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A study of motor ability of higher secondary level adolescents in Chitwan district

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Abstract
Motor activity is known to be an important factor in the promotion of people's health and physical efficiency. Regular physical activity participation has been associated with several health benefits; nevertheless, along with a high prevalence of overweight, obesity and sedentary behaviour, young people's physical inactivity has been found to be the main threat to health in the twenty-first century. Motor ability is the best marker of health condition at any age and it is connected with both motor and psychological-affective benefits. However, young people show low levels of physical fitness. The goal of the study is to analyse the motor ability levels of higher secondary level adolescents in connection with gender differences. The sample consists of 460 students, attending the class-11 and 12 of higher secondary level (boys: n: 262, age: 16,2±0,7 years, height: 173,5± 6,1 cm, weight: 68,3±10,7 kg, BMI: 22,7±3,2; girls: n=198, age: 16,2±0,7 years, height: 159,8±5,9 cm, weight: 57,6±9,0 kg, BMI: 22,5±3,0). They underwent anthropometric and motor assessment (Standing broad jump, 2 Kg Overhead Medicine Ball Throw, Sit-reach, Sit-up, 10x5 m Shuttle Run test, Leger test) during physical education classes. The outcomes pointed out that boys produced a better performance than girls in standing broad jump, 2 Kg Overhead Medicine Ball Throw, 10x5 m Shuttle Run test and Leger test, while girls only produce a better performance in Sit-reach. They need to increase motor ability levels, particularly girls, by attending physical education classes, which must offer a larger variety of motor contents and respect gender differences.

Keywords: physical fitness, young, adolescent, school.

Introduction
Motor activity is known to be an important factor in the promotion of people's health and physical efficiency. Participating in a regular physical activity has been associated with several health benefits (Biddle *et al*., 2004) [2], nevertheless, young people's physical inactivity, in conjunction with high prevalence of overweight, obesity and sedentary behaviour, has been found to be the main threat to health in the twenty-first century (Blair, 2009) [3]. Motor ability has been defined as the result of body movement generated by muscles' action which increase expenditure of energy (McArdle *et al.,* 2001) [14]. It has been erroneously defined as a synonym of aerobic fitness rather than being considered a definition that embraces all components concerning health (Hands *et al.,* 2009) [8]. Indeed, it includes different components such as endurance, strength, flexibility, coordination, balance (Knapik *et al.,* 2006) [11]. Motor ability represents the best index of health condition at any age (Ortega *et al.,* 2008) [18]. It has been positively associated with benefits on cardiovascular system, levels of total and abdominal adiposity, skeletal apparatus, depression, anxiety, self-esteem and school achievement (Catley & Tomkinson, 2013) [6] Childhood and adolescence represent crucial moments of life, when lifestyle and healthy or unhealthy behaviour determined at this age may affect health condition in adulthood. It has been demonstrated that motor ability is determining of lifestyle in connection with motor performance as well as individual health condition, and this information has produced much evidence on variation of this aspect in adolescents.

Materials and Methods
Participants
The sample consists of 460 students (boys: n= 262, age: 16,2±0,7 years, height: 173,5± 6,1 cm, weight: 68,3±10,7 kg, BMI: 22,7±3,2; girls: n=198, age: 16,2±0,7 years, height:

159,8±5,9 cm, weight: 57,6±9,0 kg, BMI: 22,5±3,0) attending the class-11 and 12 of higher secondary level. Adolescents were selected on a voluntary basis. Before selection, adolescents' teachers were informed about aim and methods of the study and they were asked for a written informed consent for their children to participate in the study.

Procedure

Subjects underwent anthropometric and motor assessment carried out during October 2012 to March 2013 during curricular physical education lessons. Height was measured by using a portable stadiometer. Weight was measured with a high precision electronic scale, which was calibrated before each measurement using a standard weight. The body mass index (BMI) was calculated by dividing the weight (expressed in kg) by the square of the height (expressed in meters). Motor abilities were assessed by:

Standing broad jump (SBJ): Subject is positioned behind the starting line with feet slightly apart in line with shoulders. Then he is required to jump horizontally as far as possible, with both feet. Distance is measured in cm from the starting point to the subject's heels. Two tests were recorded and the best one was chosen. This test evaluates lower limb explosive-strength.

Sit-up test (SU): Subject is in supine position, with the knees bent and hands behind the head. The examiner places himself in front of the subject, holding his heels. On the starting-signal, the subject raises the trunk touching knees with elbows, and then he comes back in the starting position with shoulders on the ground. Examiner counts how many times subject flexes his trunk for 30 seconds. This test evaluates endurance of the abdominal muscles.

2 Kg Overhead Medicine Ball Throw (MBT): Subject stands behind the starting line with feet slightly apart in line with shoulders, then he throws 2kg medicine ball overhead. Two tests are performed and the longest distance is reported in cm. This test evaluates the upper limb strength.

10x5 m Shuttle run test (10x5): Subject is required to run back and forth as fast as possible ten times, along a 5 m course. Test is performed twice and the best performance is chosen and expressed in decimals. This test evaluates speed of movement, agility and coordination.

Sit and reach test (SR): Sitting down with legs out straight ahead, subject bends forward slowly without dashing, trying to push fingers as far as possible on the measuring board. The position of utmost extension has to be held for 2-3 seconds. The value obtained is recorded, and it is positive if it is greater than zero and negative if it is less than zero. Test is performed twice with a few minutes rest between each set. This test evaluates flexibility of lower limbs.

Leger test (VO_2Max): Subject is required to run back and forth between two lines 20 meters apart, maintaining a pace set by a pre-recorded sound signal. Initial running speed is 8.5 km/h, increased by 0.5km/h each minute. Subjects runs in a straight line and changes direction at the end of the course, respecting the sound order. Test ends when subject is not able anymore to reach the end of the course at the rhythm of the sound signal for three consecutive times. VO_2Max indirect value is registered using the following formula: VO_2Max (ml kg^{-1} min^{-1}) = $31.025+3.238X_1 -3.248X_2 +0.1536X_1X_2$ where X_1=shuttle run maximum speed (Km h^{-1}) and X_2= age of the subject. This test evaluates aerobic endurance.

Statistical Analysis

Descriptive statistics has been used for statistical analysis (mean ± D.S.). One-way analysis of variance (ANOVA) has been used to examine differences according to gender in motor tests. Data has been analyse using the SPSS and significance set by $p<0.05$.

Results

Differences in gender in motor test

Significant differences emerged in favour of boys in standing broad jump (SBJ) ($F(1,456)=567,135$, $p<0.0005$), in sit-up ($F(1,458)=156,465$, $p<0.0005$), and in 2 Kg overhead Medicine ball throw (MBT) ($F(1,458)=487,354$, $p<0.0005$), in 10x5 m shuttle run test ($F(1,457)=100,813$, $p<0.0005$) and in Leger test ($F(1,417)=268,111$, $p<0.0005$), while significant differences emerged in sit-reach for girls ($F(1,458)=156,465$, $p<0.0005$). Results are summarised in table 1:

Table 1: Motor ability tests results by boys and girls (mean ±D.S.).

	SBJ (cm)	SR (cm)	SU (n°)	MBT (cm)	10x5 (s)	VO_2Max (ml/kg/min)
Boys (n=262)	190,2±25,3#	-0,6±9,5	20,3±3,6#	799±150,6#	19,70±2,28#	42±5,8#
Girls (n=198)	136,3±22,2	6,3±8,8#	15,9±4,0	521,9±106,2	21,93±2,44	33,8±3,7

# $p<0.0005$

Discussion

Motor ability is a powerful marker of physical condition, especially in adolescents, and this stresses need for significate and accurate assessment on this issue in young people. Although international literature has been dealing with this topic for several years, there are still few data on higher secondary level adolescents' motor ability level. Apparently, this is the first study which analyses motor ability levels of adolescents. Results from this study pointed out that boys have greater performance than girls in standing broad jump, in sit-up, in 2 Kg overhead Medicine ball throw, in 10x5 m shuttle and in Leger test, whereas, in comparison with boys, girls have greater performance in sit-reach test. Comparing these values with those in other studies, it emerged that, apparently, these results are lower than European values (Ortega *et al.,* 2011; Sauka *et al.,* 2011) [17, 19] and extra-European ones (Catley & Tomkinson, 2013) [6]. Results from this study confirm those of other Authors who emphasise better performance of boys' tests for speed, strength and endurance (Catley & Tomkinson, 2013; Marta *et al.,* 2012b; Cepero *et al* 2011[6, 13, 7]. More recent studies pointed out that boys show better values than girls in tests for speed, strength and endurance (Catley & Tomkinson, 2013; Sauka *et al.,* 2011) [6, 19]. Some researchers pointed out that, compared to girls, boys, aged 12 to 15, showed better performance in vertical jump, medicine ball throw, sit-up and push-up tests (Bovet *et al.,* 2007) [4]. Similar results have been found in Spanish adolescents aged 13 to 18 years in standing broad

jump and sit-up (Casajus *et al.,* 2007; Ortega *et al.,* 2005) [5], and in Latvian teenagers in standing broad jump, sit-up, 10x5 m shuttle run test, and in handgrip test and in endurance shuttle run test (Sauka *et al*., 2011) [19]. This difference in gender might be explained by factors of physical growth such as specific sex changes in terms of lean and fat body mass (Marta *et al.,* 2012b; Artero *et al.,* 2010) [13, 1], length of bones (Neu *et al.,* 2002) [16] and hormonal modification, particularly in testosterone (Sheffield-Moore, 2000) [20]. In regard to flexibility, in this study girls showed higher values in sit-reach in comparison to boys. These results are in line with other studies which confirmed this gender difference for flexibility (Catley & Tomkinson, 2013; Sauka *et al*., 2011) [6, 19]. Some Authors have found a positive and significant connection between physical activity and multistage fitness test (Tovar *et al*., 2008) [22]. More recent studies emphasized how subjects who have low physical activity levels have lower performance in both strength and aerobic endurance tests (Keiner *et al.,* 2013; Nes *et al.,* 2013) [10]. A study examined relationship between aerobic fitness and physical activity in 270 students aged 9 to 15 years and they found that, after puberty, difference between sexes might be explained by gender difference in physical activity levels (Sveinsson *et al.,* 2009) [21].

Conclusions

Motor ability levels are one of the most important aspects for what concerns health condition in young people. This is the first analysis carried out on such a wide sample and that assessed different motor capabilities giving a more complete picture in motor ability levels in higher secondary level students. From this study it emerged not only that boys have better performance in motor ability than girls but above all that these values are not in accordance with European and extra-European standards. This trend is nothing but the outcome of the decrease in terms of physical activity and motor ability all over the world in last decades In this context, school plays a key role in identifying and helping adolescents with low motor ability levels. School is recognized to be the ideal environment to promote activities concerning health, not only because it involves many young people, but also because some studies emphasized that interventions in this environment are more effective and successful. Physical education is part of the school curriculum and its goal is to achieve human and motor development through the knowledge and practice of various physical activities. Besides, it aims to promote healthy life styles through an increase of modest and vigorous physical activity.

When students have a positive experience from their involvement in physical education, it is more likely that they will regularly engage in physical activity in adulthood (Hardman, 2008) [9]. One of the advanced reasons for these decreased physical activity and fitness levels in young people is the reduced participation in physical education classes. It is partly due to a lack of planning, without any regard to interest, motivation and gender differences (Marta *et al*., 2012b) [13]. Physical education classes involve both boys and girls; therefore, teachers are required to find a connection between the intended goals and specificity defined by differences in gender. Some Authors underlined how, in order to increase physical activity levels, more effective intervention strategies are determined by the choice of teaching strategies: they focus on the selection of physical activity matters, as well as the organization and management of class group, by integrating ordinary physical education class with high-intensity activities (Londsale *et al*., 2013) [12]. The goals of physical education are reached through mutually integrated teaching styles (production and reproduction) (Mosston & Ashoworth, 2002) [15] and a wide variety of activities and motor tasks. It's necessary to adopt strategies to improve motor ability in adolescents, particularly in girls, during physical education classes, respecting gender differences and developing a true motivational climate.

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