both the active and the some active group (P≤0.01). Ruiz *et al.* (2006) indicated that the intensity of PA, especially vigorous PA, but not total PA is negatively related to body fatness, whereas both amount and intensity of PA are positively associated with cardiovascular fitness in children. The results suggest that PA of vigorous intensity may have a greater effect on preventing obesity in children than does PA of lower intensity, whereas both total and at least moderate to vigorous PA may improve children's cardiovascular fitness [43]. Black and white adolescents who engaged in relatively large amounts of free-living vigorous exercise were likely to be relatively fit and lean [44]. Dennison *et al.* (1988) found very inactive young adults had the lowest aerobic fitness scores (as measured by the 600-yard run) when they were youngsters [45]. It is important to note that children with the lowest PA /fitness levels and highest percentage of body fatness are most

likely to develop other risk factors for CVD, including elevated Blood pressure and serum Cholesterol levels. Sedentary lifestyle habits may be formed at a young age and aerobic fitness and PA behaviors tend to track throughout childhood and possibly into adulthood [46]. The heaviest children are more likely than their leaner counterparts to develop Type II diabetes, a serious condition that was seldom seen in youth before the number of overweight youth increased dramatically in recent years [47]. Because both of obesity and cardiorespiratory fitness track from childhood into the adult years [48], it is desirable to formulate effective preventive recommendations and strategies starting early in life. One key issue is ascertaining the intensity of PA that is most likely to lead to better cardiovascular fitness and less fatness [43].

Referring to table 1 of this study both the no active and the some active boys have significantly higher TVVPT than the active group (P=0.01). Some epidemiological studies have found weak inverse associations between hours of television viewing and PA [49, 50] and fitness [51, 52]. Robinson (1999) in his study designed a randomized trial to reduce children's television watching with the hope that this would result in an increase in the youngsters' PA and fitness levels [53]. Although television watching time was reduced, no changes were found in activity and fitness. In contrast, Epstein *et al.* (2000) included both an addition of PA and a reduction of sedentary behaviors (such as television watching) in a weight reduction program for obese children. School-related sedentary activities such as studying and doing homework were not targeted for reduction, only those performed during the children's "leisure" hours. Epstein found that both adding PA and reducing sedentary behaviors were effective in promoting weight loss and aerobic fitness in the children [54].

Based on the results of this study, higher health related physical fitness, lower fatness and TVVPT were related to higher PA level in the active group which followed the results of some related studies [44, 46, 54]. Although our results showed the some active boys were relatively leaner and fitter than the no active boys, but the active boys were fitter than both the some active and the no active boys, too. Some researches in their studies showed that high PA or vigour PA had higher benefits for children than low PA which this study followed them [43, 44]. So maybe increasing PA time and simultaneously decreasing sedentary behaviors (such as: TV watching and video game playing time) can help our children to improve their health.

CONCLUSION

Findings of this study showed that the high physically active 7-11 years old Ardabilian boys were fitter than both the no active and the some active counterparts and also leaner than the no active counterparts. Adversely the no active and the some active boys had much sedentary time (TVVPT) than the active boys. Maybe decreasing some sedentary activities (such as: TV watching and video game playing time) and simultaneously increasing PA time in children can increase health related physical fitness level of the children. Regarding this fact that the active boys have higher fitness level than the no active and the some active counterparts high PA is recommended, although it should be stated that any PA in children is better than none at all.

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