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Environmental effects on school age child psychomotricity

A. C. CAPPELLINI [1], S. MANCINI [1], S. ZUFFELLATO [1], F. BINI [1], P. POLCARO [2], A. A. CONTI [2, 3]
R. MOLINO LOVA [2], C. MACCHI [2, 3]

[1]*Department of Anatomy Histology and Legal Medicine University of Florence, Florence, Italy*
[2]*Don Carlo Gnocchi Foundation, Florence, Italy*
[3]*Department of Medical and Surgical Critical Care University of Florence, Florence, Italy*

Aim. **This study had the following aims: to verify whether children living in different environmental areas present a different development degree of the functional prerequisites of psychomotricity; to test whether a targeted psychomotricity education program could favourably modify the potential differences which may be observed; to investigate the relationship, if any, between the anthropometric differences and the functional prerequisites of psychomotricity.**

Methods. **One hundred and sixty-five Italian children, 83 males and 82 females, 6-7 years old were enrolled in this study. Based on the provenance area, the children were subdivided into two groups: the urban one (N=85) and the rural one (N=80). Both groups underwent an initial psychomotor assessment including standardised psychomotor tests aimed at evidencing the general dynamic coordination ability and the static and dynamic balance capacity of every child.**

Results. **The findings of this research point out that children living in an urban setting selectively showed a lower degree of balance development, if compared to children living in rural areas; a targeted psychomotor education program favourably modified the differences in the balance development between the two examined groups, up to their disappearance. In the urban group the body mass index had a trend towards a negative relationship with balance development.**

Conclusion. **Children grown up in an urban environment showed a delay in balance development, if compared to children of the same age grown up in rural areas. This study also clearly proves that such a delay may be regained by means of a targeted psychomotor education program.**

Key words: **Psychometrics - Movement - Child - Educational status - Human development - Evidence-Based Medicine.**

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Address reprint requests to: A. A. Conti, Dipartimento di Area Critica Medico Chirurgica, Università degli Studi di Firenze, Viale Morgagni 85, 50134, Firenze, Italy. E-mail: aa.conti@dac.unifi.it

Psychomotricity consists in performing elaborated movements within a relational/emotional and cognitive dimension in which children organize the motor experiences of their body. In this sense, psychomotricity is different from normal physical activity which, on the contrary, consists in performing movements inspired to stereotype models, generally acquired through purely training methods.[1]

Factors influencing the levels of development of physical activity in school age

children are known and, among them, the environment is considered one of the most important,[2] even if the studies so far performed have originated discordant results. Some studies [3] have, actually, shown a better physical fitness in children living in urban areas, thus suggesting that these environments offer enhanced opportunities of motor and sports activities if compared to rural contexts, which would instead favour social isolation and the acquisition of sedentary habits. Other studies [2] have, on the contrary, shown that children grown up in urban areas were more inactive, obese and have a reduced flexibility and muscular resistance if compared to children living in rural areas.

In addition, further studies [4-6] have documented that school age children grown up in an urban environment have a body composition and anthropometric features different from children grown up in rural areas, and further studies [7] have hypothesized a potential correlation between anthropometric features and psychomotricity prerequisites.

Unfortunately, as far as we know, studies investigating the relationship between environment and psychomotricity are not available in biomedical literature, despite of the fact that the notable differences between rural and urban areas may intuitively suggest significantly different environmental effects both on physical activity and on psychomotricity. In particular, environment could determine different effects on balance and coordination abilities, which represent the main functional prerequisites of psychomotricity.[8, 9]

This study had the following aims: 1) to verify whether children living in different environmental areas, the urban and the rural ones, present a different development degree of the functional prerequisites of psychomotricity; 2) to test whether a targeted psychomotricity education program could favourably modify the potential differences which may be observed; 3) to investigate the relationship, if any, between the anthropometric differences and the functional prerequisites of psychomotricity.

Materials and methods

One hundred and sixty-five children, 83 males and 82 females, were enrolled in the study; their age ranged between 6 and 7 years and they attended the first class of primary schools located in 3 small boroughs of the Italian Tuscany Region (Lastra a Signa, Capannori and Lunata). The first of these boroughs has an urban characterization, while the other two are rural ones. Based on the provenance area, the enrolled children were subdivided into two groups: the urban one (N= 85) and the rural one (N=80). The study was approved by the Ethical Committee of the University of Florence (Florence is the main town of the Tuscany Region), following a previous presentation to the involved schools of an authorization request for the administration of psychomotor tests. Since the enrolled subjects were minors, their parents (or legal tutors) signed an informed consent and allowed the preliminary exclusion from the study of the children who, at the time of the enrolment, had any disease, evaluated on an anamnestic base.

Weight and height, without shoes and with light wear, were recorded for every child; the Body Mass Index (BMI), according to the formula: weight (kg)/height^2 (m), was calculated.

Both groups underwent an initial psychomotor assessment including standardised psychomotor tests [10] aimed at evidencing the general dynamic coordination ability and the static and dynamic balance capacity of every child. Each test was individually administered, beginning with an oral description of the test and with a practical demonstration on the part of the evaluator, followed by the performance of the child. Each evaluation began with a test whose score corresponded to the actual age of the child and continued with the tests corresponding to a later age, until a complete failure was recorded. Each point in the score corresponded to 12 months of age. If the first test was not correctly performed, the test referring to an earlier age was administered till the acquisition of a full success. In the case in which the child only partially succeeded in the test (for example

TABLE I.—*General dynamic coordination. From Ozeretski-Guilmain 4-8 years (modified).*[10]

Age	Description
4 years	On-site jumping, with legs slightly bended, and which simultaneously lifted from the ground, 7 or 8 consecutive jumps.
5 years	Feet together, jumping with knees bended without taking a run, over an elastic placed 20 cm above the ground. Number of tries: two tries out of three must be successfully performed. Failure: if the subject touches the elastic; if he/she falls down (even without touching the elastic); if he/she touches the ground with his/her hands.
6 years	With eyes open walking for two metres in a straight line, alternatively placing the heel of one foot against toe tip of the other. After a 30" rest, performing the same exercise with the left foot. Failure: if the subject deviates from the straight line; if he/she sways; if he/she performs the exercise incorrectly. Number of tries: three.
7 years	With eyes open jumping for a distance of 5 metres on the left leg, with the right leg bended at 90°, with arms along the legs. After a 30" rest, performing the same exercise with the other leg. Failure: if the subject deviates from the straight line for more than 50 cm; if he/she touches the ground with his/her bended leg; if he/she oscillates his/her arms. Length: not limited. Number of tries: two for each leg.
8 years	Jumping, without taking a run, over an elastic placed 40 cm above the ground, with bended knees. Failure: if the subject touches the elastic; if he/she falls down (even without touching the elastic); if he/she touches the ground with his/her hands. Number of tries: 3 (2 out of 3 must be successfully performed).

with a single side of the body), the score of the test was reduced by half a point. The psychomotor age attributed corresponded to the score of the last fully or partially successful test, and could, therefore, be higher, equal or lower than the actual age of the child. With regard to the comparison between the psychomotor and the actual age, the latter was approximated to the nearest six months.

With regard to an analytical description of the items of the psychomotor tests regarding general dynamic coordination and static and dynamic balance, the relevant motor exercises may be reported as shown in Tables I and II.

Subsequently, the urban group children, who presented overall more considerable deficits, underwent a six-month targeted psychomotor education program, including a session of coordination and balance exercises twice a week, under the strict control of specific staff specialized in the field of psychomotricity applied to the evolutional age.

The psychomotor education program included an operative protocol based on activity proposals favouring, in children, the awareness of their bodies in relation with the external world, including objects and persons.

With regard to general dynamic coordination and static and dynamic balance, exercises predominantly adopting basic motor schemes (including walking, running, jumping, creeping, throwing and catching) were proposed. The instruments used were small tools such as balls with different dimensions and weight, small clubs, ropes, circles, sticks and large apparatuses such as the equilibrium axis, wall bars and rubber carpets. All the contents included in the play dimension regarded free body exercises, games in pairs or in groups, mixed rounds, traditional games and games of body expression even on a rhythmic and musical basis. The adopted methodology was predominantly of an inductive-child-centred type and it always placed the children at the centre of the edu-

TABLE II.—*Postural control – balance. From Ozeretski-Guilmain 4-8 years (modified).*[10]

Age	Description
4 years	With eyes open, keeping feet together and hands behind the back, bending the bust 90° and maintaining this position for 10". Number of tries: three. Failure: if he/she shifts; if he/she bends his/her legs; if the time period is under 10".
5 years	With eyes open, keeping feet together, standing on toe tips with arms along the hips and maintaining a balanced position. Length: 10". Number of tries: three. Failure: if he/she shifts; if he/she touches the ground with his/her heels; if he/she sways his/her arms.
6 years	With eyes open standing on the right leg; left leg bended 90°; left thigh parallel to the right one (slight adduction); arms along the body. After a 30" rest, performing the same exercise with the other leg. Failure: if the subject lowers the lifted leg more than 3 times, if he/she touches the ground with the lifted foot; if he/she lifts the forefoot; if he/she does not fix his/her position, moving frequently. Length: 10". Number of tries: three.
7 years	Squatting position, one arm extended, eyes shut, toe tips wide apart, heels together. Length: 10" Number of tries: three. Failure: if he/she falls down; if he/she sits down on his/her heels; if he/she touches the ground with his/her heels; if he/she leaves his/her place; if he/she lowers his/her arms three times.
8 years	With eyes open, hands behind back, stretching up on the forefoot and bending the bust 90° (with outstretched legs). Length: 10". Number of tries: two. Failure: if he/she bends his/her legs more than 3 times, if he/she shifts place, if he/she touches the ground with his/her heels.

cational proposal typical of the psychomotor approach.

The children of the rural group, instead, did not perform any targeted psychomotor activity, but continued the usual ministerial programs of school physical activity.

At the end of the six-month period, all the children underwent a second anthropometric and psychomotor evaluation, using the same tests adopted for the initial assessment.

Statistical analysis

The statistical analysis, performed by means of the STATA software 7.0 (Stata Corporation, Texas, USA) was conducted using the χ^2 test for categorical data, the Student t-test for independent samples for parametric data and the Kruskaal-Wallis test for ordinal data. General linear regression models were used for correlations. P values <0.05 were considered statistically significant.

Results

All the 165 children enrolled completed the study. Considering the participants as a whole, and referring to the test performed at the beginning of the study, approximately two out of three children (64.9%) showed a score reduced by more than half a point, that is, more than six months, with respect to their actual age, both in the tests regarding coordination and in the tests regarding balance ability. At the end of the study these same values resulted slightly lower (57.0% and 52.1% for the tests regarding balance and for the tests referring to coordination ability, respectively).

The enrolment and the allocation of the

TABLE III.—*Antropometric psychomotor features at baseline.*

	Urban group (n=85)	Rural group (n=80)	p
Weight (kg) (mean±SD)	24.6±3.9	25.4±5.5	0.300
Height (m) (mean±SD)	1.22±0.05	1.24±0.05	0.003
Body mass index (mean±SD)	16.5±1.8	16.4±2.8	0.733
Balance score (mean±SD)	5.1±1.2	5.7±1.2	0.002
Difference between balance score and actual age:			
< 0.5 (%)	76.5	52.5	0.017
≥-0.5≤0.5 (%)	22.4	41.2	
>0.5 (%)	1.1	6.3	
Coordination score (mean±SD)	5.6±1.1	5.6±1.1	0.821
Difference between coordination score and actual age:			
<-0.5 (%)	65.9	63.8	0.255
≥-0.5≤0.5 (%)	24.7	27.5	
>0.5 (%)	9.4	8.7	

TABLE IV.—*Antropometric and psychomotor features at follow up.*

	Urban group (n=85)	Rural group (n=80)	p
Weight (kg) (mean±SD)	25.2±3.9	27.2±5.3	0.005
Height (m) (mean±SD)	1.23±0.05	1.26±0.05	0.001
Body mass index (mean±SD)	16.6±1.8	17.1±2.5	0.151
Balance score (mean±SD)	5.9±1.3	6.1±1.3	0.304
Difference between balance score and actual age:			
<-0.5 (%)	63.5	50.0	0.589
≥-0.5≤0.5 (%)	30.6	38.7	
>0.5 (%)	5.9	11.3	
Coordination score (mean±SD)	6.3±1.1	6.3±1.1	0.102
Difference between coordination score and actual age:			
<-0.5 (%)	48.2	56.2	0.219
≥-0.5≤0.5 (%)	40.0	32.5	
>0.5 (%)	11.8	11.3	

recruited children did not produce any significant difference between the two groups with regard to sex (46% and 54% females in the urban and rural groups, respectively, P = 0.312), and age (6.6 ± 0.2 and 6.6 ± 0.3 years in the urban and rural groups, respectively, P = 0.987).

Table III shows the anthropometric and psychomotor features of the two groups at the beginning of the study. No significant difference was detectable with reference to weight and BMI, while height was significantly higher in the rural as compared with the urban group (by an average of 2 cm). The initial psychomotor assessment did not show significant differences with regard to the coordination ability tests. The score of the balance test was significantly lower in the children of the urban group and, consequently, the percentage of children showing a score lower of more than half a point in the balance test (with respect to their actual age) was significantly higher in that same group.

Table IV shows the anthropometric and psychomotor features of the two groups at the end of the study. Weight and height were

significantly higher in the rural group, by an average of 2 kg and 3 cm respectively; however, this finding did not produce any significant difference with regard to BMI. The final psychomotor assessment did not show any significant difference either in coordination or in balance tests.

When examining the correlation between anthropometric parameters and psychomotor prerequisites, height, weight and BMI did not point out any significant association with the scores of the balance test, either in the urban or in the rural group, while BMI showed a trend towards a negative relationship with baseline balance test scores in the urban group, even if not reaching the significance value ($P = 0.061$).

Discussion

The results of this study point out that: 1) children living in an urban environment selectively showed a lower degree of balance development, if compared to children living in rural areas; 2) a targeted psychomotor education program favourably modified the differences in the balance development between the two examined groups, up to their disappearance; 3) BMI showed a trend towards a negative relationship with balance development in the urban group.

Recent studies [11, 12] have shown that, among the numerous variables influencing physical activity levels, the environmental ones are particularly important especially due to the presence of available stimuli and spaces for ludic and physical-sports activity. However, the results of the studies comparing the levels of physical activity in the different environmental areas are discordant.[13] In fact, while some authors [2, 12] have shown that children grown up in rural areas have a higher physical activity level, other researchers [3] have documented that the urban environment provides higher opportunities for motor and sports activities, and still other authors,[11] in turn, have failed in demonstrating significant differences between the urban and the rural environments, thus concluding that the physical performance of children is definitely more influenced by school physical activity programs than by the environment in which they live.[14]

However, differently from usual physical activity, which is inspired to stereotyped movement models that children learn through purely training methods, psychomotricity is based upon the movements that children elaborate in the frame of a relational/emotional and cognitive relationship and that, in the case of insufficient "natural" development, may be acquired only by means of more specifically didactic methods.

Few studies have investigated the variables that may influence the development of psychomotor components in school age children,[15, 16] and, to the best of our knowledge, studies investigating the effects of the environment on the development of balance and coordination abilities, which represent the main functional pre-requisites of psychomotricity,[8, 9] are not currently available in the literature.

Our results show that children living in urban areas selectively present a lower degree of balance development, if compared to children living in rural environments. This finding may be explained by the fact that the rural environment provides enhanced free movement opportunities, thus allowing the children the spontaneous experimentation of different motor situations and the natural achievement of a higher balance development.

The results of our study also show that a targeted psychomotor activity, included in the school program, permits to close the initial gap of the balance development between the two examined groups.

Previous research [4, 14, 17] has shown that children grown in the urban environment have a higher height and BMI. Our study only partially confirms these data. Indeed, rural group children had a higher height (2 cm on average) in the absence of a significant difference in BMI. Of interest in our findings is the fact that in the urban group children there is a trend for BMI to negatively correlate with balance development.

In addition, our findings indicate that two out of three school age children have a psy-

chomotor development lower by more than 6 months in comparison to their actual age both in the tests referring to balance and in those regarding coordination. Such a finding may be subject to different interpretations, but in the end it warrants the need for the introduction of structured psychomotor education programs in school.

Limitations of the study

Limitations of this study include the relatively low number of subjects enrolled, the fact that the findings derive from a single Italian region and that an intervention was only carried out in the group presenting deficits at baseline evaluation.

Conclusions

In conclusion, the results of this study prove that children grown up in an urban environment show a delay in balance development, if compared to children of the same age grown up in rural areas. This study also clearly shows that such a delay may be recovered by means of a targeted psychomotor education program, and that in children living in urban areas there is a trend for overweight to correlate negatively with balance development.

Further studies are welcome to test our results in wider samples and in different territorial areas. The interesting findings of this study, documenting that two children out of three show an overall delayed psychomotor development, may act as triggers for further systematic investigation into a scientific area so far relatively, and inappropriately, neglected by international research.

Riassunto

Effetti dell'ambiente sulla psicomotricità dei bambini in età scolare

Obiettivo. Questo studio si è prefisso i seguenti obiettivi: verificare se i bambini che vivono in contesti ambientali diversi presentino un differente grado di sviluppo dei prerequisiti funzionali della psicomotricità; valutare se la conduzione di un programma educativo psicomotorio mirato sia in grado di modificare in modo favorevole le differenze potenzialmente registrabili; studiare la relazione, se presente, tra le differenze antropometriche e i pre requisiti funzionali della psicomotricità.

Metodi. In questo studio sono stati arruolati 165 bambini italiani, 83 maschi e 82 femmine, di età di 6-7 anni. Sulla base dell'area di provenienza i bambini sono stati suddivisi in due gruppi: quello urbano (N=85) e quello rurale (N=80). Entrambi i gruppi sono stati sottoposti a una valutazione psicomotoria iniziale che comprendeva test psicomotori standardizzati volti a evidenziare la capacità di coordinazione dinamica e la capacità di equilibrio dinamico di ogni partecipante.

Risultati. I risultati di questa ricerca forniscono evidenze del fatto che i bambini che vivono in un contesto urbano mostrano selettivamente un minore grado di sviluppo dell'equilibrio, se confrontati con quelli che vivono in area urbana. Un programma educativo psicomotorio mirato ha modificato favorevolmente le differenze nello sviluppo dell'equilibrio tra i due gruppi esaminati, fino a eliminare tali differenze. Nel gruppo urbano l'indice di massa corporea ha dimostrato una tendenza verso una relazione negativa con lo sviluppo dell'equilibrio.

Conclusioni. I bambini cresciuti in un ambiente urbano mostrano un ritardo nello sviluppo dell'equilibrio, se confrontati con i bambini cresciuti in aree rurali. Questo studio documenta anche con chiarezza che questo ritardo può essere colmato per mezzo di un programma formativo psicomotorio mirato.

Parole chiave: Psicomotricità - Scienze motorie - Età pediatrica - Educazione - Età evolutiva - Medicina basata sulle evidenze.

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