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Co-Relation between physical fitness and cognitive domain

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Abstract
Movement during preschool age is the primary way of action, expression, learning and development. The aim of the paper is to consider the relation between physical fitness and cognitive domain in preschool children. According to contemporary creativity theories, knowledge has an important role to play in forming of a critical level below which creativity is not possible. Insufficiently stimulated and developed motor skills and cognitive domain at this age can be the cause of decreased or 'slumbered' physical fitness. Estimation of motor performance (motor testing - validated battery of 7 motor tasks) and physical fitness (Torrens TCAM test) has been carried out in Kathmandu Valley on the sample of 224 preschool children aged 6 to 6. 5. The results show that motorically more able children (with higher level of cognitive domain) have made better results in TCAM test tasks. The obtained results point to the need to provide preschool children with suitable conditions leading to their optimal motor development and creative motor expression.

Keywords: physical fitness, cognitive domain, preschool children.

Introduction
Physical fitness can be defined as an ability to produce numerous and original motor responses to a stimulus (Wyric, 1968) [20]. Abilities and fundamental development have to succeed each other. If they did not have a chance to integrate, confirm and appreciate conceptual cognitive domain which is the cornerstone of many different disciplines, many children would not be able to learn different kinds of expertise which are necessary for optimization and complete realization of their potential. Focusing solely on skills could lead to cumulative deficits since children will never get a chance to learn and appreciate the concepts supporting (Griffin, 1992) [6]. Achievement in motor activities depends on education based on concepts and necessary cognitive domain acquisition that can prepare them for later, more sophisticated challenges within a discipline (Feldman, D., Pirito, J. 1992) [2]. Unfortunately, children today are not provided with optimal conditions (regarding environmental and educational conditions, etc.) when physical activity is in question, and such a reality has negative effects on their overall development. Within their study on talents, Abbott, Collins, (Starosta, W. 2002) [12] have pointed out that teachers believe that children will be "illiterate" in movement if they are deprived from suitable conditions for its development. Decreased physical activity in this period of life, i.e. at preschool age, has negative effects on life quality, i.e. health, family relationships holds that children in kindergarten do not reach appropriate fundamental levels of motor patterns expected for that period of life. It has been found that children are below the expected level of development regarding adequate locomotor skills and object control skills. Motorically more able children, compared to other children, have more sense for coherency; they can manage the stress better and are more immune to everyday stress that modern life brings (Sturza-Milic, 2008). Insufficiently stimulated and developed motor skills and cognitive domain in children can be a cause of decreased or "slumbered" physical fitness which can have unfavourable effects on motor and overall development of a child (Tejlor, C. 1978) [16].

Method
Participants
The study included a total number of 224 children aged 6 to 6.5 years (117 female and 107 male). All the children attended preschool institutions in Kathmandu Valley. The research was undertaken in 2013.

Procedure

The whole sample was subjected to motor testing, through the application of motor task battery. Having in mind that we are talking about preschool children, motor tasks were aiming at motor skill estimation, as well as children's cognitive domain (in the case of motor testing, it is not possible to measure skills separate from cognitive domain, especially at younger age). Having undertaken motor testing, the next step was to evaluate physical fitness, again on the whole sample. The testing was carried out individually due to specific age of the subjects. Each child was recorded in order to undertake additional, i.e. further analysis and more precise assessments.

Instruments

Motor effectiveness was estimated according to application of 7 mobile tasks battery:

1. Standing long jump (SLO) – a child jumps as far as possible on the mat marked in cm. The result is the length of jump in cm.
2. Running 20 m (R20) – a child runs 20 m starting from standing position. The result of running is measured in tenths of a second.
3. Polygon with obstacles backwards (POB) – Moving backwards as fast as possible on hands and knees a child passes a distance of 10 m, going over a box and crawling through the frame of a box. The task is measured in tenths of seconds.
4. Moving hands along bent surface (MHBS) – A Swedish box is hung on the ripstol at the height of 1 m. Sitting in a certain position on a bench, a child has a task to move his/her hands along the bent surface to reach the ripstol. The task is measured in tenths of seconds.
5. Sit-ups (SIU) – A child lies on his/her back on a mat, with bent knees and crossed arms, with hands resting on opposite shoulders. The examiner fixes the child's feet, while a child raises him/herself into sitting position and then slowly back into lying position. The result is the number of properly made sit-ups in the period of 60 seconds.
6. Tapping rate (TAP) – A child sits on a chair at a desk and in the period of 15 s uses his dominant hand to tap alternately two spots 50 cm apart on his right and left side. The result is the number of double taps.
7. Deep forward bend while seated straddled (DSS) – Sitting on the floor, with his/back on the flat vertical surface and legs straddled under the angle of 60 degrees, a child bends forward as much as possible. The result is the difference in cm between the reach of fingers when sitting straight and the reach of fingers in maximum bend position.

Motor tasks were adjusted to the sample of children and had shown optimal measuring characteristics in previous research (Bala & Popovic 2006; Sturza, 1999; Sturza-Milić, 2009). Physical fitness was evaluated according to Torrance's test Thinking Creatively in Action and Movement (TCAM), which is standard in testing children in pre-school period (Torrance, 1981). The used problem task was in how many different ways can you carry a ball? But it was slightly modified compared to original Torrence TCAM (in the original TCAM test the problem was in how many different ways you can throw the ball at the basket?). The rest of TCAM problem tasks are: In how many different ways can you move? What can you do with a plastic glass? Etc. TCAM produces three types of results (fluency, originality and flexibility). When measuring physical fitness, fluency cannot be defined in terms of the number of relevant movement responses, i.e. motor reactions (motor movement quantity). Consequently, fluency (LFLU) was calculated according to counting of all successful motor responses of a child. Originality (LORI) was determined according to the frequency of appearance of a response within subject population (motor response is considered original if it is statistically infrequent in the response sample offered by the subjects). Flexibility (LFLE) is ability of varying of ideas, i.e. making changes during motor task solving, i.e. revealing new ways and strategies of problem solving. In order to check reliability of the used test retesting has been undertaken in the case of the problem task in how many different ways are there you can carry a ball (fluency – CFLU, originality – CORI and flexibility - CFLE). According to the obtained statistically significant coefficient of correlation (for CFLU $r = 0.84$; $p = 0.01$, for CORI $r = 0.81$; $p = 0.01$ and for CFLE $r = 0.75$; $p=0.01$), as well as the value of Alfa reliability coefficient under the classical sum model (for CFLU Alfa = 0.9223; for CORI Alfa = 0.8617, and for CFLE Alfa = 0.8922) it can be concluded that the used test is of optimal reliability.

Data processing

Data processing referred to the calculation of main descriptive indicators and the indicators of deviation from the normal distribution of motor variable (SLO, SIU, POB, MHBS, DSS, TAP, R20), as well as physical fitness variable (LORI, LFLU and LFLE). In order to confirm the link between the variables motor achievement and physical fitness (originality and fluency components) Pearson's linear correlation was used.

Results

The Tables 1 and 2 show the basic descriptive indicators and the indicator of deviation from normal distribution for motor variables and the variables of physical fitness:

Table 1: Main descriptive indicators and the indicators of deviation of normal distribution for motor variables

Variable	N	Min	Max	Mean	Std	Sk	Ku
SLO	224	63.00	132.00	104.891	14.125	-.507	.081
SIU	224	7.00	38.00	21.036	3.7122	1.427	4.626
POB	224	13.89	37.65	28.648	5.818	-.977	.194
MHBS	224	8.16	36.32	18.899	4.665	.849	1.453
DSS	224	24.70	52.00	39.132	6.067	.055	-.446
TAP	224	10.00	25.00	18.812	3.333	.409	.532
R20	224	4.11	5.98	4.7945	.3505	.229	.772

N – number of subjects
Min – min. value
Max – max. Value
Mean – arithmetic mean
Std. – standard deviation
Sk – skjunis
Ku – kurtosis

Table 2: Main descriptive indicators and the indicators of deviation from normal distribution for the variables of physical fitness (fluency – CFLU, originality – CORI and flexibility – CFLE)

Variable	N	Min	Mx	ean	Std	Sk	Ku
CFLU	224	2.00	22.00	11.24	3.259	.040	.082
CORI	224	0.00	9.00	3.225	1.866	1.774	2.513
CFLE	224	0.00	11.00	8.27	2.323	1.856	3.543

The next step was to correlate the results (Pearson's linear correlation) obtained by motor testing and physical fitness testing. Table 3 shows the results obtained according to the correlation of all motor variables (SLO, SIU, POB, MHBS, DSS, TAP and R20) and the variables of physical fitness CFLU (fluency), CORI (originality) and CFLE (flexibility).

Table 3: Correlation coefficients and the achieved level of significance between motor variables (SLO, SIU, POB, MHBS, DSS, TAP and R20) and the variables of physical fitness (fluency – CFLU, originality – CORI and flexibility – CFLE).

Variables	CFLU	CORI	CFLE
SLO	r = .498* p =.000	r = .459* p =.000	r = .425* p =.000
SIU	r = .144 p =.122	r =. 124 p =.235	r = .201 p =.173
POB	r = .412* p =.000	r = .473* p =.000	r = -.389* p =.000
MHBS	r = -.309 p =.013	r = -.313 p =.066	r = -.356 p =.037
DSS	r = -.045 p =.671	r = -.032 p =.489	r = -.041 p =.651
TAP	r = .417* p =.000	r = .244 p =.023	r = .299* p =.000
R20	r = - .433* p =.000	r = -. 403* p =.000	r = -.412* p =.000

r – Pearson's correlation coefficient
p – Level of significance

Discussion

Having compared the obtained values, it can be noticed that the majority of motor variables statistically significantly correlates with the variable (fluency) - CFLU. The result leads to the conclusion that in the case of some motor tasks there is a link between motor successfulness and physical fitness, or more precisely, the ability of production of creative motor response. It has been assumed that the children motorically more successful in the stated motor tasks had achieved better results in the test of physical fitness, that is, they had been able to give higher number of motor response to the given tasks in comparison to children who had been less motorically successful. The highest correlation with CFLU (fluency) is shown in the case of motor task Standing long jump (SLO) and the task Polygon with obstacle backwards (POB). The lowest correlation is evident in the case of motor task (TAP). It should be noted that numerous authors suggest that with children the motor task long jump is not to estimate explosive strength (as it is the case with older children and adults), but the coordination of a whole body (Sternberg, R. & Lubart, T. 1993) [13]. It is similar to the motor tasks Running 20 m (R20) and Tapping rate (TAP) which do not originally estimate speed and the speed of alternative movements; in the case of children these tests are used for estimation of the way they solve coordination problems (Feldhousen, J.F.1998) [4]. It is between coordination as motor ability and intellectual abilities (especially with younger age) that a link has been noticed in numerous studies (Malina, R.M. 2004) [9]. Having in mind that in the test of physical fitness a child solves a specific motor problem (he/she should reflect on possible solutions, to remember the ways of carrying a ball), it might be that, among other things, this very moment contributed to the link between the mentioned motor tasks and LFLU (fluency). The motor variables of the tasks Moving hands along bent surface (MHBS), Sit-up (SIU), as well as Deep forward bend while seated straddled (DSS), i.e. motor task dominated by strength as motor ability, as well as flexibility, have not shown statistically significant link with the physical fitness variable (fluency) – LFLU. Similar results (as well as their analysis) have been obtained after the correlation of motor variables with the variable of physical fitness CORI (originality). The highest correlation is established in the case of the motor task Standing long jump (SLO), the motor task Polygon with obstacle backwards (POB) and Running 20 m (R20). It has been assumed that the children who had achieved the best results in the variable of physical fitness CORI (originality), i.e. those children who had given the largest number of original motor responses had been the most successful, and vice versa. It has to be emphasized here that in this case statistically significant correlation with the motor variable Tapping rate (TAP) has not been established. The same is with the motor variables Sit-ups (SIU), Moving hands along bent surface (MHBS) and Deep forward bend while seated straddled (DSS). Having correlated the motor variables with the third variable of physical fitness (flexibility) – LELE, it is noticeable that the link has been established in the case of motor tasks of predominantly coordination character, i.e. Standing long jump (SLO), Running 20 m (R20), Tapping rate (TAP) and Polygon with obstacles backwards (POB). This component of physical fitness has also shown that the children who had manifested high ability of varying of ideas were motorically most successful. In the case of the tasks Deep forward bend while seated straddled (DSS), Moving hands along bent surface (MHBS) and Sit-ups (SIU) statistically significant correlation has not been confirmed between LFLE and the motor variables. In spite of the fact that a link between motor achievements and creativity has been established, the research has shown low results in the fluency component (LFLU), which can be brought into relation with the level of cognitive domain of children, which is apparently too low. Namely, fluency is in correlation with originality, while original ideas appear only after a large number of stereotypic ones. It is beyond dispute that other components of personal traits of children should also be born in mind. Consequently, a fact should be respected that at younger age physical fitness should be studied in multivariant fashion (Robinson, N. M. (2002) [11]. Having in mind intra and inter individual factors, it could be noted that the higher level of abilities an individual possess, the greater creative performance he/she can achieve is (provided that there is support of a setting, if the personality features are appropriate and if the time is mostly used for creative activities (Griffin, S. 1992) [6]. Due to the fact the results of the research show a correlation between success of children in the performance of certain motor tasks and physical fitness manifestation (fluency and originality), it can be concluded that system positive influences on physical activity can have a decisive role, both in the development of motor successfulness and in the development of physical fitness. It is assumed that the mentioned features complement each other, especially in situations when children are faced with a motor problem of coordination nature. Consequently, during the period of childhood, we should strive to provide all the children with suitable conditions in order to ensure optimal development of movement skills and possibility of motor creative expression. Motor activities of problem and coordination character should be a part of work with preschool children. The task imposes itself as in imperative, having in mind that creative behaviour is in the basis of the development of the overall child potential, human self-actualization and progress (Subotnik, R.F. & Jarvin, and L. 2005) [15]. It is therefore necessary to ensure "enriched" environment, indicating interesting, versatile and encouraging setting for a child, offering challenges and rising the standards of his/her success. What is also essential is a complex learning setting, provocative and rich learning opportunities, abundance and variety of

equipment and requisites, the increase of motor contents paying special attention to various developmental fields at early age, as well as the adults who are "curious" and willing to comprehend the ways children perceive, understand and represent the world (Wyrik, W. 1968) [20].

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