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DEVELOPMENTAL CO-ORDINATION DISORDER IN AN ETHNO-RACIALLY DIVERSE AFRICAN NATION: SHOULD NORMS OF THE MABC BE ADJUSTED?

A. E. PIENAAR

School of Biokinetics, Recreation and Sport Sciences, North-West University of Potchefstroom, Potchefstroom, Republic of South Africa

SUMMARY

The aim of this study was to determine the incidence of Developmental Co-ordination Disorder (DCD) among 10-12 year old children (N=688) in the Northwest province of South Africa, but also to establish whether the Movement ABC (MABC) is a suitable instrument for screening purposes in this country. Children (338 male and 350 female) from 19 schools, including 10 year old (n=217), 11 year old (N=226)-12 year old (n=245) children, were evaluated with the MABC. Results showed that at least half of the participants were cases with moderate (24.8%) or severe (36.4%) DCD. Girls showed higher percentages of DCD (p>0.05). The difficulties associated with DCD differ between boys, girls and different racial groups. Comparison with the Bruininks-Oseretsky measuring instrument, and analysis of the normal distribution curves of the sample, substantiated a decision that the norms of the MABC (age band 3 and 4) should be adjusted for samples living in similar conditions.

CORRESPONDENCE:
A E Pienaar
School of Biokinetics, Recreation and Sport Sciences
North-West University
Potchefstroom
2520, Republic of South Africa
Tel: ***(+27) 018 299 1796***
Fax: ***(+27) 018 299 1796***
E-Mail: ***mbwaep@puknet.puk.ac.za***

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INTRODUCTION

The South African population consists of a mixture of different population groups, as well as of people from different socio-economic backgrounds (SES). This diversity impacts on the use of assessment instruments standardised on population groups with different backgrounds, especially where the socio-economic influences have a role to play in the development of a child. Evidence in this regard indicates that children from impoverished social environments usually receive quantitatively less stimulation than children from a better social background (Hadders-Algra, 2000), and relationships between balance, fine motor control and strength among children from low socio-economic status are indicated (Habib et al, 1999; Henneberg et al, 1995). Lower activity levels because of a low energy intake can influence fine motor development (Ferro-Luzzi, 1985; Krombholz, 1997, Verdonck and Henneberg, 1996), while cultural influences can also impact on studies in this regard (Rösblad and Gard, 1998). High percentages of underweight children (40% among boys and 13% among girls) found in the group that was researched (Underhay et al, 2002) may be an indication of malnutrition among a high percentage of them. Cameron (1991) states in this regard that the pattern of wasting and stunting

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ABBREVIATIONS:

DCD	Developmental Coordination Disorder
MABC	Movement Assessment Battery for Children
SES	Socio-economic backgrounds

KEY WORDS:
age
Developmental Co-ordination Disorder
race
sex
socio economic status

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among African children seems to be high, and it is accepted that under-nutrition affects childhood mortality rates, frequency and severity of illness, physical growth, mental development and learning capacity. Malnutrition is also associated with motor backlogs, and it is noted by this researcher that these children seen in poor countries might never reach their full developmental potential.

Developmental Co-ordination Disorder describes children who have difficulties in performing co-ordinated movements that are not explicable by mental retardation or any known psychiatric or physical disorder (American Psychiatric Association, 1994). A diagnosis is only made if the impairment interferes significantly with routine activities of daily life or with academic achievement (Wright and Sugden, 1996).

The prevalence of school-aged children with DCD is documented in the range between 3% and 22%. However, there is a general agreement among researchers that percentages range between 5% and 10 % (Dussart, 1994, Maeland, 1992; Missiuna, 1994; Wright and Sugden, 1996; Wright et al, 1994). This documented incidence varies between moderate and severe DCD, and the high variation reported between studies might have been caused by different cut-off points and methods to classify children with motor problems. It is, however, reasonably safe to conclude that one out of ten children might suffer from this condition (Cantell et al, 1994; Dussart, 1994). Generally, higher prevalence of DCD has been reported in boys than girls (Maeland, 1992, 3:1; Missiuna, 1994, 5:1; Dewey, 1991, 7:1; Henderson et al, 1992, 6:1; Pienaar et al, 1994, 3:1), although some studies show equal distribution between the sexes (Dussart, 1994).

The Movement Assessment Battery for Children (MABC) is generally considered as one of the gold standards to determine developmental co-ordination disorder, and is worldwide a well researched instrument in this regard. The manual of this test battery is also accompanied by an intervention strategy based on the cognitive-motor approach (Henderson and Sugden, 1992), making it a useful instrument with regard to intervention as well. However, it was standardised on English and American children, and the question whether the diversity among South African children is similar to these population groups arises. No studies exist where children different to those on which the MABC was standardised were studied. Results of the incidence of DCD as established by the MABC are available in

Europe (Henderson and Sugden, 1992; Maeland, 1992; Rösblad and Gard, 1998; Smits-Engelsman et al, 1998), America and Canada (Sugden and Sugden, 1991; MABC, 1992), Australia (Hoare, 1991) and Asia (Miyahara et al, 1998; Wright et al, 1994), while limited information of this nature is available about the child living in Africa.

The central focus of this study is the question as to whether South African children, influenced by their own racial diversity, socio-economic conditions and cultural influences, will experience the same magnitude and kind of problems as children in other countries. It is against this background that this study wants to determine the incidence of DCD of a moderate and severe nature amongst 10-12 year-old children living in South Africa. Also, the question whether the MABC as standardised can be used in South African circumstances, which are quite different to those it was standardised on, wants to be answered.

METHOD

This study forms part of the multi-disciplinary Thusa Bana ('help the children') research project of the Faculty of Health Sciences at the North-West University, which included researchers from Human Movement Science, Physiology, Psychology, Nutrition, and Social Sciences. In collaboration with a bio-statistician, a random sample of schools was selected from a list of all the schools in the North West Province of South Africa. The sample was stratified for region (12 regions in the province, of which each was subdivided into 4-7 districts, consisting of at least 20 schools each), gender (male/female), type of school (secondary school/primary school), and predominant ethnic group. The stratification was based on the estimated number of pupils in each ethnic group. A random sample of 10-12 year-old children (16 per age group: 8 boys and 8 girls) was selected from the class lists of the selected schools. The group (N=688) consisted of 338 boys and 350 girls from 19 primary schools and the distribution of children of each ethnic group were as follows: 98 white, 506 black, 46 coloureds, 41 Indian. A demographic questionnaire based on occupation of parents, housing, water and electricity, indicated at least 60 % of the children to be from a low socio economic (SES) background. The nature and the scope of the study were explained to the children beforehand and their parents had to give informed consent before a child was included in the study. The research was carried out following the ethical guidelines as laid down by the Declaration of Helsinki.

Measures

The MABC (Henderson and Sugden, 1992) was used to determine the level of DCD among 10-12 year-old children. The MABC was administered individually by post graduate researchers in Human Movement Studies. It consists of 4 age bands of three tests of Manual Dexterity (MD), two tests of Ball Skills, and three tests of Static and Dynamic Balance, of which age bands 3 (9-10yr) and 4 (11-12yr) were used. A total motor impairment score is derived from performance in these three sections, which can then be use to determine the level of DCD (moderate 5th-15th and severe <5th percentile). Moderate to good validity and reliability are documented for the MABC (Crawford et al, 2001; Kheng Tan et al, 2001; Smits-Engelsman et al, 2001; Wright and Sugden, 1996).

Statistical Analysis

Results were analysed with Statistica for Windows (StatSoft, 2001) for descriptive purposes (*M*, SD, percentages, and normality). Independent t-testing was used to determine differences between the sexes, and variance of analysis (ANOVA) to determine age and racial differences.

Results

From a total of 688 children between the ages of 10-12 years, Table 1 shows that 61.2% were diagnosed with DCD. The percentage of DCD was a little lower among the 10 year-old group (48.3%) compared to that of the 11 year (68.1%) and 12 year-old group (67.3%). Percentages of children classified in the severe DCD group (36.4%) were also higher than those in the moderate DCD group in each age group (24.7%). Of particular interest is the higher percentages of children classified in the severe category of DCD in all age groups.

Table 1 also shows the results of 10, 11 and 12 year-old children classified in each of the subsections of the MABC in different DCD categories. This analysis indicates that the percentages of children classified as moderate or severe cases of DCD with regard to MD and ball-skills, stayed more or less the same with increasing age. However, children classified in the DCD category for balancing skills increased dramatically from 10 (20%) to 11 years of age (60.5%) in the combined moderate and severe DCD categories. Problems with MD (62-66.3%) classifying children as DCD were the highest of all the subsections

TABLE 1: Number and percentage of 10, 11 and 12 year-old children classified according to the MABC (n & %) in different DCD levels

AGE	10 years			11 years			12 years			10-12 years
DCD Catagory	N	%	M&S%	N	%	M&S%	N	%	M&S%	%DCD
Without DCD	112	51.6		72	31.9		80	32.7		39.8
Moderate	51	23.5		54	23.9		66	26.9		24.8
Severe	54	24.8	48.3	100	44.2	68.1	99	40.4	67.3	36.5
MABC TOTAL	217	100		226	100		245	100		
Without DCD	77	35.4		76	33.6		93	37.9		
Moderate	25	11.5		34	15.0		37	15.1		
Severe	115	52.9	64.4	116	51.3	66.3	115	46.9	62.0	64.2
Manual Dexterity TOTAL	217	100		226	100		245	100		
Without DCD	192	88.4		198	87.6		211	86.1		
Moderate	16	8.7		20	7.1		30	12.2		
Severe	9	4.1	12.8	8	3.9	10.9	4	1.6	13.8	12.5
Ball TOTAL	217	100		226	100		245	100		
Without DCD	182	83.8		89	39.3		96	39.1		
Moderate	23	10.5		75	33.1		80	32.6		
Severe	12	5.5	20.0	62	27.4	60.5	68	27.2	60.3	46.9
Balance TOTAL	217	100		226	100		245	100		

M & S% = moderate and severe DCD %

from age 10, while results obtained for ball skills (10.9-13.8%) indicated the lowest percentages of DCD children. MD also showed the highest contribution to the MABC total at all ages.

Differences between the 10, 11 and 12 year-old children with regard to their mean totals in the subsections showed no statistical significance, although the MABC total (Table 2) indicated significant higher totals among the 11 year-old (M= 15.78) compared to the 10 year-old (M=14.09) children. Although the structure within each age band of the MABC is similar, tests within each age band differ and might have played a role in this increase (9-10 and 11-12). This tendency of increasing DCD with age is, however, supported by the findings of Wright and Sugden (1996), who documented that Singaporean teachers reported an even greater prevalence and increased severity of DCD with increasing age. Percentages of problems experienced with manual dexterity and balancing skills were, however, still very high compared to ball-skills that showed a very low contribution to the DCD classification of the subjects (Table 1).

With regard to differences between boys and girls classified with DCD, girls showed tendencies towards higher levels of overall DCD (67% and 57%) and severe DCD (40% and 32%, Table 3). This tendency

TABLE 2: Significance of differences between 10, 11 and 12 year-old children with DCD in each subsection and the MABC Total

	10 Years	11 Years	12 Years	Difference
MABC sections	Mean (SD)	Mean (SD)	Mean (SD)	p-value
MABC Total	14.09 (3.81)	15.78 (4.66)	15.32 (4.42)	*0.0137 (10/11yrs)
Manual Dexterity	8.76 (2.61)	8.5 (2.66)	8.22 (2.31)	NS
Balancing Skills	6.65 (1.71)	7.63 (2.21)	7.74 (2.21)	NS
Ball Skills	4.4 (1.73)	4.0 (1.64)	3.75 (1.54)	NS

NS= non significant difference, $p>0.05$;
* significant difference, $p<0.05$

TABLE 3: Descriptive information and significance of differences between 10- to12-year old boys and girls with DCD.

	BOYS (n=193)				GIRLS (n=236)				Significance of differences		
MABC sections	N	%	*M*	SD	N	%	*M*	SD	df	t-value	p
MABC Total	193	57.1	14.92	4.17	236	67.4	15.35	4.60	427	-0.83	NS
Manual Dexterity	209	61.8	8.39	2.48	233	66.5	8.56	2.58	440	-0.70	NS
Ball Skills	33	9.7	3.39	0.96	54	15.4	4.39	1.83	85	-2.89	0.0047*
Balancing Skills	152	44.9	7.37	2.03	168	48.0	7.76	2.29	318	-1.58	NS

TABLE 4: Descriptive information and significance of differences between 10- to12-year old boys and girls from different racial backgrounds

	WHITE		BLACK		COLOURED		INDIAN		
BOYS	*M*	%	*M*	%	*M*	%	*M*	%	p
MABC Total	16.62	35.4	14.78	60.5	15.68	61.5	14.44	50	NS
MD Total	8.44	35.4	8.39	67.8	8.87	73	7.0	33	NS
Ball Skills Total	3.55	18.7	3.31	8.9	3.0	3.8	4.0	5.5	NS
Balance	7.33	37.5	7.27	45.5	7.58	46.1	8.35	55.5	NS
GIRLS									
MABC Total	15.97	36.7	18.22	72.6	13.60	45.4	16.78	82.6	NS
MD Total	8.18	32.6	8.67	75.3	7.23	59	8.77	52.1	NS
Ball Skills Total	4.17	12.2	4.13	13.2	3.50	9	5.42	52.1	NS
Balance Total	7.44	42.8	7.84	47.6	7.14	31.8	7.82	73.9	NS

NS= non significant difference, $p>0.05$;
* significant difference, $p<0.05$

is different from a general, though not consistent finding that the boy-girl ratio is around three to one. However, an equal distribution of boys and girls was reported by Dussart (1994), while Crawford et al (2001) found significantly more females than males in the DCD group. A possible influence might be lowering activity levels reported for girls in the age group of 10-12, compared to boys, which might influence their motor competency negatively. A recently finalized study by Cloete et al (2004) on the same population with regard to their physical activity levels, substantiates a decline in activity levels among the girls. Raudsepp and Jürimäe (1996) highlighted the fact that physical activity is necessary in the growth phase in order to sustain normal growth and development. No significant differences were, however, found between the mean totals with regard to MD, balance, and the MABC total, while means for ball skills related problems were significantly higher among girls ($p= 0.0047$).

Although no statistical signifcant differences were found between the means of the DCD children in different racial groups (Table 4 and 5), being from a specific gender and belonging to a specific racial group showed a relation with the incidence of DCD found. The percentages of DCD indicated the highest DCD levels among Indian children, while manual dexterity was the sub-item showing the highest percentage of problems among Black and Coloured children, and ball skill related problems were the highest among White boys and Indian girls. Literature reports that motor development can to some extent be shaped by cultural demands, and the different kinds of activities in which those children engage are likely to differ between countries, according to Rösblad and Gard (1998). It is also noted that cross cultural differences could shed light on the degree to which the environments (school curriculum or sport activities) in which children grow up might influence motor development. Therefore, it cannot be assumed, according to Tan et al (2001), that test items that are discriminative in a given country and culture will apply across other cultures.

An analysis testing for normality among the sample (Figure 1a-d), revealed normal distribution as well as acceptable skewness and kurtosis of the MABC total, MD, balance, and ball skills (although to a lesser degree).

Also, comparison with the Bruininks Oseretsky test for motor proficiency (Table 6) revealed correlations substantiating the

TABLE 5: Significance of differences with regard to DCD between children from different racial backgrounds

	WHITE		BLACK		COLOURED		INDIAN		Difference
MABC sections	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	p
MABC Total	16.27	5.11	15.02	4.18	14.88	3.94	16.03	6.31	NS
MD Total	8.32	2.52	8.53	2.52	8.20	2.69	8.14	2.65	NS
Ball Skills Total	3.80	1.27	3.81	1.42	3.30	0.57	5.3	2.38	NS
Balance Total	7.39	2.47	7.57	2.16	7.42	1.71	8.07	2.29	NS

NS= non significant difference, $p>0.05$;
* significant difference, $p<0.05$

TABLE 6: The relationship between the scores of the MABC and the Bruininks-Oseretsky Short Form (BOTM-SF)

N	MABC		BOTMP-SF		Significance of correlation	
9	TI Score 17.44	% ile 4.55	S Score 51.4	% ile 25	R 0.62	p 0.0782

TI= total impairment score;
S score= standard score,

TABLE 7: Recommended norms for determining DCD among 9-12 year old children in the North West Province of South Africa

	Manual Dexterity		Ball Skills		Balance		MABC Total	
Percentile	5th	15th	5th	15th	5th	15th	5th	15th
9-12 yrs	13	10.5	4	2	11	9	22	18

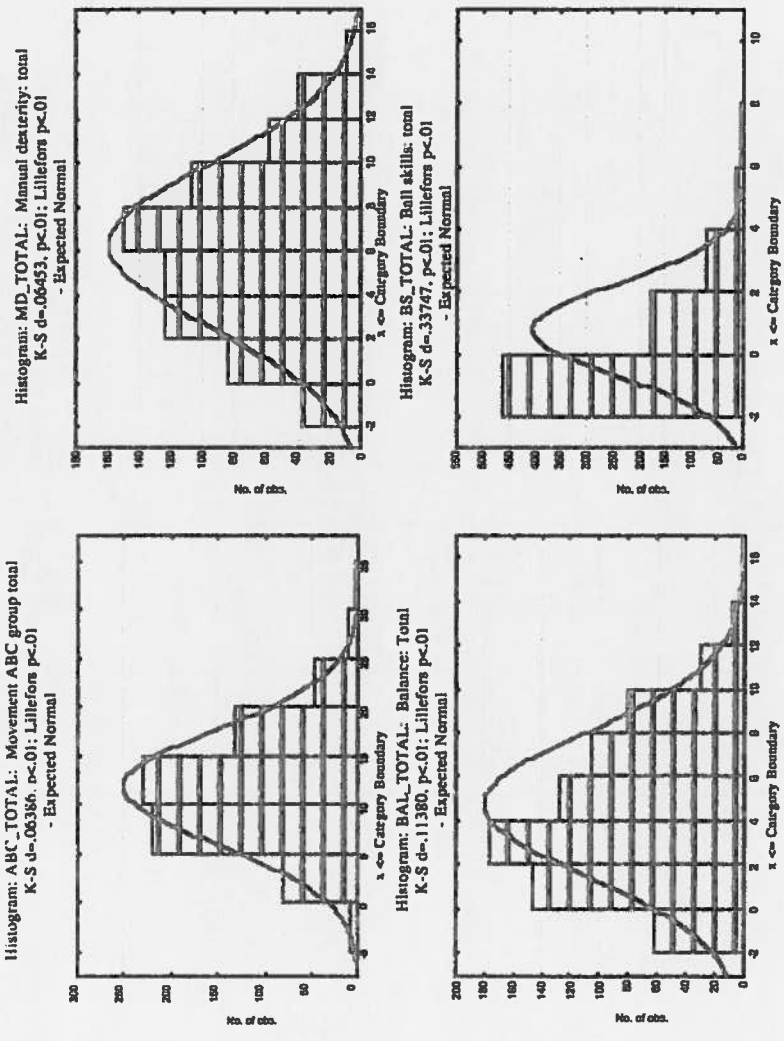

FIGURE 1: Distribution of the MABC total (a), Manual dexterity (b), Balance (c) and Ball skills (d)

correctness of the results. Two recently finalized studies on smaller and more specific populations in the same province (Prinsloo and Pienaar, 2003), and in the same age groups, also ruled out the influence of poor testing conditions, eg. cold winter temperatures, which were suspected of contributing to the results. From this it was concluded that the group could be seen as an homogeneous, rather than an heterogeneous group, but it was still clear that they differ from samples on which the MABC was standardised, as well as from other population groups in the world that were researched with the MABC.

Discussion

Compared to the documented incidence of DCD world-wide, surprise and disbelief was the first reaction when the final incidence of DCD (61.2%, of which 24.8% cases with DCD of a moderate magnitude and 36.4% with a severe magnitude) of this studied group was available.

From a clinical perspective, it will be an impossible task to render remedial help to the number of children classified in the DCD group, firstly because of the remote location where some of these children live, and secondly because there are no people available in these areas who have knowledge of how to deal with the problems of these children.

Hence a decision was made to adjust the norms for children living in the North West Province of South Africa or in similar conditions. Percentiles similar to the standard MABC (85th and 95th percentile) were used as cut-off points (15% and 5%). Table 7 show the recommended norms determined from the 85th and 95th percentile of this group.

Although it was decided to adjust the norms of the standard MABC when evaluating children with the test in environments such as what was found in this study, valuable insight was gained from the analysis of the results. No further action can be taken towards implementing the measures necassary for addressing the problem until the extent of the condition is ascertained. Differences found with regard to age, domain, race and sex are especially valuable when recommendations have to be made towards the rectifying of problem areas. It is, however, clear that factors other than ethno-racio diversity, but which were not the aim of this study to determine, could have contributed to the high incidence of DCD found in this study. Results with regard to balance

and fine motor related problems were, however, in accordance with research indicating a higher percentage of such problems among children from lower SES circumstances, which apply to 60% of this studied group. The high percentages of underweight (40% among boys and 13% among girls) reported by Underhay (2002) and the growth spurt are also examples of such factors.

CONCLUSIONS

It is clear that the problem of possible malnutrition among a high percentage of the children is a priority that should be dealt with firstly, However, the indicated problem areas with regard to DCD which may impact on school progress and of which some are more problematic among certain age groups, genders and racial groups (like MD deficiencies), should also be addressed, Suggestions to alleviate these backlogs will be given to the Educational Board of the North West Province, and it is hoped that they will develop strategies to deal with it in a proper manner. Physical education classes, conducted by a trained person (of whom none exist at this stage) will be a step in the right direction, as such a person will not only be able to stimulate these children with appropriate activities, but will also be able to identify children who need help for motor deficiencies sooner, and help them to a certain extent. However, when considering the fact that one fifth of teachers in South Africa currently are not properly qualified for the classes they are responsible for, and the highest amount of these teachers are found in the North West Province (32.2%) (Joubert, 2001), especially in the very remote areas, the alleviation of problems associated with DCD will not be a priority nor an easy task.

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