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Original Article

Prevalence of hamstring tightness and hamstring flexibility of 9-11 years old children of different obesity and physical activity levels in Malaysia and Sri Lanka

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Abstract:
Background: Physical activity is thought to be decreased in children since the past few decades increasing risks of diseases related to overweight and obesity among children as they enter adulthood. Flexibility is an important physical fitness marker determining normal biomechanical function in sports and activities of daily life. Inadequate flexibility is a causative factor that may lead to muscle injury, particularly if the hamstring group of muscles is involved. *Objectives*: To identify the prevalence of hamstring tightness, to assess the association of hamstring flexibility with physical activity level, BMI and to compare the hamstring flexibility scores between subjects of different obesity and physical activity levels among 9-11 year old children. *Materials and Methods*: 385 (Mean age 10.1 ± 0.7) Malaysian and 389 (Mean 9.9 ± 0.8) Sri Lankan subjects were recruited. Correlations were performed by Spearman's correlation test and the subjects of different physical activity and obesity levels were compared by one way ANOVA analysis. *Results and Conclusion*: The results revealed 43.4% and 44.2% Malaysian and 51.2% and 51.9 % Sri Lankan children with hamstring tightness on dominant and non-dominant side respectively. There was a significant positive weak to moderate correlation between hamstring flexibility and physical activity level among Malaysian ($r = 0.31–0.33$) and Sri Lankan (0.21-0.31) subjects ($p < 0.001$). Subjects in the "high" physical activity category obtained significantly higher scores of hamstring flexibility compared to "low" physical activity subjects in both countries ($p<0.05$).
Key Words: hamstring tightness, flexibility, obesity, physical activity.

Introduction

Apart from traditional definitions, flexibility is also defined as the mobility of a body segment, which is dependent on the tolerance of soft tissue to movement and the ability of the soft tissue to work with forces applied to it (Houglum, 2010). Some advantages of possessing adequate flexibility include: reduced risk of injury (Bandy, Irion, & Briggler, 1997); relief from pain and enhanced athletic performance (Worrell, Smith, & Winegardner, 1994; Aedo-Muñoz et al., 2019). Inadequate flexibility is a causative factor that leads to muscle injury, and this statement is true in particular for the hamstring group of muscles (Funk, Swank, Adams, & Treolo, 2001). Children spend most of their school time in different class activities like reading, writing, drawing etc. and are at a higher risk of adapting poor postural habits because of sitting for long hour (Dutta & Dhara, 2012). Since the hamstring muscles bend the knee, this long hours of sitting can lead to shortening of this muscle group (Vadivelan & Priyaraj, 2015).

A large number of school children had limited lumbar and hamstring flexibility, in a school in Spain where about 18-38 % children had reduced hamstring flexibility (Brodersen, Pedersen, & Reimers, 1994; Castro-Pinero et al., 2009; Harreby et al., 1999). Hamstring tightness has been associated with lower back pain among children and it is also observed that children with tight hamstrings pose a greater risk of low back pain during their adulthood (Hestbaek, Leboeuf-Yde, Kyvik, & Manniche, 2006; Kujala, Taimela, Salminen, & Oksanen, 1994; Mikkelsson et al., 2006).

Physical activity is an important health related lifestyle component and is thought to be decreased in children since the past few decades and hence, increases risks of diseases related to overweight and obesity among children as they enter adulthood (Ebbeling, Pawlak, & Ludwig, 2002).

Reduced physical activity levels among children lead to excess body weight or obesity, whereby excess energy intake along with unhealthy eating patterns, also a combination of both leads to resultant excess energy (Güngör, 2014). There are findings from research that suggest high levels of obesity have a negative influence on physical fitness parameters (Abel et al., 2018). Research suggests that health related fitness parameters such as BMI, body composition parameters and flexibility may vary in different obesity and physical activity levels.

Despite, the information in literature about the importance of hamstring flexibility among young

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children and the ill effects of its tightness, there is a serious dearth in information about the prevalence of hamstring tightness, the association of hamstring flexibility with such important components as: obesity and physical activity level among young children in Sri Lanka and Malaysia.

Methodology

Participants. This was a descriptive cross sectional study designinvolving 385 subjects from Malaysia and 389 subjects from Sri Lanka.

Procedure. The height of the subjects was measured using the tape mounted on the wall. The height of the subjects, gender and age was keyed to the Karada scanner (HBF- 375). The readings of body weight and BMI were recorded as well.Hamstring flexibility was measured using passive straight leg raise test. The cut-off point to identify subjects with hamstring tightness was set at 80 degrees for passive straight leg raise test. This is in accordance with the reference criterion by (Kendall, McCreary, & Provance, 1993; Palmer & Epler, 2002), which established the cutoff for passing the passive straight leg raise test should be greater than or equal to 80 degrees to be categorized as normal hamstring flexibility.

Data Collection. In Malaysia the questionnaire formulated by Kowalski and team (Kowalski, Crocker, & Donen, 2004) to assess physical activity level among children was validated in Malay language and used in this study (Zaki et al., 2016).The questionnaire was validated in Sinhala language and used in the study.

The mean score of the 9 questions was classified as: ≤ 2 = low activity, ≥ 2 and ≤ 3 = "moderate activity", ≥ 3 "high activity"(Al Husaini, 2017; Chen, Lee, Chiu, & Jeng, 2008).

Ethical principles meant for research involving human subjects were followed and research protocol was approved by the Research and Ethics Committee of the UniversitiSains Malaysia. Ethical approval was obtained from Ethics and Research Committee of Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka.

*Statistical Analysis.*The statistical analysis was performed using SPSS version 24.The correlations were assessed using Spearman's correlation coefficient. The subjects of different physical activity and obesity levels were compared using one way Analysis of Variance (ANOVA). A Post hoc Tukey's test was conducted to analyze pair wise comparisons.

Results

The descriptive details of the Malaysian and Sri Lankan subjects are presented in Table 1.

Table 1 Descriptive statistics of Malaysian and Sri Lankan subjects (Mean±SD)

	Malaysian Subjects			**Sri Lankan Subjects**		
	Boys (N = 184)	**Girls** (N = 201)	**Total** (N = 385)	**Boys** (N = 195)	**Girls** (N = 194)	**Total** (N = 389)
Age (years)	10.14 ± 0.71	10.01 ± 0.73	10.1 ± 0.7	9.93 ± 0.75	9.92 ± 0.7	9.9 ± 0.8
Height (cm)	135.4 ± 6.4	134.3 ± 8.2	134.8 ± 7.4	133.6 ± 6.8	133.5 ± 7.4	133.6 ± 7.1
Body Mass (kg)	32.27 ± 8.8	31.9 ± 10.6	32.1 ± 9.7	27.6 ± 5.9	28.4 ± 7.1	28.1 ± 6.5
Body Mass Index (BMI)	17.7 ± 3.7	17.6 ± 4.2	17.7 ± 3.9	15.4 ± 2.2	15.7 ± 2.7	15.6 ± 2.5
PSLRD	76.5 ± 7.6	79.2 ± 7.6	77.9 ± 7.7	71.7 ± 9.7	75.6 ± 11.2	73.3 ± 10.6
PSLRND	75.3 ± 7.8	78.1 ± 7.6	76.7 ± 7.9	70.4 ± 9.9	74.6 ± 11.4	72.1 ± 10.9
PAQ C	2.6 ± 0.41	2.5 ± 0.4	2.5 ± 0.4	2.5 ± 0.5	2.2 ± 0.4	2.4 ± 0.5

Passive straight leg raise test score dominant side (PSLRD), Passive straight leg raise test score non-dominant side (PSLRND), Physical activity (PAQ C)

As seen in Table 1 the mean scores for hamstring flexibility appear to be higher among Malaysian subjects compared to that of Sri Lankan subjects.The prevalence of hamstring tightness among Malaysian and Sri Lankan subjects is given in Table 2.

Table 2 Prevalence of Hamstring tightness among Malaysian subjects and Sri Lankan subjects (%)

	Malaysian Subjects			**Sri Lankan Subjects**		
	Boys (N=184)	**Girls** (N=201)	**Combined** (N=385)	**Boys** (N=195)	**Girls** (N=194)	**Combined** (N=389)
PSLRD (%)	89(48.3)	78(38.8)	167(43.3)	118 (60.5)	81 (41.7)	199 (51.2)
PSLRND (%)	91 (49.4)	79 (39.3)	170(44.1)	120 (61.4)	82 (42.3)	202 (51.9)

Passive Straight leg raise test score dominant side (PSLRD), Passive straight leg raise test non-dominant side (PSLRND).

Findings from Table 2 reveal that the percentage of hamstring tightness was more or less close to 50% among the Malaysian and Sri Lankan subjects.Results of Spearman's correlation coefficient are presented in Table 3 for Malaysian and Sri Lankan subjects.

Table 3 Correlation between hamstring flexibility and physical activity among Malaysian and Sri Lankan subjects

	Malaysian Subjects			Sri Lankan subjects		
Variables	**PSLRD**	**PLSRND**	**PAQ C**	**PSLRD**	**PLSRND**	**PAQ C**
PSLRD	-	-	0.33 **	-	-	0.26 **
P value			0.00			0.00
PSLRND	-	-	0.32 **	-	-	0.27 **
P value			0.00			0.00
PAQ C	0.33 **	0.32 **	-	0.26 **	0.27 **	-
P value	0.00	0.00		0.00	0.00	

Passive Straight leg raise test score dominant side (PSLRD), Passive straight leg raise test non dominant side (PSLRND), Physical activity (PAQ C), ** $p < 0.001$, *$p < 0.05$.

Results in Table 3 revealed a moderate correlation (Cohen's classification) between hamstring flexibility and physical activity among Malaysian subjects and a weak correlation was seen among Sri Lankan subjects.Means scores of Hamstring flexibility according to different physical activity levels among Malaysian and Sri Lankan subjects is presented in Table 4.

Table 4 Mean and standard deviation of hamstring flexibility scores based on physical activity levels of subjects of both countries

	Malaysian Subjects		Sri Lankan Subjects	
Physical activity level	**PSLRD Mean ± SD**	**PSLRND Mean ± SD**	**PSLRD Mean ± SD**	**PSLRND Mean ± SD**
Low (N = 37)	74.6± 6.9	73.5 ± 7.1	69.4 ± 11.3	68.1 ± 11.4
Moderate (N = 286)	77.8 ± 7.7	76.5 ± 7.8	74.8± 10.1	73.7± 10.4
High (N = 62)	80.4 ± 7.4	79.3 ± 7.5	74.9± 10.4	73.9± 10.7

Standard Deviation (SD), Passive Straight leg raise test score dominant side (PSLRD), Passive straight leg raise test non dominant side (PSLRND).

The comparison of mean scores of hamstring flexibility (Table 4) among subjects of different physical activity level by one way ANOVA revealed a significant difference with $p < 0.05$ between the groups. A post Hoc analysis for further comparisons revealed that the subjects of "high" physical activity category obtained significantly higher hamstring flexibility scores compared to those of "low" physical activity among subjects of both countries ($p < 0.05$).

Results of Spearman's correlation coefficient for Hamstring flexibility and BMI are presented in Table 5 for Malaysian and Sri Lankan subjects.

Table 5 Correlation between Hamstring flexibility and BMI among Malaysian and Sri Lankan subjects

	Malaysian Subjects			Sri Lankan Subjects		
	PSLRD	**PSLRND**	**BMI**	**PSLRD**	**PSLRND**	**BMI**
PSLRD	-	-	-0.07	-	-	-0.06
P value			0.16			0.20
PSLRND	-	-	-0.08	-	-	-0.05
P value			0.13			0.19
BMI	-0.07	-0.08	-	-0.06	-0.05	-
P value	0.16	0.13		0.20	0.19	

Passive Straight leg raise test score dominant side (PSLRD), Passive straight leg raise test non dominant side (PSLRND), Body Mass Index (BMI), ** $p< 0.001$, *$p < 0.05$ As seen in Table 5 there was no significant correlation between hamstring flexibility and BMI among subjects of both countries. However, further analysis of hamstring flexibility among subjects of different obesity levels is presented in the next table.

The mean scores of hamstring flexibility according to different obesity levels for Malaysian and Sri Lankan subjects are presented in Table 6.

Table 6 Mean scores of Hamstring flexibility according to different obesity levels among Malaysian and Sri Lankan subjects (Mean±SD)

Obesity level	PSLRD	PSLRND	PSLRD	PSLRND
UW (N = 38)	77.7 ± 7.5	76.6 ± 7.5	72.9 ± 10.5	71.8 ± 10.8
NW (N = 259)	78.5 ± 7.7	77.3 ± 7.8	74.1 ± 10.5	72.9 ± 10.7
OW (N = 82)	76.3 ± 7.8	74.9 ± 7.8	69.1 ± 13.4	67.8 ± 13.3
OB (N = 6)	76.6 ± 8.5	75.6 ± 8.1	-	-

Underweight (UW), Normal Weight (NW), Over weight (OW),Obese (OB), Standard Deviation (SD), Passive Straight leg raise test score dominant side (PSLRD), Passive straight leg raise test non dominant side (PSLRND).

A one way ANOVA comparison of mean scores of hamstring flexibility of subjects of different obesity levels revealed that there was no significant difference ($p > 0.05$) between the hamstring flexibility scores of the subjects of different obesity levels in both countries. However, it can be seen in Table 6the mean scores for hamstring flexibility were higher among normal weight subjects compared to overweight and subjects.

Discussion

The main aim of the study was assessing the prevalence of hamstring tightness among young sedentary children. The findings reveal that the prevalence of hamstring tightness was more or less 50% among subjects from both countries. This finding emphasizes the need to assess hamstring tightness at early age and address it.

While considering results from other countries, in a survey of 7781 children aged 6 – 12 years old, to identify the problem of occurrence of faulty postures among children in the city of Zeliona Gora of Poland; 79.4 % of the children were found to have decreased hamstring flexibility (Permoda, Permoda, & Chudak, 2010). Further, in a study among 769 Danish children revealed that in children above 10 years of age there was 40 % and 75 % hamstring tightness in girls and boys respectively. There was more than 40 degrees lag in the active knee extension test (Lima, Martins, Moraes, & Silva, 2019).

Physical activity is well documented and understood to be important for good health and also hamstring flexibility is an important health related muscular fitness component. Thus, in the present study aimed at assessing correlation between hamstring flexibility and physical activity level. The findings of present study revealed that subjects of high physical activity had significantly higher scores for hamstring flexibility.

The findings revealed a weak positive correlation between hamstring flexibility and physical activity. The reason for a weak correlation identified in this study but not a strong correlation could be that though the children involve in physical activity, the activities in specific may not involve movements that increase joint range of motion or improve flexibility. This finding provides added information that children may indulge in general physical activity and still be asymptomatic for hamstring tightness. As a result, if flexibility deficiency is not identified and addressed well on time, the child will still remain at risk to develop ill effects of hamstring tightness such as back pain and leg injuries in future. This finding emphasizes the need to train and include specific activities that enhance full joint movement and thus, reduce hamstring tightness and improve flexibility.

Tables 6 revealed that there were 06 obese children among the 385 Malay subjects recruited in the study. On the other hand, among the Sri Lankan subjects there were no obese children. The presence of higher percentage of subjects who are underweight and absence of subjects who are obese among Sri Lankan children may be associated with nutritional status, socioeconomic background and genetic predisposition. While considering children from Government and rural schools 1/3rd of primary school were shown to have low BMI. It was recommended to study underlying issues leading to nutritional problems and thus, thinness at the National level in Sri Lanka(Naotunna et al., 2017).

Results from Table 3 revealed that there was no significant correlation between hamstring flexibility and BMI. The results when narrowed to compare the hamstring flexibility scores between subjects of different obesity levels showed that the normal weight subjects had higher mean scores for hamstring flexibility when compared to overweight and obese subjects.

Globally in the present era there is little or no encouragement to involve in physical activity among young children. There is decreasing opportunity for them to expend energy (Ludwig & Pollack, 2009). Children most of their time watching television, video games and other electronic devices and media, thus, they are in a sedentary seated position most parts of the day (Caroli, Argentieri, Cardone, & Masi, 2004; Hesketh, Wake, Graham, & Waters, 2007).

This practice of involving in sedentary lifestyle and assuming seated position can lead to tightness in the hamstring muscles. This tightness in hamstring muscles may in turn be a hidden reason of discomfort that may inhibit children from getting involved in physical activity.

The present study indicated that the overweight and obese subjects scored lower hamstring flexibility scores than normal weight subjects. This whole scenario appears to be a vicious circle.

The findings emphasize the need to identify and address hamstring tightness. Further it is suggested that when physical activity programmes are formulated to address overweight and obesity among young sedentary children, it must include, flexibility exercises as well, to prevent the ill effects of asymptomatic hamstring tightness if present and to have better exercise benefits.

Conclusion

The results revealed 43.4% and 44.2% Malaysian subjects with hamstring tightness on dominant and non-dominant side respectively; 51.2% and 51.9 % Sri Lankan children with hamstring tightness on dominant and non-dominant side.There was a significant positive weak correlation between hamstring flexibility and physical activity level among Malaysian. Subjects in the "high" physical activity category obtained significantly higher scores of hamstring flexibility compared to "low" physical activity subjects in both countries.

Conflicts of interest

Authors have no conflicts of interest to declare.

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