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RELATIONSHIP BETWEEN FACTORS OF NEUROMOTOR FITNESS AND CHILDREN'S INDIGENOUS GAMES: LINKAGE WITH FUNDAMENTAL MOTOR SKILLS

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ABSTRACT

This study investigated the impact of Fundamental Motor Skills (FMS) on children's Indigenous Games (IGs). Two hundred and three (203) children (Age: Mean=9.2; SD=1.322) from Camp and Tsiamo Primary Schools volunteered for the study. Following a pilot study, participants were assessed in koi, diphiri and dibeke indigenous games popular among Batswana children. Physical neuromotor tests measuring power, strength, speed, coordination and agility were also administered. Current findings were similar to previous studies done elsewhere. There was a weak relationship between fundamental motor skills in children's indigenous games and the neuromotor fitness items.

Key words: Indigenous games; Physical neuromotor performance; Fundamental movement skills.

BACKGROUND

Fundamental Motor Skills (FMS) are a prerequisite for the development of advanced movement skills necessary for children's sustained participation and achievement in daily physical activities and sport. The FMS required in performing locomotive skills (running, walking, hopping, galloping, skipping), manipulative skills (throwing, catching, kicking, striking, bouncing) and stability skills (balancing, standing, hanging, climbing) are entirely dependent on relevant opportunities for engaging in physical play by children. The FMS must be developed in the period between early childhood (2-3 years old) and later childhood (7-10 years old) and not later. The development of FMS may be effective if there is deliberate interaction of the organism with the task constraints and the environmental opportunities (Davids & Bennett, 2008). Furthermore, the science of motor learning and human performance is linked to the practical challenges of teaching and learning in the classroom (Renshaw *et al*., 2010).

Research findings on FMS are clear that: (a) FMS does not develop with maturity but must be learned (Raudsepp & Pall, 2006); (b) failure to participate in meaningful physical activities may lead to lack of mastering the basic motor skills necessary for further participation and achievement in later childhood and adulthood (Akbari *et al*., 2009); (c) there are gender differences in the performance of some of the FMS, mostly favouring boys at both preschool and elementary school levels (Goodway *et al*., 2010); (d) acquisition of motor skill proficiency in childhood is a predictor of adolescent proficiency in physical activities and enjoyment (Barnett *et al*., 2009).

While aware of these motor behavioural changes, persistent participation in physical activities also contributes to the development of children's physical fitness. In a study of motor fitness among Dutch youth, Runhaar *et al*. (2010), identified physical fitness as dichotomously consisting of neuromotor fitness (with neuromuscular strength, speed of movement, coordination, and agility as its variables) and aerobic fitness (activities demanding muscular endurance over prolonged time). When children participate in rigorous physical activities on a regular basis, they develop neuromotor fitness that is important in learning and development of FMS (Runhaar *et al*., 2010). Within a school Physical Education curriculum, the proficiency of children's movements is defined by: (a) direction (left/right, forward/back, across, around); (b) levels (high, medium, low, over, under); (c) movement dimensions (large, small); and (d) expressiveness (smooth, quick, ballistic, fluent, stiff) (Wharton-Boyd, 1983; Breslin *et al*., 2008). It is considered that successful performance of these movement qualities is an indicator that development of children's FMS is taking place. However, the persistent challenge with Physical Education teachers in elementary schools is having a robust assessment battery that objectively and subjectively measures the physiological, psychological, sociological and ecological constraints and enablers. Similarly, research is challenged to develop multiple assessment tools that are highly valid, fair, educative and explicit (Hands, 2003; Netelenbos, 2005).

Although not well studied, the informal learning from which the child engages in solitary games or with others at either home or school environmental settings has recently been highly considered to be effective in developing FMS (Raudsepp & Pall, 2006; Akbari *et al*., 2009). Rather than competing against each other, learning from free play complements the instructional Physical Education offered by the school program. During pre-elementary and elementary school levels, children participate in a variety of free games including indigenous games (IGs). Typically, children's traditional games are characterised by movement variability that challenges not only their neuromotor fitness but also cognitive and social skills (Lyoka, 2007).

Although studies are limited, significant correlations between FMS and outside school free play physical activities and games have been reported (McKenzie *et al*., 2004; Raudsepp & Pall, 2006). The understanding is that children who frequently engage in moderate to vigorous physical activities are likely to acquire more FMS than their sedentary counterparts. Different from the school selected games and sport, IGs are generic in character; mostly associated with a variety of locomotive and manipulative movement skills that involve more gross motor movement than fine motor movement. As emphasised in other studies (Venetsanou & Kambas, 2004; Breslin *et al*., 2008), the impact of physical activities from other cultures; the IGs in this case, are critical learning situations where children would be challenged to modify and adapt the new movements in their movement repertoire leading to increased movement experiences. Based on a longitudinal study (Runhaar *et al*., 2010), the impact of neuromotor fitness on FMS development has further been emphasised. Although neuromotor fitness among Dutch children had decreased from 1980 to 2006, the study reported that neuromotor fitness is still important for children's learning, successful performance and enjoyment during physical activities.

Other studies on the impact of physical activities and games found that children develop not only their motor proficiency but also gain neuromotor fitness (Butcher & Eaton, 1989; Fisher *et al*., 2005; Lacy & Hastad, 2007). However, studies examining the relationship between neuromotor fitness and children's IGs are lacking among elementary school children. The premise is that, if there is a correlation between physical activity and children's motor proficiency (Wrotniak *et al*., 2006; Cliff *et al*., 2009) then IGs should contribute toward children's neuromotor fitness necessary for learning and acquisition of the FMS. The question is, to what extent are movements in IGs related to the neuromotor fitness variables?

PURPOSE OF THE STUDY

The current study is motivated by the assumption that on a daily basis, children engage more in IGs (that are in the form of free play) than instructional-based activities. Most of the previously cited studies on FMS have focused more on pre-elementary school children than elementary level. It is important to know whether children from six years old are able to retain and effectively use their previously acquired FMS during physical activities and games. While acknowledging the contribution of the hidden curriculum in the development of children's FMS, the facilitators of children's learning and development still believe and think within the instructional box.

The purpose of this study was therefore to examine whether FMS in IGs may influence neuromotor fitness of elementary school children.

The objectives of this study were: (a) to identify neuromotor fitness variables that discriminate performance on gender basis; and (b) to establish whether a relationship exists between variables of neuromotor fitness and fundamental motor skills relevant in children's IGs.

METHOD

A baseline study was designed to assess the developing neuromotor fitness in terms of speed, muscular strength, coordination and power among elementary school children. Performance assessment of selected IGs was aimed at identifying the development of related FMS and if they were related to neuromotor fitness variables. Oral interviews were administered to establish preferences of participants in the IGs. A pilot study was carried out to improve the quality of the measurement instruments, as well as administrative procedures. The school authorities consented to the participation of all the pupils.

Participants

A total of 203 Batswana children (Age: Mean=9.11; SD=1.360) from Tsiamo and Camp Primary schools volunteered for the study, of which 93 were boys (Age: Mean=9.27**;** SD=1.322**)** and 110 girls (Age: Mean=8.96; SD=1.390). Structured selection of participants from classes 2, 3 and 4 was mainly based on class levels rather than age. Being rural, children in classes had mixed age levels within a range of ±2 years. Children with disabilities or those who were ill were excluded.

Instrumentation

Tests of neuromotor fitness (broad jump for lower trunk strength/power, throw for distance, and coordination of upper body) were administered to the 203 children. *Dibeke, diphiri* and *koi* games were administered to assess their capability to play such games successfully within the given time and/or series. A verbal interview was given to assess participant's self-efficacy toward the indigenous games.

Administrative procedures

All tests were administered at the school premises. Participants were consulted before volunteering to participate. Terminal feedback was given instantly after completion of each activity (terminal). During piloting, *reliability* in testing and scoring was established (90%). Three field research assistants had prior training in administering and recording the assessment instruments. Experts in the field of motor development and performance established both face validity and content validity of the measurement instruments. Administration of the neuromotor fitness assessment was completed within 50 minutes. Three trials were allowed for each test and the best score was recorded.

For the IGs activities the following procedures were observed:

Diphiri **instructions** (chase and catch game): All students who assumed to be baby hyenas stood in the safe area of the field (size of a soccer field). Two students pretending to be hungry lions stood in the middle of the field. During play they pretend to be mother hyenas for the children and they call their children from the other side of the field to join them. As children respond to the call and run across the field, they encounter the hungry lions that go after them. They have to run fast to the other side of the field for their safety. During this situation, the lions catch some. Those caught become small lions and they also join the hunt for the baby hyenas. The activity continues until all the children have been caught. The equipment required was five stop watches, score cards and whistles. Five timekeepers with stop watches stood on the side lines to time those who got caught in the field. The elapsed time was recorded from the moment the child started to run until he/she got caught. The activity was repeated three times to allow for the best performance to be recorded. The longer a child stays in the game before being caught is a strong indicator of the performance level of fundamental movement skills and specific motor skills of the game.

Dibeke instructions (targeting and throwing to hit game): Following the command, students start running from the safe zone across the unsafe zone to the other safe zone. The stopwatch is started once they step across the line to enter the unsafe zone. During the activity, two students standing on either side of the lanes with one tennis ball each, aim at hitting any one of the runners. Runners have the responsibility to dodge the ball as they cross the unsafe area to the other side of the safe zone. The throwers (hitters) are helped by others to retrieve the balls that go beyond the court. The area was equivalent to a volleyball court to accommodate 10-15 participants. The equipment required was two tennis balls (soft), three stop watches and score cards. The timekeepers stop the watch when someone gets hit and the student goes out of play. The elapsed time between stepping in the unsafe zone following the command to start and when the ball hits one it recorded on the score card. A winner can also be the one who crosses the unsafe zones seven (7) times without being hit by the ball. In this case, total time taken to complete the repetitions was recorded. The longer it took to get hit or complete seven crosses along the unsafe area was an indication of the performance level of the fundamental movement skills and motor skills of the game.

Koi instructions (rope skipping game): The student stand with legs apart and parallel with hands apart from the body. The game begins with a song that ends with a command to start the skipping exercise. The student starts to jump the rope that is swung by two students standing opposite each other at rope length. The jumping activity continues until the student has reached total exhaustion (cannot jump any more). The equipment required includes a stopwatch, skipping rope and score card. The elapsed time is measured from the moment the child starts to skip the rope until when jumping stops due to exhaustion. Three trials were given to each participant and the best time was recorded. The participant having the longest time on the game activity was considered to have competent physical motor performance and skipping technique, as well as fundamental movement skills.

Oral interviews were conducted with each participant immediately after completing all the activity tests to establish their preferences. A pen was used to enter their responses on the entry score sheet.

Data analysis

The t-test was applied for gender performance differences; the ANOVA for interclass group differences; and the Pearson Moment of Correlation was applied to establish performance differences, as well as correlations between indigenous games and components of neuromotor fitness. Children's preferences were analysed as percentages of frequency responses.

RESULTS AND DISCUSSION

This baseline study was challenged by a lack of standard criteria for assessing the children's indigenous games performances. The validity of the current findings was strengthened by intra-group differences and similarities, as well as support from related studies done elsewhere.

Gender differences of performance

The t-test results discriminated performance differences between girls and boys in all the activities (Table 1).

There were no significant performance differences between girls and boys in the selected indigenous games performance, suggesting that children who actively engage in physical play would not differ significantly in their developing FMS. However, the noted performance differences in the components of neuromotor fitness have also been reported in a study on the *throw for distance* and the *broad jump* (Delas *et al*., 2008). Boys were better in throwing and jumping activities mainly because they participated in other sport such as soccer and tennis after classes. Such games are associated with explosive strength, speed and coordination. On the other hand, most of the girls preferred to play less vigorous games but were highly skilled in activities such as hand clapping games, aiming and dodging and hopping.

TABLE 1: **PERFORMANCE DIFFERENCES BY GENDER**

Activity	**Mean Boys** (n=93)	**Mean Girls** (n=110)	**F-ratio**	**Sign.** p<0.05	**Difference**
Diphiri	0.632	1.327	5.815	0.837	None
Dibeke	0.177	0.184	0.225	0.200	None
Koi	0.125	0.149	1.300	0.546	None
Broad jump	1.545	1.382	5.527	0.000	Yes
30m.-sprint	5.096	5.927	0.949	0.002	Yes
Throw for distance	28.253	20.373	1.689	0.000	Yes

Contribution of movement experiences gained from IGs toward neuromotor fitness performance

The motive for this question was to identify kinds of movement patterns common in IGs and variables of neuromotor fitness that are influenced by the FMS.

Except for a weak correlation observed in *koi* and the *30m-sprint* shuttle run, there were no significant correlations between FMS used in indigenous games and those from the physical motor performances (Table 2). These findings are similar to a study of FMS and habitual physical activities of children reported by Fisher *et al*. (2005). These differences could be attributed to: (a) children at this age level are generalists who play any game because of interest, inspiration or curiosity; and (b) there is also a possibility that FMS used in neuromotor fitness performances did not transfer during performances of IGs. For instance, a lack of correlation between *dibeke* vs. *broad jump*, *koi* vs. *throw for distance*, *diphiri* vs. *throw for distance* and so on. In principle, gross motor related movements are involved in IGs while there is specificity of FMS during performances of the neuromotor fitness variables, like jumping, running and throwing. This emphasises the relevance of IGs in developmental FMS in children frequently engaged in physical activities and games (Rose & Christina, 2006).

TABLE 2: **PERFORMANCE CORRELATIONS BETWEEN IGs AND NEUROMOTOR FITNESS VARIABLES**

Variables	**Dibeke**	**Diphiri**	**Koi**	**Broad jump**	**30m.-sprint**	**Throw for distance**
Dibeke	-	0.260**	0.311**	-0.071	0.085	-0.131
Diphiri	0.260**	-	0.353**	0.051	0.058	-0.023
Koi	0.311**	0.353**	-	0.051	0.189*	-0.074

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

Performance differences between classes

ANOVA was used to identify class performance differences in the physical activities on a class basis. Significant variations in *broad jump* ($F_{13.360}$), *30m-sprint* ($F_{5.794}$) and *throw for* *distance* ($F_{16.347}$) at $p<0.05$ were noted (Table 3). These differences could be attributed to maturational effects among children, individual motor fitness differences (*broad jump* and *30m-sprint*), differences in motivational levels, as well as body management skills. In throwing, for example, boys outperformed girls. Transfer of learning can happen when there is similarity of movement patterns in focused activities (Rose & Christina, 2006). In due consideration, the movement patterns common in IGs are generic in form, hence significantly important for fundamentals of movement skills (Gallahue & Donnelly, 2003) and associated factors of physical motor performance.

TABLE 3: **PERFORMANCE DIFFERENCES BETWEEN GROUPS**

Variable	Class Mean (n=55)	Class Mean (n=50)	F-ratio (ANOVA)	Significance (p<.05)	Difference
Dibeke	25.284	12.671	1.177	0.312	None
Diphiri	0.102	0.051	1.845	0.162	None
Koi	0.178	0.089	0.924	0.401	None
Broad jump	0.086	0.043	13.360	0.000	Yes
30m.-sprint	3.468	1.734	5.794	0.004	Yes
Throw for distance	308.332	154.166	16.347	0.000	Yes

Gender differences in activity preference

The answers to this question provided some clue about children’s choice of games and related value. However, the validity of these views was challenged by the fact that children’s interests vary with time, experiences, education, change of places and peer influences. However, probing questions were used to qualify their responses and is supported by similar findings from other scholars. Current findings are similar with previous studies on motor proficiency related to performances of FMS and physical activity levels in children (Wrotniak *et al*., 2006; Delas *et al*., 2008). Children’s levels of interest were indirectly expressed by the high frequency of responses in IGs participation, as well as the use of weekend free time for playing games for both girls and boys.

Play *diphiri* at home

The popularity of *diphiri* among boys and girls is shown in Figure 1. It seems that *diphiri* was enjoyed due to a high popularity among boys and girls in all classes. Given the large number of the girls in schools, 98% liked to play *diphiri* similarly quite often, while 79% of the boys liked the game generally. Boys would play occasionally, as their interest seemed to have shifted to other sport like soccer and tennis. However, girls play *diphiri* quite often because it is much more inclusive in nature.

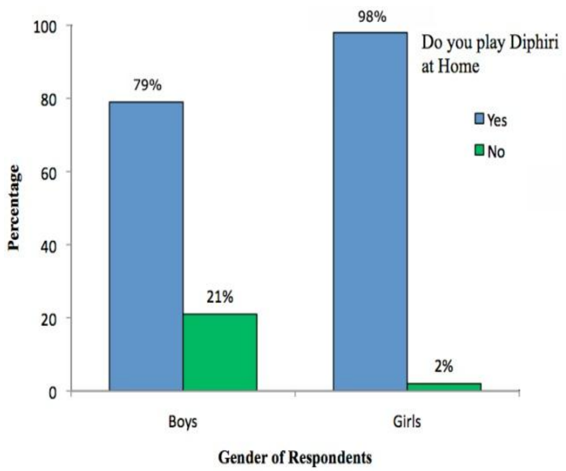

FIGURE 1: **PARTICIPATION IN *DIPHIRI***

Play *dibeke* at home

Dibeke was one of the popular games among children but boys had their interest and time devoted to other games such as soccer and basketball. The children's responses on participating in *dibeke* at home are shown in Figure 2. The responses from those interviewed indicated that boy's (65%) liked the game as they grew up playing it, while girls (75%) still continued to play *dibeke* either at home and school.

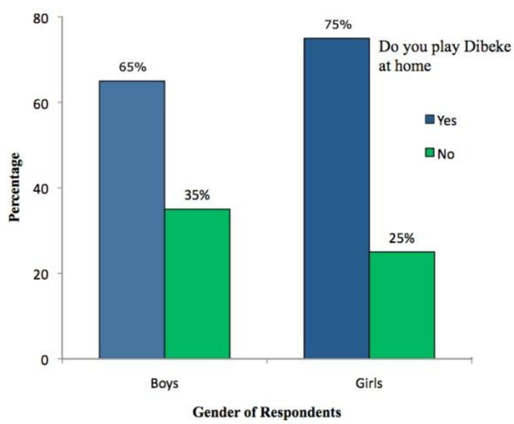

FIGURE 2: **PARTICIPATION IN *DIBEKE***

Play *koi* at home

Although *koi* was a popular game across genders, there were differences in views about of participation frequency (Figure 3).

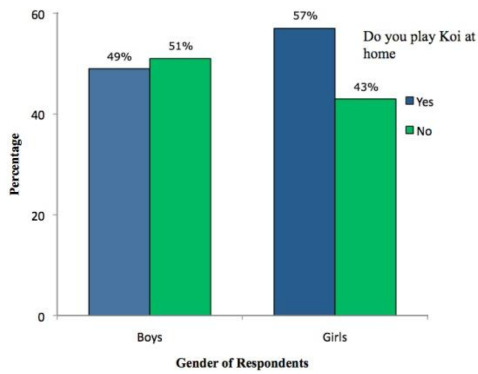

FIGURE 3: **PARTICIPATION IN *KOI***

Frequency of participation in outdoor activities at home

The answers obtained from this probing question provided a general framework about children's preferences of IGs. Children had free time to play on Fridays (they leave early from school) and Sundays on weekends (Figure 4).

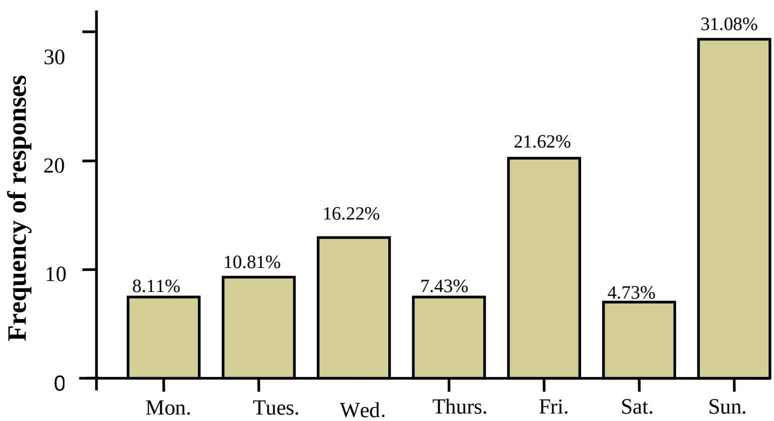

FIGURE 4: **FREQUENCY OF PARTICIPATION IN PHYSICAL GAMES AT HOME**

Children like to play, as well as engage in other physical activities on a daily basis. This was indicated by the number of days they engaged in play per week when they were free. In general terms, girls preferred IGs with less physical contact but that require a high level of skill, while boys engaged in competitive contact sport like soccer and basketball (Lever, 1978).

SUMMARY

Children's views on IGs participation indicated that they were interested in and still wanted to participate actively. This points to their high self-efficacy toward sport and games both at home and schools settings. On the other hand, lack of significant correlations between IGs and components of physical motor performances, suggest that the movement skills used in performing physical motor skills were different from those used in IGs performances.

However, longitudinal studies would best describe the coupling phases of the developmental movement skills among children with age and sex differences being accounted for in children six to 10 years old. Due to tender ages and levels of motor development, children are generalists in games participation, which can make experimental control a significant challenge.

The moving to learn concept (Barret, 1973; Derri & Pachta, 2007) seems to favour the way children learn different movement techniques and skills. Physical Education and sport programs provide ideal opportunities for incorporating children's IGs. Generalisations from the findings of the current study are limited, however, accumulated knowledge from previous studies, methodology, sample size and criterion revealed the following:

- Overall, girls seem to play IGs more than boys on a daily basis. The main reason being a social environmental one where boys prefer to play soccer either at home or school.
- Holistically, children's IGs have potential in developmental fundamental movement skills because they may be transferable to other sport and games.
- The broad participation demonstrated by children in IGs is a potential indicator of their interest, hence there is potential for learning and future development.
- Lack of correlation between IGs and components of neuromotor fitness could be a methodological challenge because current findings are in agreement with Netelenbos (2005) that the low concurrent validity of children's FMS could be due to multiple influences of children's developmental processes or experimental errors. More research is needed in this area.

CONCLUSION

There was no substantiated correlation between neuromotor fitness and the children's participation in IGs. More studies are needed in this sensitive area of children's development.

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