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A comparative study of physical fitness level of Terai and hilly region students in Nepal

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Abstract
This study assessed the fitness level of 10-13 year-old Terai Region students in Nepal. 75 Hilly Region males (mean ± SD, 11.0 ± 0.6 y; 144 ± 7.0 cm; 37.6 ± 9.0 kg), 73 Hilly Region females (mean ± SD, 11.3 ± 0.7 y; 147 ± 9.0 cm; 36.2 ± 10.6 kg), 49 Terai Region males (mean ± SD, 12.0 ± 1.6 y; 146 ± 11.0 cm; 36.4 ± 7.9 kg) and 31 Terai Region females (mean ± SD, 11.2 ± 1.7 y; 144 ± 12.0 cm; 40.6 ± 11.7 kg) volunteered for study. Students performed five tests (Push-Up, Sit-Up, Sit and Reach, 4 x 10m Shuttle-Run and 1 Mile-Run). Males performed better in all the tests, with the exception of the Sit and Reach test. Hilly Region students performed better in Push-Up, Sit-Up and 1 Mile-Run tests than Terai Region students. Hilly Region females performed better in 4 x 10m Shuttle-Run than Terai Region females (13.44 ± 0.76 vs. 14.42 ± 1.25). However, Terai Region students performed better in Sit and Reach test than Hilly Region students (23.9 ± 6.2 vs. 22.5 ± 6.3). We concluded that Terai Region students should exercise more and should be included in games and sports programmes in schools; as Terai Region students can perform equally to Hilly Region students if given the chance.

Keywords: Hilly Region, Terai Region, Push-up, Sit-up, Sit and Reach, Shuttle-run, 1 Mile-run.

Introduction
Physical fitness is the ability to perform daily activities with vitality and having less chance of developing chronic diseases (American College of Sports Medicine, 2010) [1]. Physical fitness may be considered to involve two components: *health-related fitness* which includes body composition, cardiorespiratory fitness, muscular endurance, strength and flexibility and *skill related fitness* which includes agility, reaction time, speed, power and balance (Jackson *et al.,* 1990) [4]. It has been indicated that sedentary individuals have higher chances for developing inactive-related diseases such as cardiovascular diseases, obesity, type 2 diabetes and hypertension (Bouchard *et al.,* 2007) [2], which given the relationship between activity and fitness in children (Rowlands *et al.,* 1998), infers that a higher the level of physical fitness may lower the opportunity for developing these diseases. It has been indicated that students are less active and have a low fitness level (Longmuir and Bar, 2000) [5]. However, it has been indicated that children have higher percent of body fat (Winnick and Short, 1986) [6]. Therefore, the aim of this study was to assess the physical fitness level of Terai Region students in Nepal compared to their Hilly Region counterparts and whether gender affected these findings. As most Terai Region students in Nepal study in public schools, we hypothesized that the physical fitness level of Terai Region students would be lower compared to their Hilly Region counterparts, regardless of gender.

Method
Participants
Seventy five Hilly Region male students (mean ± SD, 11.0 ± 0.6 y; 144 ± 7.0 cm; 37.6 ± 9.0 kg), 73 Hilly Region female students (mean ± SD, 11.3 ± 0.7 y; 147 ± 9.0 cm; 36.2 ± 10.6 kg), 49 Terai Region male students (mean ± SD, 12.0 ± 1.6 y; 146 ± 11.0 cm; 36.4 ± 7.9 kg) and 31 female Terai Region students (mean ± SD, 11.2 ± 1.7 y; 144 ± 12.0 cm; 40.6 ± 11.7 kg) volunteered to take part in the study. Students were recruited from public schools.

Procedures
Each student (Hilly Region and Terai Region) completed five exercise tests. On the first day, all basic and anthropometric measurements were taken. On the second day, students performed four exercise tests (i.e., Push-Up, Sit-Up, 4 X 10m Shuttle-Run and Sit and Reach) conducted in the schools and in random order. On the third and the last day, students performed an endurance exercise test (1 Mile-Run (1609m)). This was performed on a separate and last day of testing in order not to affect the results of the other exercise tests. The 1 Mile-Run exercise test was performed at the track of school in order to standardize the distance (1609 m). Each student ran 4 laps and 9 meters. Students were told to avoid any vigorous exercise (with the exception of the previous day's testing) during the 48 hours prior to the exercise tests and before the endurance exercise test. Proper warming up and stretching exercises were performed by all the students before each exercise test.

Exercise tests
Each student (Hilly Region and Terai Region) performed five exercise tests. In the second day students performed 4 exercise tests in a random order. These exercise tests are:

Push-Up test
The aim of this exercise test is to measure strength and muscular endurance for the upper back and the upper arm muscles. Students were told to lie prone, with arms at shoulder width or a little bit wider, the palm of the hands facing forward, and feet close together and look forward. At the start students were told to extend their arms fully (180° in the elbows' joints) while keeping the body in the straight position and to flex the elbows until the upper arm was parallel with the floor (90° in the elbows' joints). This was counted as one repetition. Students were told to do as many repetitions as possible in one minute (60 seconds). Only precise repetitions were counted. The exercise test was terminated if any part of the students' body touched the floor except the feet and the palms of the hand or if the 1 minute duration was finished. A stopwatch was used to count and control the time. The researchers demonstrated the exercise test in front of the students, until the students were totally satisfied that they could perform the test.

Sit-Up test
The aim of this test is to measure strength and muscular endurance of the abdominal muscles. Students were told to lie on their back, put their arms in a cross position on the chest, put their feet on the floor and to bend their knees. The distance between the heel of the feet and the buttocks for all students was around 30 cm. The feet of the performer student were anchored by another student. At the start, students we told to curl up to touch their knees by the elbows and lie down on their back (starting position). This was counted as one repetition. Only precise repetitions were counted. For example, if the students moved his/her arms from the crossing position this repetition was not counted. Also if the elbows did not touch the knees this was not counted. The test was terminated after 1 min. A stopwatch was used to count and control the time. The students performed the Sit-Up exercise test on a mat (200 x 100 x 4 cm). Before the exercise test was started the researchers performed the exercise test in front of the students until the students were confident that they could perform the test.

Sit and Reach test
The aim of this exercise test is to measure flexibility the lower back and the hamstring muscles. A box with the measurement scale was placed on the floor against a wall. The 23 cm mark on the measurement scale was level with the student's feet. Students were told to remove shoes before the test and place their feet against the box. Students were not allowed to flex their knees. Another student was told to press the knees against the floor for the student who was performing the exercise test in order not to flex the knees. Students were told to place one hand on the top of the other hand and to face the palms of the hands down, bend forward and reach as far as possible toward the 23 cm mark. Students were given three attempts and to hold the hands in the farthest position for 1 second. The students performed the Sit and Reach exercise test on a mat (200 x 100 x 4 cm) which was placed underneath the box. Before the exercise test was started the researchers performed the exercise test in front of the students until the students were totally satisfied that they could perform the test.

4 X 10m Shuttle-Run test
The aim of this exercise test is to measure speed and agility. Two lines were drawn on the ground 10 meters apart. The width of these lines was 1 meter. Two blocks of wood (5 x 5 x 10 cm) were put behind one of these lines. The students were told to run from the starting line to get one of the two blocks and put it behind the starting line and run back to get the second block and run through the starting line. Students had the chance to run in sport shoes or run barefoot. The students were told to finish this distance as quick as possible. If the student threw the first block, he/she was asked to do the exercise test again. If the block fell down from the student while running he/she was asked to do the exercise test again. Two stopwatches were used and the average time of the two stopwatches was recorded. Time was recorded in seconds and milliseconds. Before the exercise test was started the researchers performed the exercise test in front of the students until the students were totally satisfied that they could perform the test.

1 Mile-Run test
The aim of this exercise test is to measure cardiorespiratory fitness. This exercise test was performed on the last day in order not to affect the results of the other exercise tests. This exercise test was performed at football ground of the school. The students ran in groups of 10 students. Stopwatches were used to count and control the time.

Data analysis
A series of two factor ANOVAs (Hilly Region students and Terai Region students (Gender; male and female) were used to assess whether there was a significant difference in these exercise tests between Hilly Region students and Terai Region students and between male and female and whether performance on the various tests moderated by gender. Alpha was set at P 0.05. Data were analyzed using Statistical Package for Social Sciences (SPSS) for Windows, PC software, version 16.

Results

Table 1: Shows the results of the five exercise tests for both Hilly Region students and Terai Region students (i.e., Push-Up, Sit-Up, Sit and Reach, 4 x 10m Shuttle-Run and 1 Mile Run). Values are (Mean ± SD).

Student/Exercise test	Push-Up	Sit-Up	Sit & reach (cm)	Shuttle-Run (s)	1 Mile-Run (min.s)
Hilly Region male students	16.1 ± 10.2*°	37.0 ± 9.9°	21.6 ± 6.6	12.92 ± 0.86*	9.38 ± 1.29*°
Hilly Region female students	12.9 ± 7.8°	39.3 ± 7.8°	23.4 ± 5.9*	13.44 ± 0.76	11.36 ± 1.38
Terai Region male students	14.7 ± 7.2*	28.5 ± 11.3	22.7 ± 7.0°	12.88 ± 1.07*°	10.13 ± 2.13*°
Terai Region female students	7.8 ± 5.3	24.3 ± 9.8	25.8 ± 4.1*°	14.42 ± 1.25	12.53 ± 1.58

* Significant difference between male students and female students

° Significant difference between Hilly Region students and Terai Region students

Push-Up Test

Two way ANOVA showed that males performed better in the Push-Up exercise test compared to their female counterparts ($F_{(1,224)} = 18.63$, $P<0.05$). It also showed that Hilly Region students performed better in the Push-Up exercise test compared to their Terai Region counterparts ($F_{(1,224)} = 7.63$, $P<0.05$). There was no significant group x gender interaction on the Push-Up results ($F_{(1,224)} = 2.48$, $P>0.05$). (Table 1)

Sit-Up Test

Two way ANOVA showed that Hilly Region students performed better in the Sit-Up test compared to their Terai Region counterparts ($F_{(1,224)} = 75.22$, $P<0.05$). There was no significant difference between male and female in the Sit-Up exercise test ($F_{(1,224)} = 0.53$, $P>0.05$). There was a significant interaction between group x gender on the Sit-Up results ($F_{(1,224)} = 5.83$, $P>0.05$). Post hoc analysis using independent-sample t-test with Bonferroni adjustment (P = 0.0125) showed that Terai Region male students performed better than Terai Region female students in the Sit-Up exercise test (P = 0.088).
(Table 1)

Sit and Reach Test

Two way ANOVA showed that Terai Region students performed better in the Sit and Reach exercise test compared to their Hilly Region counterparts ($F_{(1,224)} = 4.09$, $P<0.05$). Two way ANOVA showed that females performed better in the Sit and Reach test compared to the males ($F_{(1,224)} = 7.98$, $P<0.05$). There was no significant group x gender interaction for the Sit and Reach exercise test results ($F_{(1,224)} = 0.67$, $P>0.05$). (Table 1)

Shuttle Run Test

Two way ANOVA showed that males performed better in the 4 x 10m Shuttle-Run exercise test compared to their female counterparts ($F_{(1,224)} = 59.60$, $P<0.05$). Two way ANOVA showed that Hilly Region students performed better in the 4 x 10m Shuttle-Run exercise test compared to their Terai Region counterparts ($F_{(1,224)} = 12.38$, $P<0.05$). There was a significant group x gender interaction for the 4 x 10m Shuttle-Run results ($F_{(1,224)} = 14.98$, $P<0.05$). Post hoc analysis using independent-sample t-test with Bonferroni adjustment (P = 0.0125) showed that Hilly Region female students performed better than Terai Region female students in the Shuttle-Run test (P = 0.000). (Table 1)

1 Mile Run Test

Two way ANOVA showed that males performed better in the 1 Mile-Run exercise test compared to their female counterparts ($F_{(1,224)} = 85.17$, $P<0.05$). Two way ANOVA showed that Hilly Region students performed better in the 1 Mile-Run exercise test compared to their Terai Region counterparts ($F_{(1,224)} = 13.98$, $P<0.05$). There was no significant group x gender interaction for the 1 Mile-Run exercise test results ($F_{(1,224)} = 2.07$, $P>0.05$). (Table 1)

Discussion

This is the first study in Nepal to compare physical fitness of Terai Region students to their Hilly Region counterparts. Hilly Region students performed better than Terai Region students in the Sit-Up exercise test. Hilly Region students out performed Terai Region students in the 1 Mile-Run exercise test. Hilly Region female students performed better in 4x10m Shuttle-Run exercise test than Terai Region female student With the exception of the flexibility measurement, the lower physical fitness of Terai Region students compared to their Hilly Region peers is not surprising, as most of Terai Region students in Nepal study at poor infrastructure schools. This in turn will limit opportunities to benefit from exercise programmes offered to Hilly Region students in the schools. In fact, one of the schools from which we recruited some Terai Region participants for the study, did not have a physical education teacher or indeed a teacher who is familiar with sign language was delivering the physical education classes. Furthermore, in most Terai Region schools, physical education classes are delivered by non PE instructors and these instructors may be less likely to learn new techniques in physical activity and training compared to Hilly Region instructors.

Conclusions

Physical fitness of Terai Region students was significantly lower compared to their Hilly Region counterparts in the Push-Up, Sit-Up and 1 Mile-Run exercise tests. The results also revealed that Hilly Region female students performed better in the 4 x 10m Shuttle-Run exercise test compared to their Terai Region female students. However, the results showed that Terai Region students performed better than Hilly Region students in the Sit and Reach exercise test. Therefore, based on these findings we strongly recommend that Terai Region students in Nepal in the age of 10 – 13 years old to be more active during their life. Being more active will be reflected in higher level of physical fitness and this should in turn be reflected by a lowering of inactive-related diseases, such as obesity, type 2 diabetes, cardiac diseases, hypertension and dyslipidemia. Given that Terai Region students may perform equally to Hilly Region students if given the chance, I also recommend that Terai Region students be included in games and sports in schools to benefit from enhanced quality of life from physical education programme in schools.

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