# Relationship between Physical Activity and Physical Fitness of Ellisras Rural Primary School Children of South Africa
# 南非鄉鎮小學生的身體活動與體適能

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## Abstract

The aim of this study was to determine the relationship between physical activity and fitness in 212 South African rural primary school children. A questionnaire was used to gather physical activities performed during the whole week. The results show a few significant relationships between physical activity and sit-ups, shuttle run and 1600m run in girls, but none in boys. The gender difference may be explained by a ceiling effect in boys. The general absence of significant findings may be explained by the low nutritional status, unrecorded physical activity duration, high levels of physical activity, and heterogeneity in growth and maturation.

Key words: Physical fitness, physical activity, rural primary school children, South Africa

## 摘 要

本文旨在探討南非鄉鎮地區小學生身體活動量與體適能的關係.以問卷方式進行調查學童過去一星期的身體活動量,結果顯示女學童的身體活動量與仰臥起坐,來回跑及一千六百米跑有顯著相關,而男生的活動量與體適能卻沒有相關,這現象可能受其他因素影響所致.

## Introduction

Physical activity has been recognised as an important tool for prevention of diseases in developed countries (Bassuk & Manson, 2003; Haskell, 2003; Mackechnie & Mosca, 2003). Research clearly shows that physical inactivity is associated with an increased risk of chronic diseases (Davies et al., 1995; Oguma & Shinoda-Tagawa, 2004), while increasing regular physical activity has been presumed to be an important tool for the prevention of diseases (NIH Consensus Development Panel on Physical Activity and Cardiovascular Health, 1996; US Department of Health and Human Services, 1996). It is suggested that physically inactive children are likely to become inactive adults (Kuth & Cooper, 1992). As a result, physically inactive children have the potential to become extensive consumers of health care, contributing significantly to health care costs in the future (Riddoch & Boreham, 1995). The prevention of chronic disease should therefore begin in childhood (Aarts et al., 1997; Berenson & Pickkof, 1995). Because the effects of physical activity on health are thought to go partly through physical fitness (Kannel et al., 1985; Barnowski et al., 1992), it is important to have clear information on the relationship between physical activity and physical fitness. In contrast with the abundance of information in the developed countries on this relationship, such information is sparse in developing countries like South Africa.

Therefore, we performed a study to determine the relationship between physical activity and physical fitness in rural primary school children in the Ellisras region of the Limpopo Province of South Africa.

## Methods

### Subjects and Design

The subjects described here participate in the ongoing observational Ellisras Longitudinal Study (ELS), which started in 1996. This longitudinal study concerns growth and life-style of children in the Ellisras rural areas of South Africa. For the study presented here, cross-sectional data for physical activity and physical fitness collected in 2001 were used. These data were assessed in 212 children (112 boys and 100 girls) within the age range of 7-14 years. The aim of the study was explained to the subjects and their parents who gave informed consent. The Ethics Committee of the University of the North approved the study.

### Data Collection

#### *Physical Activity*

Physical activity was assessed using a questionnaire adopted from Prista et al. (2000), which was developed to incorporate activities that are common in these areas. Fifteen research assistants helped in the collection of the data. Subjects were asked how many times per week they performed each activity included in the questionnaire. The questionnaire included four types of activities, namely, household tasks indoor (i.e. cleaning the house, washing clothes, cooking, washing the dishes) and outdoor (i.e. cutting the wood, animal husbandry, fetching water, agriculture), outdoor games (i.e. traditional games such as: tseretsere, banabaka, dance, diketo, katsekatse tswara legotlo, legotlo, kgati, luto, mambalobalo, maphitlaphitlwane, mmasekitlane, mmela, mokoko, morabaraba, pekwa, sekapukapu, sekonopa, sekotiwa, sepini, setimela), and unorganized sports (i.e. non-curricular physical education, soccer, netball, karate, drum majorette, athletics and volleyball). The score for the four types of activities was attained by a multiplication of the number of activities reported with the number of days per week engaged in those activities. In addition, a total physical activity score was calculated through a summation of the four types of activities.

#### *Physical Fitness*

Physical fitness test items were assessed using the European Tests of Physical Fitness (1988) and American Alliance for Health, Physical Education, Recreation and Dance (1980) test batteries. The physical fitness test items assessed were classified into the following categories: three strength items: standing long jump (cm): the best out of three trials was recorded as a score; bent arm hang (sec.): a child has to hang as long as possible with the chin above a bar; and sit ups: a child has to sit down on a gymnasium mat with the hands behind the neck, the knees bent at 90 degrees and the feet flat on the mat. Then the child has to lie down on his/her back, shoulders touching the mat and return to sitting position with the elbows out in front so that they touch his/her knees. The total number of correctly performed sit-ups in 30 sec is the score. Three items assessed running capability: shuttle run (sec.): time taken to complete 10x5m shuttle run; 50 meter run (sec.): sprinting from standing start; and 1600 meter run (sec.): endurance run, time taken to run four laps of 400 meters. One item measures balance (flamingo balance): standing on one leg on a metal beam as long as possible, the total number of errors committed in one minute is the score. One item measures flexibility (sit and reach (cm)): a child has to push a bar forward with fingers of both hands

together while sitting with legs stretched. Finally, plate tapping (sec.) measures speed of the arm: tapping a plate 25 times with one hand interchangeably on the left and right sides of the other hand. The test-retest reliability of the measurements were moderate to high (0.4 to 0.8; Monyeki et al., 2003).

### *Data Analysis*

Differences between boys and girls in physical activity and physical fitness items were analyzed using linear regression analyses corrected for age. The relationship between physical activity and physical fitness (outcome variable) was also analyzed with linear regression analyses. Standardized regression coefficients corrected for age and gender are reported. Interaction terms between physical activity and gender, and between physical activity and age were added to the regression_models in order to investigate possible effect modification. If a significant interaction with gender was found, separate coefficients were reported for boys and girls. Where a significant interaction with age was found, it is reflected in the tables. The data of all fitness items were recoded for the regression analyses in such a way that high scores indicate better performance. All analyses were performed with SPSS software.

## Results

Table 1 shows the descriptive information for the four types of physical activities, and total physical activity. A significant gender difference was only found for indoor household activities. Table 2 shows the descriptive information for the physical fitness items. Significant gender differences were found for standing long jump, bent arm hang, 50m sprint, and 1600m run.

Table 3 shows the standardized regression coefficients and the p-values for the four categories of physical activity and total physical activity with the nine physical fitness items. For girls, significant positive associations were found between total physical activity and sit-ups, 10x5m shuttle run, and 1600m run. The significant positive associations between total physical activity and sit-ups, and shuttle run were due to positive associations in all four activity categories. The significant positive association between total physical activity and 1600m run was mainly due to the positive associations with traditional games and indoor household activities.

For the remaining physical fitness items (standing long jump, bent arm hang, flamingo balance, plate tapping and sit and reach) no significant associations with either total physical activity or the four separate categories were found.

**Table 1. Means (M) and Standard Deviations (SD) of the Four of Physical Activity Categories (Number of Activities Multiplied by Number of Days per Week Engaged in Those Activities).**

| | Boys (n= 112) | | Girls (n=100) | | Age adjusted gender difference |
|---|---|---|---|---|---|
| | **M** | **SD** | **M** | **SD** | **p-value** |
| Indoor | 6.3 | 4.4 | 8.0 | 5.4 | .01 |
| Outdoor | 8.7 | 4.6 | 8.9 | 5.2 | .74 |
| Traditional Games | 27.7 | 16.1 | 26.6 | 14.2 | .69 |
| Sport | 7.4 | 4.5 | 6.4 | 4.9 | .14 |
| Total Physical Activity | 50.0 | 22.1 | 50.1 | 20.4 | .96 |

**Table 2. Descriptive Characteristics (Means (M), Standard Deviations (SD) and Gender Difference) of Physical Fitness Items.**

| | Boys (n= 112) | | Girls (n=100) | | Age adjusted gender difference |
|---|---|---|---|---|---|
| | M | SD | M | SD | p- value |
| Standing long jump (cm) | 131.5 | 16.6 | 126.9 | 17.3 | .05 |
| Bent arm hang (sec.) | 8.6 | 3.8 | 5.0 | 7.2 | .001 |
| Sit ups | 16.5 | 6.6 | 15.2 | 6.6 | .17 |
| Shuttle run (sec.) | 22.0 | 1.7 | 22.3 | 1.8 | .37 |
| 50m sprint (sec.) | 9.2 | 0.8 | 9.7 | 1.0 | <.001 |
| 1600m run (sec.) | 458.5 | 40.5 | 518.2 | 70.3 | <.001 |
| Flamingo balance | 10.1 | 5.2 | 10.5 | 4.8 | .49 |
| Plate tapping (sec.) | 19.0 | 4.2 | 19.0 | 3.6 | .97 |
| Sit and reach (cm) | 16.0 | 4.1 | 16.8 | 4.2 | .12 |

**Table 3. Standardized Regression Coefficients (*b*) and p-values of Relationship between Four Categories of Physical Activities#, Total Physical Activities and Nine Physical Fitness Parameters*.**

| | Indoor household | | Outdoor household | | Traditional Games | | Sports | | Total physical activity | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *b* | *p* | *b* | *P* | *b* | *p* | *b* | *p* | *b* | *p* |
| Standing long jump | .019 | .79 | .034 | .62 | .087 | .22 | .069 | .32 | .087 | .20 |
| Bent arm hang | .038 | .59 | -.001 | .90 | .000 | .99 | .018 | .79 | .010 | .88 |
| Sit-ups | B -.004 | .97 | B-.025 | .79 | B-.048 | .61 | B-.168 | .07 | B-.075 | .43 |
| | G .155 | .14 | G .273 | .01 | G .316 | <.001 | G .253 | .01 | G .385 | <.001 |
| Shuttle run | B -.137 | .17 | B .045 | .64 | B .007 | .95 | B .063 | .52 | B-.053 | .59 |
| | G .187 | .08 | G .228 | .03 | G .141 | .19 | G .117 | .27 | G .228 | .03 |
| 50m Sprint | -.005 | 94 | -.056 | .42 | B-.054 | .57 | -.088 | .20 | -.007 | .92 |
| | | | | | G .055 | .15 | | | | |
| 1600m run | B - .049 | .62 | B-.032 | .75 | B-.055 | .57 | B .017 | .86 | B-.019 | .84 |
| | G .182 | .09 | G .024 | .82 | G .324 | <.002 | G .030 | .78 | G .277 | .01 |
| Flamingo balance | .119 | .11 | .082 | .24 | .031 | .66 | .000 | .99 | .066 | .35 |
| Plate tapping | .013 | .86 | .014 | .84 | .062 | .38 | .013 | .85 | .052 | .45 |
| Sit and reach | .021 | .77 | .036 | .60 | -.022 | .76 | -.060 | .39 | -.015 | .83 |

# The number of activities in a category times the number of days per week engaged in those activities as scores

* For each fitness variable a high score indicates high fitness, and all analyses are controlled for age and gender (unless results are stratified in boys and girls because of significant gender interaction)

B = boys

G = girls

## Discussion

In this study, the associations between physical activity and physical fitness in rural primary school children were investigated. The results showed significant positive associations between total physical activity and sit-ups, shuttle run and endurance run. Most surprising, this was only found in girls. No significant associations between activity and fitness were found in boys.

In contrast with the innumerous studies stating that boys have higher levels of physical activity and physical fitness than girls, there appears to be no literature that has discussed the question of gender differences in the relationships between physical activity and fitness. The observed gender differences in the relationships between total physical activity_and fitness that were found in the present study may be explained by a ceiling effect in boys. Most boys may have had such a high level of fitness which made the differences in their levels of physical activity to be insufficient to cause further differences in the fitness items. The relatively poor performance of girls as compared with the boys (especially with respect to endurance-running) may have made them more sensitive to differences in physical activity.

The present result_of hardly any significant findings is (partly) in contrast with research findings from developed countries. For instance, Jurimae and Jurisson (1997) found that total physical activity was associated with 7 out of 9 fitness items tested. Studies by Butcher and Eaton (1989) and Schumucker et al. (1984) reported that total physical activity has a significant positive relationship with strength items, while Beunen et al. (1992) revealed that physical activity relates closely with cardiorespiratory fitness. A study by Pate and Ross (1995) showed that children who were more engaged in community-based physical activity had better health related fitness. Another study by Dollman et al. (2002) found a significant association of 1.6 k run/walk time with the number of club sports played by both boys and girls. Unfortunately, none of these studies presented the results for both boys and girls separately.

Alike those from developed countries, most studies from developing countries report significant relationships between physical activity and fitness items. In a study performed in Mozambique, total physical activity was significantly associated with endurance performance (Prista et al., 1997). Satyanarayana et al. (1979) revealed that physical activity and work capacity were significantly related in Indian children. In contrast, in Senegal, it was concluded that the lack of variations in physical activities resulted in no significant associations between physical activity and physical fitness (Benefice, 1993). This, however, can not be concluded in the present study, because the ELS participants perform quite many activities that differ in type, and they are heterogeneous with respect to the amount of physical activity engaged in, as can be interpreted from the relatively large standard deviations in Table 1.

Then, what may be the reasons for the general absence of significant findings in our study as compared with the generally significant findings in developing and developed countries? Firstly, the poor nutritional status of these children (Monyeki et al., 2003) may have affected the muscle mass, making it difficult to observe relationships between physical activity and fitness.

A second reason may be that duration was not incorporated in the physical activity assessment of the present study. With a questionnaire it is difficult to determine the duration of the activities performed, since in these children time is not conceived in conventional terms like urban or city children do. Normally, when the children in rural areas perform a physical activity they use the sun as their time monitor, meaning that if it is still light they can go on playing. In these rural areas most children have a low socioeconomic background, for example with a high level of illiteracy among elderly people who often have the guardianship over children. Furthermore, it is very rare here for parents to buy watches for their children. For these reasons it was impossible to get reliable data on the exact time children spent in physical activities. Instead of combining intensity, frequency and duration into a physical activity score, we multiplied the number of activities by the number of days per week engaged in these activities. The validity of this method is strengthened by findings from Armstrong and Bray (1991), Morrow and Freedson (1994) and Harro and Riddoch (2000) who revealed that self-report of physical activity by children is problematic because children are less conscious of time than adults. We therefore do not expect that the non-significant findings have been caused by low validity of the physical activity measurement instrument used.

Third, physical activity levels are rather high in this rural area where walking is the primary mode of transportation because of the lack of resources. It could be hypothesized that in the upper part of this physical activity distribution, differences in physical activity are not associated with differences in fitness anymore.

Fourth, variation among children in growth and maturation may have resulted in not finding strong relationships between physical activity and fitness in the present study. Growth and maturation were unfortunately not assessed in the present study, but are thought to affect the relationships between activity and fitness (Malina & Bouchard, 1991). Furthermore, the absence of significant relationships between physical activity, and sit and reach, flamingo balance and plate tapping may be explained by the fact that many subjects were at the pre-pubertal stage when children have difficulties to perform such tests (Malina & Bouchard, 1991).

Finally, because the positive relationship between physical activity and fitness is intuitively expected, researchers and journals may have been hesitant to publish non-significant findings. This publication bias may have been strengthened by social conformism to the widespread public health campaigns promoting a physically active lifestyle, and may explain the difference of our findings with the literature.

In conclusion, the present results do not show many relationships between physical activity and fitness. However, the few significant relationships were found between physical activity and sit-ups, shuttle run and 1600m run in girls, but none in boys.

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