Visual Motor Integration in Children living in Childcare Institutions in Gauteng

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ABSTRACT

The research examined the relationship between institutionalisation factors and visual motor integration. A quantitative study of 50 children from nine childcare institutions of varying socio-economic circumstances, within the Gauteng Province, was undertaken. The participants came from different race groups, genders and their ages ranged from 6 to 10 years.

Interview questionnaires were used to obtain the relevant information on client and environmental factors related to the institutions that could influence visual motor integration. The Beery-Buktenica Developmental Test of Visual Motor Integration, 4th Edition (DTVMI) was used to obtain an objective measure of the participants' visual motor integration abilities.

The analysis of the data revealed statistically significant differences in the mean standard scores related to age, types of play engaged in and the socioeconomic circumstances of the institutions. Other factors contributing to lower scores included length of institutionalisation, health, coping with academic tasks and the play resources available in the institutions.

Key words: Child care institution, Visual motor integration, Play, Socio economic status

Introduction

In South Africa, there are many children living in childcare institutions due to factors such as maternal mortality, abandonment and improper or inadequate care by parents or other family members. The problem of child institutionalisation is further compounded by the rising HIV/AIDS infection rates in South Africa, resulting in a high maternal mortality rate and thus an increased number of children being orphaned[1]. This is a great concern as institutionalisation has been found to negatively affect a child's physical, cognitive, emotional and social development. Factors affecting this include a lack of physical and staff resources available[2,3,4] and the nutrition provided[5].

Research has shown that youths raised in childcare intuitions lack emotional responsiveness[6] as a result of authoritative staff interaction styles, which tend to be used when staffing resources are lacking in institutions. Wolff and Fesseha found that these authoritative staff interactions and styles of childcare management which attempted to create a secure environment through explicit rules and an over structured schedule[7], are less beneficial than in a group setting where the staff share the responsibilities of child management, encourage individuality of the children and develop stable personal ties with the children. According to Tepper et al[8], where no secure attachment existed between children and their caregivers, developmental milestones failed to appear normally. This environment is therefore not optimal for the development of various skills, as the child lacks adequate stimulation with the child's need for play often being neglected as well[9]. Play is the primary occupation of children and is the mechanism through which they master their environment[10]. Regular sessions of structured play have been found to significantly improve the development of children living in childcare institutions[11]. Institutionalisation has also been shown to have a negative impact on the development of cognitive skills that are necessary for the development of sensory processing and perceptual abilities[12] which may include visual motor integration. Evidence also shows that nutrition plays a role in measures specific to visual motor integration[13]. In a study of the relationship between malnutrition and intellectual performance in rural primary school children, it was found that even moderate degrees of malnutrition influenced IQ scores and had a great effect on immediate memory, visual perception and Visual Motor Integration (VMI)[14].

In this study, the effect of institutionalisation on the development of visual motor integration was investigated as visual motor integration is of particular interest to occupational therapists. Visual motor integration is the degree to which visual perception, the process responsible for the reception and cognition of visual stimuli[10], and finger-hand movements are well coordinated[15]. Visual motor integration is an important occupational performance component related to scholastic requirements in school work as it is the skill that underpins the ability to legibly copy letters off the blackboard[16] and the spatial organisation of written work on a page. Although the relationship between visual motor integration and academic achievement is not clearly understood[17], research shows that performance on a VMI task is significantly correlated to a child's occupational performance in academic work at school, particularly in relation to spatial perceptual abilities needed for reading, writing, spelling and arithmetic[18].

No conclusive research regarding the direct relationship between visual motor integration and institutionalisation has been presented in the literature, but other studies indicate that visual motor integration is related to many factors. A correlation between the development of visual motor integration and socio-economic status has been demonstrated with children from higher socio economic status environments scoring better on visual motor integration tests[19,20].

Purpose of the Study

The purpose of this study was to establish which factors influence visual motor integration test scores of children in child care institutions. The factors investigated in this study were demographic, factors relating to the individual child's development including gender, age, population group and internal or personal factors which consisted of personal background history, current academic and nutritional status, developmental level and medical history. Other factors considered included the child's health prior to admission to the institution, the type of play the child engages in, the length of the child's institutionalisation as well as their contact with their family.

The external or environmental factors considered were the socio-economic status of the childcare institution, the resources available at the institution and staff: child ratio, staff education level as well as staff selection and training at the institution.

Methodology

A quantitative non-experimental cross sectional design was used in the study.

Population and sample

The participants were school-going South African children between the ages of 6 years 0 months and 9 years 11 months of age living in childcare institutions in the Gauteng area. Nine childcare institutions were selected using stratified sampling in terms of socio-economic status from a list of 56 registered institutions situated in the East Rand, Central Johannesburg, Soweto, South Rand, North Rand and Pretoria.

Fifty participants attending school from Grade 1 to Grade 4 were selected by the staff at the institutions on the basis of their availability using convenience non-probability sampling. The participants were identified for inclusion in the study by the social workers at the respective institutions. Participants selected included both males and females from all the main population groups represented in South Africa. Inclusion criteria were that the child must be between the age of 6 year 0 months and 9 years 11 months, and should have been at the child care institution for at least three months.

Exclusion criteria included children identified with a physical or mental disability or a medical condition or who had had previous therapeutic intervention in the form of occupational, speech and/ or physiotherapy.

Measurement Tools

Data was gathered using three measurement tools:

1. The Beery-Buktenica Developmental Test of Visual Motor Integration, 4th Edition[15] (DTVMI) comprising tests for visual motor integration, visual perception and motor co-ordination, was administered to the participants individually, after they had given verbal assent. This test is a reliable and valid measure of visual motor integration abilities which does not show significant differences related to gender, residence, or ethnicity[15], but is sensitive to socio economic status[19,20].
2. A Caregiver Questionnaire developed by the researchers. This questionnaire included questions on the personal factors for each child including the child's weight, height, medication and the types of play the child typically engaged in, a brief developmental checklist based on the ability to complete tasks of daily living, the child's school history and his/her participation in extramural activities.
3. An Institution Questionnaire which was also developed by the researchers. The Institution Questionnaire was designed to elicit information about the institution's facilities, the number of years it had been operating, the nutrition the children received, the number of staff members working directly with the children, the number of children at the institution, the staff selection procedure, training available to staff and the use of volunteers. The Institution Questionnaire also included questions on the availability of professional services, the institution's resources for excursions or field trips, the types of toys and outside play areas available for the children to use.

Both questionnaires had closed ended questions with answers which were either numbers, yes/no options or a scale of 1-5. These answers were scored numerically and the results were used in the analysis of the data. Open ended questions and comments attached to most close ended questions allowed for explanation of the answers given in the close ended questions so the data could be interpreted correctly. Menus and timetables were requested when appropriate. The content validity of the questionnaires was established by using literature to design the questions and consulting a group of five experienced occupational therapists to review the questions before use. Since self-report questionnaires were used, no inter-rater reliability testing was deemed necessary.

Method

The Caregiver Questionnaire was completed by the primary caregivers, after they had received an information sheet and signed informed consent for each participant on the day of their VMI assessment. Before administration of the Caregiver Questionnaire, caregivers were trained to identify imaginative, passive, active, imitative, manipulative and social play as well as a category labelled 'other' to ensure that they understood the play terminology and to improve the reliability of this part of the questionnaire.

After signing informed consent the manager of each childcare institution was requested to complete the Institution Questionnaire.

Children were assessed individually in a quiet room at the institution in which they lived by one of the student researchers, once they had given verbal assent.

Ethical approval for the study was obtained from the Ethics Committee for research on human subjects, University of the Witwatersrand.

Data Analysis

Standard scores and z-scores were calculated for each component of the DTVMI for each participant. Since standard scores indicate a level of performance that is adjusted for age, the mean standard score for the total sample, for each of the three components of the DTVMI was then calculated. The standard scores were then used in the following analyses:

- Pearson's correlation coefficients were used to establish the relationship between the demographic and personal or internal factors identified as having a possible association with visual motor integration.
- The association between the visual motor integration component of the DTVMI and external or environmental factors was also analysed using Pearson's correlation coefficient.
- A Mann-Whitney U-test was used to establish the difference between the mean standard scores on the visual motor integration aspect only of the test (the visual perceptual and motor co-ordination components were not included in this analysis) and the socio-economic circumstances of the homes

Results and Discussion

Demographics

Nine institutions agreed to participate when approached and the socioeconomic status of each institution was checked according to the funding per child. The nine institutions used were funded either by a non profit organisation (NGO) or by an NGO in combination with government funding supplemented by fund raising. The sample consisted of one institution that was categorised as having circumstances that placed them in a low socio-economic group as they were supported by NGO funds alone. Four of institutions fell into a low to middle socio-economic group and only received subsidies from the State for each child. A further three institutions fell into a middle socio-economic group as they received State subsidies and extra funding per child from an NGO and one into the middle to high socio-economic group where the funding per child was further increased by external fundraising. All of the institutions provided a basic level of care in terms of general resources like running water, electricity and indoor bathrooms and flushing toilets. The socio-economic circumstances of the various institutions also varied in accordance with the respective geographical locations within the Gauteng Province.

Table 1: Results of the Visual Motor Integration, visual perceptual and Motor Coordination components of the DTVMI

						Mean Standard Scores and z Scores on the Beery-Buktenica Developmental Test of Visual Motor Integration		
						VMI Standard Score (z Score)	**Visual Standard Score (z Score)**	**Motor Standard Score (z Score)**
Total Group						88.02 (-0.80)	84.38 (-1.04)	92.78 (-0.48)
Gender by Age group	**6 years 0 months to 6 years 11 months**	**7 years 0 months to 7 years 11 months**	**8 years months to 8 years 11 months**	**0 9 years 0 months to 9 years 11 months**	**Total**			
Male	1	8	4	8	21	88.28 (-0.78)	83.19 (-1.12)	92.09 (-0.52)
Female	4	8	12	5	29	87.79 (-0.81)	85.24 (-0.98)	93.27 (-0.45)
Population Group						**VMI**	**Visual**	**Motor**
African					25	85.88 (-0.94)	81.4 (-1.24)	90.92 (-0.61)
Indian					4	88 (-0.80)	92.75 (-0.48)	103 (0.20
Coloured					7	89.85 (-0.68)	86 (-0.93)	92 (-0.53
White					14	90.92 (-0.61)	87.21 (-0.85)	93.57 (-0.43)

The number of participants available at each institution for the study ranged from three to eight with 58% of the participants being female and 42% male. In the total sample of 52 participants, 50% were African, 28% were White, 14% were Coloured and 8 % were Indian. Only six participants fell into the 6 year age group with the rest of the sample being equally distributed into the 7 year, 8 year and 9 year age groups (*Table 1*).

Results of the Visual Motor Integration, Motor and Co-ordination Test Scores

The standard scores for each component of the Beery-Buktenica Developmental Test of Visual Motor Integration, 4th Edition (DTVMI)[15], that is the visual motor integration, visual perception and motor co-ordination tests were established for the children in each age group. The mean standard scores for the total sample for each section fell between 81.4 and 103 (*Table 1*). This indicated that the participants scored in a low to average range with z scores of -1.24 to + 0.20. Average scores are defined by Beery for this test[15] at one standard deviation above and below the mean.

In the **Visual Motor Integration** section of the DTVMI test[15] the actual standard scores fell between 72 (z score, -1.86) and 119 (z score, +1.26). This result was skewed as 30% of participants scored in the low (standard scores 68-82), range with only 2% of participants scoring in the high range (standard scores 118-132). While 67% of participants fell into the average range (standard scores 83 -117) the scores were clustered at the lower end of this range (see *Table II* and *Figure 1*). This is supported by the results found by Rens on another representative South African sample of children who were drawn from a school going population living at home in the Eastern Cape, where 99% of children scored between 68-117[21].

Table 11: Distribution of the standard scores on all the tests of the DTVMI

Standard Score range	Visual Motor integration n=50	Visual Supplemental Test n=50	Motor Supplemental Test n=50
40-67 Very Low		8	
68-82 Low	15	18	1
83-117 Average	34	22	49
118-132 High	1	2	

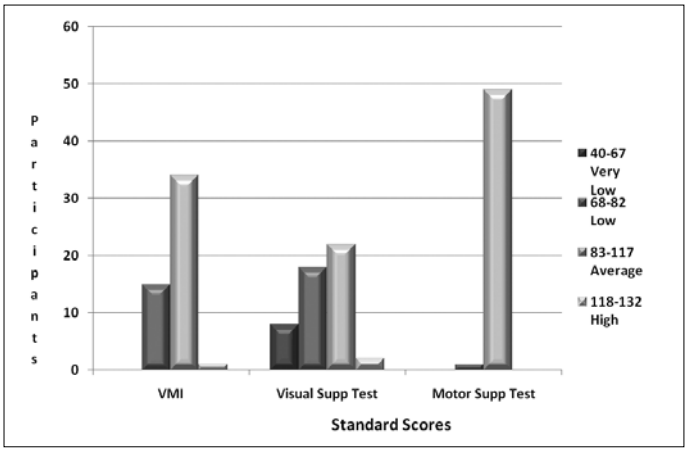

Figure 1: Distribution of Standard Scores on all the subtests of the DTVMI

Poor performance on the visual motor integration section of the test could be a result of inadequate integration or coordination of visual perceptual and/or motor coordination abilities if scores on the supplemental tests indicate that there are no deficits in either of these aspects. In this study visual motor integration scores appear to be affected by poor visual perceptual abilities[15].

The participants obtained standard scores between 51 (z score, -3.26) and 123 (z score, 1.53) for the **Visual Perceptual Supplemental Test**[15]. There was a larger distribution of these scores than those of the visual motor integration component which varied between very low (standard scores <67) and high (standard scores 120-129). The distribution was however more skewed towards lower scores with the 16% of participants falling into the very low range and 36% into the low range. These results confirm the findings of Rens[21], where 62% of her sample, scored at these levels. Thus further testing of visual perception should be done to confirm these results if they are to be used for diagnostic purposes as indicated by Beery[15].

Scores for the **Motor Coordination Supplemental Test**[15] were normally distributed between standard scores of 68 (z score, -2.13) and 113 (z score, 0.86) with 98% of participants scoring in the average range with a z score of above -1.00, which again agrees with the findings of Rens[21].

Since the results found in this study were similar to Rens' study it would seem that institutionalisation *per se* does not appear to affect the results of children measured on the DTVMI[15]. Association between demographic and personal or internal factors and the standard scores on the three components of the DTVMI indicate that both these factors may have some influence.

Visual Motor Integration Scores and Demographic Factors

The mean standard scores for each of the three tests that make up the DTVMI were compared to the demographic factors of gender, race, age, length of institutionalisation, the ability of participants to carry out age appropriate tasks of daily living and the types of play in which they engaged. The participants' current and past medical histories, as well as their academic achievement, nutritional status and family contact, were also considered.

✣ Age of participants

Age was the one factor which showed significant negative correlations ($p \leq 0.05$) with the mean scores for the three tests that make up the DTVMI. The results indicated that the older participants had greater visual motor integration ($r=-0.91$), visual perceptual ($r=-0.89$) and motor co-ordination problems ($r=-0.99$) (see *Figure 2*).

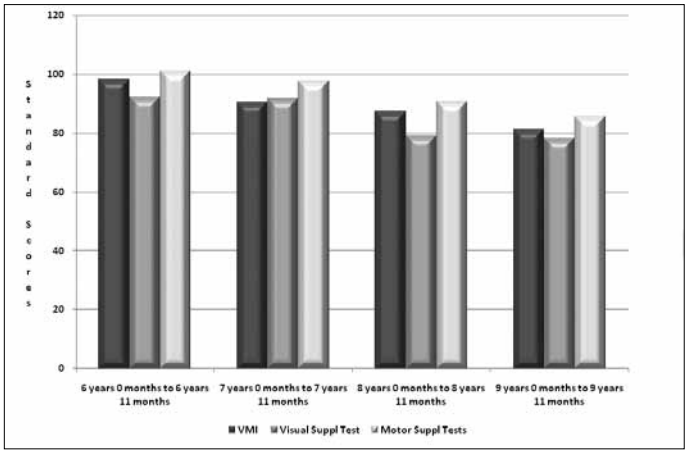

Figure 2: Mean scores on the three components of the DTVMI compared to the age of participants

These results are contradictory to findings reported in the literature and are of concern as they suggest a compounding effect of developmental delay in the older participants. Care must be taken in interpreting these results as the standard error of measurement that occurs in any test could account for the differences between the age groups. Beery sets the measurement error in the test at a range of 5 points on either side of the standard score obtained. Thus it can be assumed that the true standard score for VMI for 6 year olds, who obtained at score of 98, lies between 103 and 93[15].

The differences in the scores between the 9 year olds and 6 year olds ranged from 16 to 13 points which is more than can be accounted for by the standard error of measurement indicating a real decrease in visual motor integration ability with age in this study.

A limitation to the study occurred in participant selection, as a greater number of older children were included in the sample. This may have influenced the results. The older children may have been those that the staff identified as experiencing difficulties, and they, therefore, selected them to participate in this study. The skewed selection could possibly have played a role in the results that showed lower mean standard scores for the three components that make up the DTVMI for the older participants. There was also a variation in the number of participants within each age band between institutions and some institutions had a majority of participants that fell into the older age bands.

✣ Gender and population group

No differences for gender and population group were found when comparing mean scores for the three components of the DTVMI, with the mean scores falling into the average to low range. The lack of gender and cultural bias of the visual motor integration section of the test[15] in this study supports results found in a multi-ethnic South African study[23]. However, results of this study showed low scores for the Visual Perception component in the African population group only, supporting the findings of a study done in the Eastern Cape[21].

Visual Motor Integration Scores and Internal or Personal Factors

✣ Time in the Institution

The length of time spent at the institution also showed a non-significant negative association with the mean scores for the three components of the DTVMI, suggesting that those children who had been in institutions for more than two years had lower scores. This finding could be related to the age differences discussed above but the trend is supported by the findings reported in the literature where a significant relationship between the length of institutionalisation and sensory integration problems were found[22]. Poor sensory integration may negatively affect the participants' visual motor integration.

✣ Types of play

The only other factor that showed an association with the mean scores of the three tests that make up the VMI, was the types of play that the participants engaged in. It was clear from the analysis that very few participants had opportunities to engage in imitative play with most of the sample taking part in active and social play. The mean standard scores in each of the three components of the DTVMI increased in relation to the number of types of play in which the participants engaged, with a statistically significant and high correlation of 0.6 ($p<0.05$) with the visual motor integration component of the test. Similar results were found for the visual perceptual ($r=0.45$) and motor co-ordination components ($r = 0.48$) of the test. This suggests a strong association between types of play engaged in and the development of visual motor integration (see *Figure 3*).

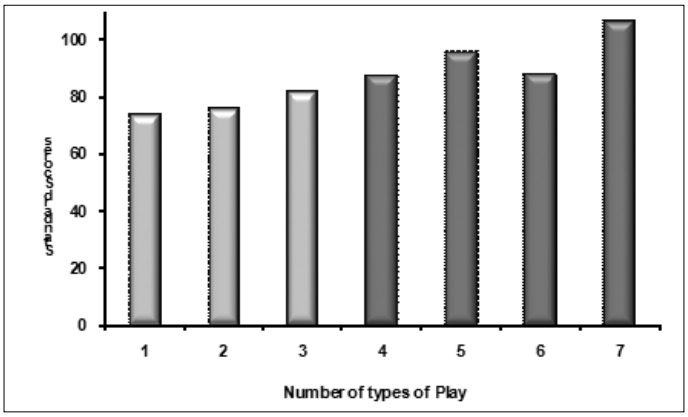

Figure 3: Relationship between the number of types of play and the scores on the DTVMI

✣ Developmental tasks

Information on the mastery of developmentally appropriate tasks was obtained from caregivers who checked milestone task achievement in selected everyday activities in children between the age of 6 and 9 years. Comparison of the results for developmental tasks with mean scores for the three components of the DTVMI, revealed a low association (less than $r = 0.31$) between these variables. Participants whose standard scores were in the low range between 83.3 and 80, were found to be those that had not yet attained mastery of developmentally appropriate tasks such as writing their own name and counting to 20.

No statistically significant correlations were found in the comparison between the participants' academic coping at school and their mean scores for the three components of the DTVMI, despite evidence reported in the literature of strong correlations between mastery of academic work and visual motor integration[18]. However, Individuals who were reported as having difficulties academically had mean scores in the low range.

✣ Nutrition

In terms of nutrition no participants were underweight and the participants from four institutions with height below the normal limit achieved scores for the three components of the DTVMI that were within the normal range. Twelve of the participants were found to have had serious health conditions in the past that included malnutrition, tuberculosis, general neglect, burns, vision problems, jaundice, asthma and skin conditions. Those children with histories of ill health all obtained scores within the normal range. However, the reliability of this information could have been influenced by the lack of records of the childrens' medical histories prior to admission to the institutions[24]. Six of the participants suffered from medical conditions during the study period. These conditions included skin problems and asthma. These participants were also included in the sample. There was no significant correlation between the mean standard scores for the three components of the DTVMI and participants' health status during the period of the study. The scores of those that had been ill did however fall below the normal range. This factor is considered to be important as studies reveal that medical complications resulting in lengthy hospitalisation could negatively influence the development of visual cognitive skills and therefore visual motor integration[25].

✣ Family contact

The mean standard scores in each of the three components of the DTVMI for participants who had contact with their families compared to those who did not indicated that this factor did not appear to have any effect on the participants' development of visual motor integration skills.

Visual Motor Integration Scores and Environmental or External Factors

The external factors were considered only in relation to the participants' visual motor integration skills. Kulp[18] also only considered the association of visual motor integration and external factors[18]. Factors considered included the socio-economic circumstances of the childcare institution, staff factors and the resources available at the institution.

✣ Socio-economic factors

With respect to the socio-economic circumstances of each of the institutions, the participants in institutions of a low and low to middle socio-economic group, achieved lower mean standard scores on the visual motor integration component of the DTVMI than those from institutions in higher socio economic groups. This finding supports results reported by Beery[15] as well as results of a South African study that found that test scores increased proportionally with increases in socio-economic status[26]. Participants in the current study achieved mean standard scores in the visual motor integration component of the DTVMI between 87 to 84.66 while participants in institutions in the middle and middle to high socio-economic group achieved mean scores of between 94.81 and 91. Both sets of scores fall within the average range. In the institutions with lower socioeconomic circumstances the participants scored in the below average range on the Visual Perception component, but no participants scored below average for the Motor Coordination component. The results of a Mann-Whitney U-test indicted that the participants in institutions of middle socio-economic group had significantly higher mean scores ($p<0.05$) than those in institutions of low to middle and low socio-economic status.

These results may be influenced by a number of other factors linked to the socio-economic circumstances of the institution. These factors include the staff-child ratio, help from a variety of professionals and volunteers and stability in terms of the length time that the institution has been operating. Resources such as toys, play space and the availability of extramural and sport facilities are also important. Other influential factors could have been the occurrence of family visits and weekend visits to extended family as well as the in-service training for staff.

✣ Staff

Staff factors within institutions considered for this study other than those mentioned in the purpose of the study, were the presence and variety of help from professionals and volunteers and whether staff members are assigned to specific groups of children. The selection criteria used in employment of staff as well as the in-service training of staff members would affect the quality of care provided to children in the institution and was thus considered to be an important factor. Selection procedures for staff employment were determined to be an interview, the submission of a Curriculum Vitae, reference checks, a qualification in basic child care, psychometric testing, past experience, personality factors and a training period at the institution. All institutions provided staff members with some form of training ranging from either an extensive course dealing with all aspects of childcare, in-house training and workshops on child development to a basic childcare qualification. Furthermore, ongoing supervision and consultation sessions were offered to staff.

The staff-child ratio varied from 1:19 to 1:3 in the various institutions. The results revealed no trend in comparing the mean standard visual motor integration scores with staff-child ratios with a negative correlation of -0.14 between the two variables being found. Since staff members being assigned to specific groups of children would affect the childrens' attachment to a caregiver, this factor was investigated. Two institutions did not assign staff members to specific groups of children while the remaining institutions did assign specific staff members to groups of children. The results revealed that there were no differences in the comparison between mean scores of the visual motor integration component of the DTVMI of and those institutions that assigned staff members and those who did not. This was not true for the moderate correlation of 0.44 found between mean standard visual motor integration scores compared to the types and numbers of professional staff and volunteers at an institution.

All the participating institutions had the services of at least two types of professional staff and volunteers. All but one institution had the services of a resident social worker and psychologist. Occupational therapists and speech and language therapists offer services at four of the institutions and five institutions also employed remedial teachers. The institutions with low to middle socio-economic circumstances were found to have higher numbers of professionals offering services.

✣ Resources

All the institutions were well resourced for play, nutrition and extra mural activities. Toys and other equipment for active, passive and manipulative play were available at all the institutions with five of the nine institutions having resources for imitative play and one institution also had resources for imaginative play. Results revealed that children from the two institutions where participants scored in the low range on the mean standard scores of the visual motor integration section of the DTVMI, had access to only three types of play resources. These institutions lacked resources for imitative or imaginative play. Although the correlation found for the number of types of play resources compared to the mean standard scores was low at 0.36, this finding supports the strong correlation found between the types of play that the children regularly engaged in and the higher mean standard scores on the DTVMI. Thus, the availability of various types of play at the institutions appears to be associated with the development of visual motor integration skills found in the participants in this study.

✣ Nutrition and extra-mural activities

The other two resources considered were nutrition and extra mural activities and whether correlations existed between them and the mean scores for the visual motor integration component of the DTVMI. Nutritional resources available at the institutions were evaluated by means of the Institution Questionnaire. The importance of this factor relates to the link between under nutrition and small stature, significant wasting and stunting of growth that can be found in institutionalised children[6,27]. Results on the Institutional Question-

naire revealed that all the participating institutions provided three meals a day as well as tea for the children. No relationship could be established between mean scores and the nutrition offered at the institution or the extramural activities that approximately 60% of the participants had access to. The type of activities, which included sport, excursions and holidays, depended to some extent on the institution's financial resources.

A limitation of the study accepted by the researchers was the brief developmental assessment designed for this study, although drawn from the literature, needed to be adjusted to include a greater range of developmental tasks that were more appropriate to the various age groups assessed.

Conclusion

Developmental delay has been linked to factors within institutions in the literature[3]. The relationship between visual motor integration and factors that might affect the development of institutionalised children between the ages of 6 and 9 years were investigated in this study. The factors included demographic factors such as age, population group and gender; milestone attainment and types of play; nutritional status; environmental factors such as the socioeconomic circumstances of the childcare institution; the staffing and levels of resourcing in the institutions. Three factors were identified as indicating a significant relationship with the mean scores the three components that make up the DTVMI. These factors were the number of types of play the child engaged in, the number of professional and volunteers available at the institution and the socioeconomic circumstances of the institution. The association between the number of types of play and the play resources in the institution and visual motor integration was the most significant finding of this study.

This was a pilot study that screened a large number of factors and their association with visual motor integration. Results should be viewed in this light and more in depth research on relevant factors is suggested.

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