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Somatic and functional status of boys from various social and environmental categories

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Summary

Study aim: To assess the somatic and fitness status of adolescent boys from polluted industrial areas.
Material and methods: A group of 313 boys aged 11 – 15 years from 5 villages located in the copper mine area in South-Western Poland were classified by the degree of lead and cadmium pollution (high – very high) and by parents' education (primary – secondary or higher). Somatic (body height and mass, BMI, body fat content) and functional (handgrip strength, standing broad jump, sit-and-reach, plate tapping, 1-kg medicinal ball throw, reaction time) were recorded. The data were standardised against age-specific means and standard deviations and subjected to two-way ANOVA.
Results: Boys from more polluted area had significantly ($p<0.01$) higher BMI than those from the less polluted one but only when their parents had primary education. Explosive strength was significantly higher in the less polluted area ($p<0.05$) and when parents had higher than primary education ($p<0.01$). In case of reaction speed only the degree of environmental pollution had significant effect ($p<0.05$), no significant effects being noted for other variables
Conclusions: The results pointed to the importance of parents' education in shaping health-directed behaviours, which may compensate for the negative impact of a degraded environment.

Key words: Somatic development – Functional development – Pollution - Auxology

Introduction

A number of studies [2,13,15,21,22,24,26,27,29] pointed to the relationship between the ecological status of inhabited environments and the somatic status of children from those areas. Environmental pollution has become one of the prime factors of many diseases and disorders of psychosomatic development [3,10,17,25,30]. Also socio-economic factors, like parents' education, number of children per family, etc., are among those affecting that development, interactions between various factors acting as amplifiers or inhibitors of adverse effects.

Children inhabiting areas close to mines, smelting plants, etc., are particularly at risk [6,7,14,16]; toxins generated by the industry are taken up mostly from air of contaminated food products [28]. Those negative effects are likely to be compensated by proper hygiene, leisure conditions and other behaviours of educated, conscientious parents even in heavily polluted areas. Insufficient number or quality of reports concerning the interaction of pollution and parents' education prompted us to undertake this study on the somatic and fitness status of boys aged 11 – 15 years.

Material and Methods

A group of 313 boys aged 11 – 15 years from 5 villages located in the copper mine area in South-Western Poland were studied in autumn 1998. The degree of environmental pollution was assessed from lead and cadmium fallouts (g/m^2/year) reported for the period 1991 – 1996 [25] by using Pearson's 1–r distances. The boys were classified into 4 categories according to the following criteria: degree of pollution (low – high; see Fig. 1 and Table 1) and parents' education (primary of both parents – secondary or higher of at least one parent).

The following data were recorded: body height (by using anthropometer; 0.1 cm accuracy), body mass (electronic balance; 0.1 kg accuracy), BMI; EUROFIT tests: handgrip strength (hydraulic hand dynamometer, Jamar 5030J1 CE; USA), standing broad jump, sit-and-reach, plate tapping; other fitness tests: 1-kg medicinal ball throw, reaction time (by using Piórkowski's device, which measures visual-motor co-ordination [5]). These variables are regarded as reliably reflecting the human motor fitness [31].

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The somatic and fitness data were standardised using age-specific means and standard deviations determined for the entire cohort examined then and subsequently subjected to two-way ANOVA followed by *post-hoc* Student's *t*-test for unpaired data, the level of $p \le 0.05$ being considered significant.

Results

The pollution of lead and cadmium with dust in the studied areas was highly exceeding the Polish norms of admissible fallout of those elements (0.1 and 0.01 $g \cdot m^2$ /year, respectively). Yet, two sub-areas cold be discerned, the pollution in the less contaminated being about twice that in the more contaminated one (see Fig. 1 and Table 1).

Table 1. Mean pollution (g/m2/year) of lead and cadmium in 1991 – 1996 in the villages studied

	Very highly polluted	Highly polluted
Lead	69.4	34.8
Cadmium	1.64	0.78

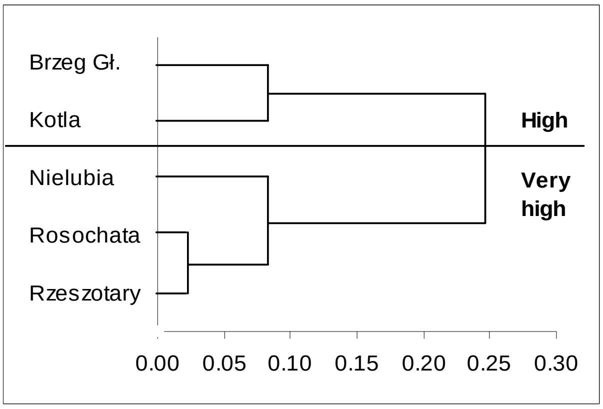

Fig. 1. Cluster analysis of the studied villages; two pollution areas were discerned: high and very high

No significant between-category differences were found for most variables. In case of BMI (and body mass) the interaction environment×education proved significant; the only significant difference was found between boys whose parents had primary education, those from very highly polluted area being heavier ($p<0.01$) than those from the less polluted one (see Table 1).

Table 2. Mean standardised values (±SD) of somatic and fitness variables of boys aged 11 – 15 years

Environment	Very highly polluted		Highly polluted		Factor	
Parents' education	Primary	Secondary +	Primary	Secondary +	Environ-ment	Educa-tion
Variable	(n = 76)	(n = 71)	(n = 80)	(n = 86)		
Body height	0.02 ± 1.09	-0.01 ± 0.97	-0.23 ± 1.05	0.08 ± 1.00		
Body mass	0.12 ± 1.05	-0.10 ± 1.05	-0.32 ± 0.78 oo	-0.04 ± 0.92		
BMI	0.16 ± 1.05	-0.15 ± 1.06	-0.29 ± 0.67 oo	-0.11 ± 0.89		
Handgrip	0.22 ± 1.05	0.21 ± 1.04	-0.03 ± 1.03	0.22 ± 0.97		
Standing broad jump	-0.07 ± 0.97	0.09 ± 1.01	0.18 ± 1.18	0.41 ± 0.82	*	**
Medicinal ball throw	0.19 ± 1.10	0.19 ± 0.95	0.11 ± 1.11	0.33 ± 0.95		
Sit-and-reach	-0.29 ± 0.92	-0.58 ± 1.25	-0.30 ± 0.86	-0.23 ± 1.18		
Plate tapping	0.15 ± 1.19	0.06 ± 0.94	0.00 ± 0.96	-0.16 ± 0.87		
Reaction speed	-0.27 ± 1.02	-0.08 ± 1.22	0.12 ± 0.94	0.27 ± 1.18	*	

Legend: Secondary + – One or both parents had secondary education or higher; oo Significantly ($p<0.01$) different from the respective value for very highly polluted area; * $p<0.05$; ** $p<0.01$

In case of explosive power (standing broad jump) and co-ordination (reaction speed) no significant environment×education interaction was found. Both environment and parents' education had significant effect on explosive power ($p<0.05$ and 0.01, respectively): lower contamination and higher education positively affected that trait. Reaction speed was positively affected only by lower contamination ($p<0.05$), parents' education having no significant effect. No significant effects of either factor were noted for all other fitness variables studied.

Discussion

No marked effects of environmental pollution on somatic features were noted in this study except that BMI of boys, whose parents had only primary education, from very highly polluted area was significantly higher than of those from a lower polluted region or whose parents had secondary education. On the other hand, the degree of environmental pollution significantly affected the explosive strength (standing broad jump) and co-ordination (reaction speed). This was in accordance with the reports of other authors who observed no marked negative effects of pollution on somatic traits [3,29] and with the view that functional features were more sensitive to negative environmental changes than the somatic ones [4,10,23].

The significant, negative effect of pollution degree on motor/visual co-ordination (reaction speed) could have been due to neurotoxic effects of heavy metals [1, 2,9,18,19]. Similar observation was reported by Mleczko *et al*. [23] who noted worsened co-ordination skills in populations inhabiting degraded areas. A compensation of those effects by parents' education was noted only in case of explosive strength (standing broad jump). The role of education may be seen in e.g. correcting hygienic behaviours of children, like eating with dirty hands or biting nails, which increase the risk of contamination with heavy metals. Among the risk factors are also old buildings with contaminated walls and roofs, dusted air, pollution-exposed jobs, imbalanced diet, especially calcium deficient, etc. [7,8,11,12,20].

Summing up, although only in one variable the effect of parents' education proved significant, it emphasises its role in the upbringing of children, e.g. in shaping health-directed behaviours, which may compensate for the negative impact of a degraded environment.

References

1. Andrzejak R., R.Smolik (1996) Współczesne problemy ekspozycji na ołów ze szczególnym uwzględnieniem sytuacji w Polsce. *Postępy Higieny i Medycyny Doświadczalnej* 50:581-595.

2. Bellinger D. (1996) The neuropsychological toxicity of lead exposure in children. *Pediatria Polska*, 4(Suppl.):131-138.

3. Bocheńska Z. (1984) Rozwój fizyczny dziecka w środowisku przemysłowym. Zeszyty Naukowe #31, AWF, Kraków.

4. Bouchard C., R.M.Malina (1983) Genetics of physiological fitness and motor performance. *Exerc.Sport Sci.Rev.* 11:155-168.

5. Bud R., J.D.Warner (1998) Instruments of Science: a Historical Encyclopedia. Garland, New York, p. 648.

6. Carrizales L., I.Razo, J.I.Téllez-Hernández , R.Torres-Nerio, A.Torres, L.E.Batres, A.C.Cubillas, F.Díaz-Barriga (2006) Exposure to arsenic and lead of children living near a copper-smelter in San Luis Potosi, Mexico: Importance of soil contamination for exposure of children. *Environ.Res.* 101:1-10.

7. Chiaradia M, B.L.Gulson, K.MacDonald (1997) Contamination of houses by workers occupationally exposed in a lead-zinc-copper mine and impact on blood lead concentrations in the families. *Occup.Environ.Med*. 54:117–124.

8. Clark C.S., R.L.Bornschein, P.Succop, S.S.Que Hee, P.B. Hammond, B.Peace (1985) Condition and type of housing as an indicator of potential environmental lead exposure and pediatric blood lead levels. *Environ.Res*. 38:46-53.

9. Cotter-Howells J., I.Thornton (1991) Sources and pathways of environmental lead to children in a Derbyshire mining village. *Environ.Geo.Health* 13:127–135.

10. Elżanowska D., A.Siniarska (1982) Sprawność psychomotoryczna ludności z terenów o różnym stopniu uprzemysłowienia. In: N.Wolański, A.Siniarska. (eds.) Ekologia Populacji Ludzkich. Ossolineum, Wrocław.

11. Emond M., B.Lanphear, A.Watts, S.Eberly (1997) Measurement error and its impact on the estimated relationship between dust lead and children blood lead: Members of the Rochester Lead-in-Dust Study Group. *Environ.Res.* 72:82-92.

12. Fernandez G.O., R.R.Martinez, T.I.Fortoul, E.Palazuelos (1997) High blood lead levels in ceramic folk art workers in Michoacan, Mexico. *Arch. Environ.Health* 52:51-55.

13. Graef J. (1994) Clinical aspects of lead poisoning in children. Proc.Intern.Conf. "Child Health in an Ecologically Degraded Environment", Legnica, Poland.

14. Gruszczyński L., R.Andrzejak., K.Lisowska (1996) Występowanie podwyższonych stężeń ołowiu we krwi u dzieci zamieszkałych w Lubinie. *Pediatria Polska* 4(Suppl.):101-109.

15. Gulson B., M.Korsch, M.Matisons, C.Douglas, L.Gillam, V.McLaughlin (2009) Windblown lead carbonate as the main source of lead in blood of children from a seaside community: an example of local birds as "Canaries in the Mine". *Environ. Health Persp.* 117:148-154.

16. Hulanicka B., E.Kolasa, A.Waliszko (1994) Dziewczęta z Górnego Śląska. Monografie Zakładu Antropologii PAN #11, Wrocław.

17. Ignasiak Z., E.Bakońska-Pacoń, P.Wolski (1996) Próba oceny wpływu środowiska na zróżnicowanie wybranych cech u dzieci z regionu dolnego śląska. In: A.Malinowski, B.Łuczak, J.Grabowska (eds.) Antropologia a Medycyna i Promocja Zdrowia. Uniwersytet Łódzki, Łódź.

18. Junco-Munoz P., R.Ottman, J.H.Lee, S.A.Barton, S.Rivas, R.M.Cerda-Flores (1996) Blood lead concentrations and associated factors in residents of Monterey, Mexico. *Arch.Med.Res.* 27:4-12.

19. Kapka L., A.Baumgartner, E.Siwińska, L.E.Knudsen, D. Anderson, D.Mielzyńska (2007) Environmental lead exposure increases micronuclei in children. *Mutagenesis* 22:201-207.

20. Lanphear B., M.Weitzman, N.Winter, S.Eberly, B.Yakir, M.Tanner, M.Emond, T.Matte (1996) Lead-contaminated house dust and urban children's blood lead levels. *Am.J.Publ.Health* 86:1416-1421.

21. Mleczko E., T.Ambroży, J.Szopa., M.Żychowska (1999) The influence of environmental pollution on somatic and functional development of children and young people from Cracow region, Poland. *J.Human Kinetics* 1:5-24.

22. Mleczko E., T.Ambroży (1997) Zanieczyszczenia środowiska naturalnego a rozwój somatyczny i funkcjonalny dzieci i młodzieży z regionu krakowskiego. *Antropomotoryka* 16:3-21.

23. Mleczko E., M.Ozimek (2000) Rozwój somatyczny i motoryczny młodzieży krakowskiej między 15 a 19 rokiem życia z uwzględnieniem czynników środowiskowych. Studia i Monografie AWF Kraków, #14.

24. Needleman H.L., C.Gatsonis (1990) Low-level lead exposure and the IQ of children. *JAMA* 263:673-678.

25. Raport o stanie środowiska województwa legnickiego. Wojewoda legnicki, Legnica, 1990-1997.

26. Schell L.M. (1991) Human growth and urban pollution. *Coll.Antropol.* 15:59-71.

27. Schwartz J. (1994) Low-level exposure and children's IQ: a meta-analysis and search for a threshold. *Environ.Res.* 65: 42-55.

28. Schwela D. (2000) Air pollution and health in urban areas. *Rev.Environ.Health* 15:13-42.

29. Siniarska A. (1984) Rozwój psychoruchowy mieszkańców niektórych regionów Polski o różnym stopniu uprzemysłowienia. In: Zeszyty Naukowe AWF Kraków #31.

30. Szopa J. (1990) Genetyczne i środowiskowe uwarunkowania rozwoju somatycznego między 7 a 14 rokiem życia: wyniki longitudinalnych badań rodzinnych. Wydawnictwa Monograficzne AWF Kraków #42.

31. Szopa J., W.Chwała, T.Ruchlewicz (1998) Badania struktury zdolności motorycznych o podłożu energetycznym i trafności ich testowania. *Antropomotoryka* 17:3-36.

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