

Environmental Factors Affecting Preschoolers' Motor Development

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Published online: 21 October 2009
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Abstract The process of development occurs according to the pattern established by the genetic potential and also by the influence of environmental factors. The aim of the present study was to focus on the main environmental factors affecting motor development. The review of the literature revealed that family features, such as socioeconomic status, mother's educational level, and the existence of siblings can affect children's motor competence. Preschool centers have also become important for children's development, due to the large amount of time children spend at them nowadays. Moreover, the social cultural context in which a child is reared forms certain demands for his/her motor behavior, favoring specific aspects of motor development and impairing others. A very influential factor (and consequently a very significant educational means) is the use of intervention movement programs. A developmentally adequate movement program can enhance motor development, thus preventing the long term negative consequences that an unfavorable influence of several genetic or the aforementioned environmental factors may have.

Keywords Child development · Motor development · Motor skills · Gross motor · Fine motor · Motor performance · Motor abilities · Children · Preschool · Environmental influence · Home environment · Family · Maternal · Siblings · Child rearing ·

Neighborhood · Schooling · Social · Socioeconomic · Social class · Ethnicity · Cross-cultural differences · Physical activity · Movement program · Psychomotor education program · Intervention program

Introduction

The development of motor competence during infancy and childhood is dependent upon and influenced by the growth and maturity characteristics of the child (morphological, physiological, and neuromuscular). As the motor development occurs in a specific social context, the environment in which a child is reared is important. Each context places specific demands on the motor competencies and physical activities of infants and children. The society in which a child lives; the school setting he/she follows; the quality of living conditions; the family size or number of siblings; interactions among siblings and overall socioeconomic circumstances are potentially important factors to take under consideration. The purpose of the present study was to focus on the aforementioned factors to examine their potential influence on children's motor development.

Methods

A literature search for articles related to the environmental factors that influence preschoolers' motor development was performed with the MEDLINE (1975–2009), PsycINFO (1975–2009) and SportDiscus (1975–2009) electronic databases. Subject headings and keywords included: child development, motor development, motor skills, gross motor, fine motor, motor performance, motor abilities, children, preschool, environmental influence, home environment,

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family, maternal, siblings, child rearing, neighborhood, schooling, social, socioeconomic, social class, ethnicity, cross-cultural differences, physical activity, movement program, psychomotor education program, and intervention program. Moreover, as information about the influence of the social-cultural context on children's motor development are usually provided in studies referring to the standardization of motor assessment tools in various countries, the word "standardization" was included as a keyword too.

Search terms relating to development were combined with "or" as were search terms relating to the examined environmental factors. The results of the grouped searches for development and the environmental factors were then combined with "and" to retrieve articles pertaining to the influence of those factors on children's motor development. Reference lists in original studies and reviews were also examined for appropriate articles.

Only articles meeting the following criteria were selected for review: (a) Study participants were preschool-aged children (2–6 years) where possible and (b) article was published later than 1975. Several studies cited here had major outcome measures other than those pertinent to the objectives of this project. These alternative outcomes may not be described at all or are briefly mentioned.

Results

A review of article titles yielded 57 articles. After reviewing the articles' abstracts, 34 articles met the inclusion criteria. A search of retrieved articles' reference lists led to six additional articles that met criteria for this review. Of the articles retrieved, twenty study the influence of the family (socioeconomic status, mother, sibling interaction), seven examine the effect of schooling, five refer to the social-cultural context effects and eight deal with movement programs. Among them, 17 articles examine exclusively aspects of the motor development and four focus on children's physical activity, while in the rest the motor development is studied as a part of the child's general development. For the motor assessment of the participants 11 standardized assessment tools were used (Table 1).

Apart from the aforementioned tools, in order to evaluate children's motor developmental level, some researchers used tasks such as standing broad jump and shuttle run (Krombholz 1997), tasks that assess static and dynamic balance, fine motor skill and manipulatory coordination (Barros et al. 2003) or selected items among the most used assessment tools (Lejarraga et al. 2002). Moreover, both the observation of children's motor behaviour and its videotaping (Abramovitch et al. 1979; Erbaugh and Clifton 1984; Lamb 1978), as well as questionnaires that

mothers answered (Jackson et al. 2000) have been used too (Table 1).

Review of Environmental Factors Affecting Motor Development Family

Variation in rearing conditions is frequently indicated as a significant factor influencing motor development during infancy and childhood. Differences in child-rearing practices highlight parents' role in providing opportunities for action. As early as infancy, parents promote action by organizing and constraining the circumstances surrounding infants' developing skills (Reed and Bril 1996). Caregivers decide whether infants are on the floor (Adolph 2002), whether they have access to stairs (Berger et al. 2007), and whether they sleep on their stomachs or on their backs (Davis et al. 1998). The family environment quality seems to be directly associated with the intellectual and motor development of the family members (Poresky and Henderson 1982) with the boys being more susceptible than girls to the surrounding influences (Nordberg et al. 1991).

Indicative of the influence of the family on the children's development were the findings of Leitschuh and Dunn's (2001) research. They studied 28 3- to 6-year-olds who had been exposed to cocaine and other drugs and who were growing up with foster mothers. Motor development delays observed during infancy had been overcome by the time of the examination. The researchers attributed the children's high scores on the Test of Gross Motor Development (TGMD; Ulrich 1985) to the favorable upbringing conditions and the timely intervention after the motor delay.

Family Socioeconomic Status

It is believed that a permissive, accepting family environment contributes to children's motor development (Williams and Scott 1953). Lejarraga et al. (2002) examined the psychomotor development of 3,573 boys and girls, aged 0.01–5.99 years in Argentina. The results indicated that higher social class and educational level of the mother was related to the better psychomotor performance in children over 1 year of age. The researchers noted that, the situation of low social class correlating to better scores in developmental tests during infancy was caused by indigenous child-upbringing practices that have a positive influence on development, such as nursing and close contact between baby and its mother.

However, in the majority of relevant studies children of lower social classes seem to perform worse than those of the middle classes in motor development assessment batteries (Bax and Whitmore 1987; Camp et al. 1977; Giagazolou

Table 1 Motor assessment tools used in the reviewed studies

Assessment tool	Study	Examined environmental factors
Standardized tests		
Bayley scales of infant development (Bayley 1969)	Klebanov et al. (1998)	Socioeconomic status
	Poresky and Henderson (1982)	Family
	Leitschuh and Dunn's (2001)	Mother
Denver developmental screening test (Frankenburg et al. 1992)	Al-Naquib et al. (1999)	Social-cultural context
	Camp et al. (1977)	Socioeconomic status
	Durmazlar et al. (1998)	Mother
	Najman et al. (1992)	Mother
	Ittenbach and Harrison (1990)	Mother
Early screening profiles (Harrison 1990)	Giagazoglou et al. (2005)	Socioeconomic status
	Giagazoglou et al. (2008)	Schooling
	Larsson et al. (1994)	Socioeconomic status
	Nordberg et al. (1991)	Family
	Victoria et al. (1990)	Social-cultural context
Griffith's scale (Griffiths 1984)	Krombholz (1997)	Socioeconomic status
	To et al. (2001)	Mother
Körperkoordinationstest für Kinder (body coordination test for children; Kiphard and Schilling 1974)	Kambas et al. (2005)	Movement programs
Motor and social development scale (Baker et al. 1993)	Venetsanou and Kambas (2004)	Movement programs
	Zachopoulou et al. (2004)	Movement programs
	Zimmer et al. (2008)	Movement programs
	Motoriktest für vier-bis sechsjährige Kinder (motor assessment battery for children 4–6 years; Zimmer and Volkamer 1987)	Chow et al. (2001)
Movement assessment battery for children (Henderson and Sugden 1992)	Waelvelde et al. (2008)	Schooling
	Butterfield et al. (2003)	Social-cultural context
Ohio State University Scale of intragross motor assessment (Loovis and Ersing 1979)	Loovis and Butterfield (1993)	Social-cultural context
	Najman et al. (1992)	Mother
Peabody developmental motor scales (Folio and Fewell 1983)	Wang (2004)	Movement program
	Deli et al. (2006)	Movement program
Test of gross motor development (Ulrich 1985)	Derri et al. (2001)	Movement program
	Leitschuh and Dunn's (2001)	Mother
	Krombholz (1997)	Socioeconomic status
Non-standardised tests		
Standing broad jump and shuttle run	Barros et al. (2003)	Schooling
Tasks assessing static and dynamic balance, fine motor skill, manipulatory coordination	Rule and Stewart (2002)	Schooling
Penny posting test	Abramovitch et al. (1979)	Siblings
Observation and videotaping	Lamb (1978)	Siblings
	Erbaugh and Clifton (1984)	Siblings
	Jackson et al. (2000)	Mother
Questionnaire		

et al. 2005; Krombholz 1997; Larsson et al. 1994). A number of explanations for the lower-class children's poor performance may be offered. Their perceptual-motor problems may be related to poor pre- and post-natal nutrition which may have affected the central nervous system or it may simply be due to a lack of experience. Those children may not be encouraged to develop skills such as fine motor ones that will be useful for their school achievement. Apart from that, especially the poor urban children living in

apartment blocks may suffer from the lack of enough space that prevents them from developing their gross motor skills too. On the other hand, children from higher classes may have a greater number and variety of toys than children from lower classes, due to their superior socio-economic status.

It is interesting to note that although in previous research (Hindley 1976) it has been found that the social class does not affect children's performance in developmental tests

until the age of 1½ years, more recent studies suggest that the influence of the family problems in a child's development has already started at the age of 1 year. Moreover, it seems that in young children, those factors exert a greater influence than community allowances, such as libraries, parks, etc. (Klebanov et al. 1998).

Mother

Mother is a central person in the child's rearing process and she undoubtedly plays an irreplaceable role in her offspring's development. Several researchers suggest that mother's role has an increasing effect as the child grows (Durmazlar et al. 1998; To et al. 2001). To et al. (2001) attempted to determine biological, social and environmental correlates of poor development among 6,982 children aged 0–3 years. According to the results low maternal education, maternal depression, parenting practices and low income adequacy begin to play a role in child's development at 2 years of age.

Durmazlar et al. (1998) suggest that mother's influence becomes stronger after the age of 3 years. One thousand and ninety-one children aged 0–72 months who were administered the Denver II (Frankenburg et al. 1992) participated in their study. The results indicated that children with mothers of higher educational levels developed earlier, particularly in fine motor and language skills. The differences between the "high educated mother" group and the "low educated mother" group were more marked in the 37–72 month-old group. According to the researchers, that finding reflects the increasing effect of mother's education as the child grows. They also note that the influence of the mother's educational level is more important in countries in which a pre-school education is not provided to all children. That characteristic may place children whose mothers have a low educational level at a disadvantageous position at school. The aforementioned finding is consistent with previous studies (Ittenbach and Harrison 1990; Najman et al. 1992). Children whose mothers have little education, a feature that is often associated with serious financial problems have 1.5–4 times more possibilities of having developmental backwardness (Najman et al. 1992).

Jackson et al. (2000) in studying the influence of mother's education in the development of children from one-parent families, found that a mother's higher education, which produced an increased income resulting in reduced financial problems, had a direct positive effect on mother's psychology and consequently on children's improved development.

Siblings

Typically, certain child-rearing practices of the mother are seen as leading to particular child outcomes. However,

when the child has siblings, the situation is much more complex than this simple causal model suggests because the influence of the child's siblings as well as that of the parents must be considered. The family can be viewed as an interactional network consisting of three sub-systems: parent–child interactions, parent–parent interactions and sibling–sibling interactions (Circirelli 1975). Thus, a child's position in the family and sibling sex status may be potentially important influence factors. Children interact with their siblings in the home and, by so doing, often acquire their first extensive social experience with other children. Studies have shown that, irrespective of the age difference among the children of a family, the elder siblings lead the younger's behaviour (Circirelli 1975) and those in turn imitate elders' movements (Abramovitch et al. 1979; Lamb 1978).

One of the typical sequences is found to be that an older child initially performs a task while younger siblings watch or stand nearby, spending much time observing the performance of the older sibling. Then, younger children replicate the movements of older brothers and sisters four times as frequently as older siblings performing the acts (Erbaugh and Clifton 1984). This finding suggests that the older siblings often served as models for their younger siblings regarding motor skills. The girls, especially, seem to play an important role in their siblings' encouragement (Erbaugh and Clifton 1984).

Schooling

Nowadays, the large number of working mothers has led many children to pre-school centres at a very young age. Taking into consideration that most children spend many hours of their day in school, the influence of its characteristics on children's development is worth examining.

Barros et al. (2003) attempted to identify some environmental risk factors for the motor development in two groups of 100 5-year-old healthy children from 2-child care centers and a private school. According to the results, the children from the child care centers remained behind in fine motor skills. This may be due to a poor training of the use of the hands (drawing, playing with games, etc.). A lack of an appropriate pedagogic orientation was identified in the child care centers as their basic function was simply to look after and feed the children.

Attending preschool classes from the age of 2 years 6 months, and participating in a more formal curriculum at the age of 4 led the 267 Flemish preschool aged children who participated in Waelvelde et al.'s (2008) study to have significantly higher scores on the M-ABC than its standardization sample. In Flanders by the age of 5 years, therefore, many children are competent at graphic tasks

such as coloring, tracing, etc. and teachers are beginning to prepare them for formal handwriting lessons, which begin at six. This contrasts with preschool activities in the United States and according to Waelvelde et al. (2008) might explain the tendency for Flemish children to do better on the manual dexterity tasks in the test. Similarly, the Flemish children's superiority on the static balance task might also be explained by the physical education training in the Flemish preschool classes.

Regarding the fine motor skills, it seems that it is not only the amount of fine motor activity but its type that results in higher performance. In Rule and Stewart's study (2002) an experimental group of 101 children participated in 50 different sets of activities for a 6-month period. Teachers coached students in following specific steps to use tweezers, tongs, and spoons to manipulate a variety of objects. Although experimental and control group teachers reported equal amounts of fine motor activity in their classrooms, the experimental group outperformed the control one. Rule and Stewart (2002) concluded that the nature of the activities and how children are instructed in completing them appear to be important factors.

Children's physical activity levels can also be importantly affected by the preschool they attend. Studies that examine the physical activity levels of children while they attend preschools to determine the extent to which children's physical activity varies among different school settings, show that the preschool which a child attends is a significant predictor of vigorous physical activity (Bower et al. 2008; Dowda et al. 2004; Pate et al. 2004). That finding makes child care settings a potential force in both motor development and combating childhood obesity (Story et al. 2006).

In a recent study of Giagazoglou et al. (2008), the influence of preschool-type setting (public vs. private) on children's gross motor development was examined. Three hundred preschool children enrolled at the two aforementioned types of preschool centers were administered the Locomotor scale of the Griffiths Test No II (Griffiths 1984). Results revealed that children who attended the private preschool type-setting, having plenty of open space for play, gymnasium, courts and playgrounds and including daily exercise physical activity programs, displayed a higher gross motor score than children who participated in public preschool centers that had limited spaces for sports and free play and did not include any physical education lessons into their schedule.

Social-cultural Context

Several researchers have examined the influence of the society and cultural context on the development of children

of different nationalities. In some cultures, caregivers carry newborns as if they were fragile and protect them from intense stimulation while in others, they throw newborns into the air and catch them. It is obvious, that each culture seems to favour some aspects of development to the detriment of others.

Al-Naquib et al. (1999) studied the development of 936 children of Arab ethnic origin and culture, with the Denver Developmental Screening Test (DDST; Frankenburg et al. 1992) and found that in a culture, like the aforementioned, where mothers, grandmothers, older sisters and even nannies take primary responsibility in getting a child dressed (sometimes as late as elementary school) the children showed poor performance in functional tasks, such as dressing and putting on clothes or removing garments.

The influence of the cultural context is clearly demonstrated in cross-cultural research. In Victora et al.'s (1990) study, Brazilian children's motor development was compared to that of English children. According to the results, the Brazilians—living in a society that stresses spontaneous, informal, playful and physically active kinds of behaviors—outperform English children in vigorous activities like running and jumping. On the other hand, British children, whose culture appears to stimulate self-contained, quiet, independent, objective and work-oriented behavior, seem to be encouraged to develop skills which will be useful for their later school performance, such as fine motor movements.

Chow et al. (2001) examined the suitability of Movement Assessment Battery for Children (M-ABC; Henderson and Sugden 1992) in Hong Kong and they found that children there have significant differences from children that live in USA. Specifically, children from Hong Kong performed significantly better on items contained in the manual dexterity sections, whereas children from USA were better at the projection and reception of moving objects. Children's very different natural social environment may be the answer for the aforementioned results. In Hong Kong, children are taught to use chopsticks from 2 years of age and by 4 years of age, many can write 30 Chinese characters in addition to the English alphabet. Writing and reading are taught in preschool, which all children attend from 3 years of age. In contrast, in the United States not all children attend preschool, and reading and writing may not be specifically targeted. Additionally, in Hong Kong most of the children live in sky scrapers in urban areas and outdoor play is very limited, while in the USA it is a part of the daily life.

Apart from the influence of the society on children as a whole, of great importance seems to be the impact of social stereotypes on boys' and girls' motor development. It is well known that cultural conditioning for specific sex-associated roles begins early in life, and that there are sex

differences in how boys and girls are reared. According to Malina (2004), sex differences in early motor competence need to be examined in the content of opportunity for and frequency of practice, appropriateness of models, guided instruction, and so on. In some societies, different anticipated roles for the two sexes have already been formed in the first years of children's lives (Al-Haroun 1988; Nelson et al. 1986), while even when both boys and girls participate in sports they may have qualitatively different opportunities (Butterfield et al. 2003; Loovis and Butterfield 1993).

Intervention Movement Programs

It is established that motor proficiency is associated with the daily motor behaviour of children (Butcher and Eaton 1989). The more opportunities given to children for practice, the more they develop their movement repertoire and refine the fundamental motor skills (Cleland and Gallahue 1993). Training intervention is considered to be the most important factor which may influence motor development (Roth and Winter 1994). Through developmentally appropriate programs, a smooth transition from the elementary to the mature stage of the motor development in a large variety of fundamental movements occurs (Gallahue and Ozmun 1998). A large amount of research gives evidence for the positive results of a variety of intervention movement programs on the motor development of preschool children. For example, music/movement programs have been shown to improve children's skills like galloping, leaping, horizontal jump, skipping (Derri et al. 2001) or jumping and balance skills (Zachopoulou et al. 2004).

In a recent study, Deli et al. (2006) aimed at identifying the effects of two 10-week intervention programs on fundamental locomotor skill performance in kindergarten children. For that purpose two experimental groups followed a movement program and a music movement program, respectively, while a control group participated only in free-play. The results revealed that both of the experimental groups significantly improved their performance compared to the free-play group in running, hopping, leaping, horizontal jump, and skipping. A previous study conducted by Wang (2004) had produced similar findings. Wang investigated the effects of a creative movement program on gross motor skills of preschool children. Results of this study showed that students participating in the creative movement program scored significantly higher in gross motor skills than those in the control group whose members participated only in free-play.

The use of the Psychomotor Intervention Programs is an educational method that is considered the most appropriate

for preschool children (Volkamer and Zimmer 1986; Zimmer 2006; Zimmer and Circus 1993). Zimmer et al. (2008) applied a Psychomotor Training Program to 233 preschoolers, examining its effectiveness on children's motor proficiency. Two hundred and twelve children following just the typical education programme of the public Kindergarten served as the control group. According to the results, while both groups improved their scores on Motoriktest für vier-bis sechsjährige Kinder 4–6 (Zimmer and Volkamer 1987) the motor proficiency improvement in the children who followed the Psychomotor Training Program was significantly greater than the children of the control group. This finding is consistent with previous studies in which a Psychomotor Program (Kambas et al. 2005) or a program based on Psychomotor Education principles (Venetsanou and Kambas 2004) was applied.

Conclusion

It is well known that the process of development occurs according to the pattern that is established by the genetic potential and also by the influence of environmental factors. First of all, the family in which a child is reared plays a leading role in its development. Factors, such as the family's socioeconomic status, mother's educational level and the existence or the absence of siblings affect children's development. Permissive, accepting families, providing a healthy effective environment and plenty of opportunities for perceptual-motor experiences help their children's development.

Taking into consideration the large amount of time that present day children spent at preschool settings, their significance for children's motor development is obvious. Preschool centres with adequate equipment and appropriate care, as well as a specific pedagogic methodology for the age group, provide more opportunities for an appropriate development of children's motor abilities. Apart from schooling, the society in which a child lives forms a specific cultural context that favors certain aspects of motor development.

The last, but not least, important environmental factor, among those examined in this study, affecting children's motor development is the use of movement programs. When a child's living conditions act as an unfavorable influence on development, these circumstances may cause undesirable repercussions on motor development. Fortunately, early intervention programmes have been shown to enhance the motor development of children. Preschool educators should be aware of the importance of both the early identification of possible risk factors that could impair normal development and intervention with developmentally adequate movement programs. The use of

motor activities planned according to each child's needs and a safe and opportunity-rich environment favor the normal motor development, precluding in that way long-term negative consequences that the unfavourable influence of several genetic or the aforementioned environmental factors may have.

In this study, an attempt was made to provide evidence for the influence of some important environmental factors on children's motor development. However, many questions remain unanswered, as the environment in which a child is being reared is a multifactorial system. Consequently, a study of the factors affecting children's motor development can not be limited to one approach.

Further research is required so as the influence of factors such as the living environment (urban or rural), the computer technology or the amount of time that children spend watching television instead of playing outdoors can be more fully examined. The "new" skills, such as the use of computer keyboards, joysticks, or electronic pencils on touch screens and their extended practice since a very young age may contribute to the change of the fine motor skills nature and have a significant influence on the academic performance, the extent of which not only in the motor development but also in the cognitive and socio-affective one has not been fully explored yet. Moreover, the indirect experience of many motor games that are nowadays provided as computer ones and the huge amount of entertainment opportunities in front of a screen dramatically increase children's sedentary behavior, a fact that has been approved to be associated with serious future health problems, such as obesity and cardiovascular diseases. How much will children's motor performance be affected in the future by that continuously increasing trend for sedentary behavior? It is believed that the motor skills and abilities developmental level of young children is associated with a motor active behavior in the adulthood and that the motor activity is largely connected with the prevention of both the obesity and the cardiovascular diseases. In that direction, however, further research is needed to understand the precise relationship between the type of motor skills and abilities related to the above parameters at a young age as well as the long-term consequences for human health.

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