The role of family configuration in early childhood intellectual development in the context of an extended family system in Pakistan

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Received : 28-09-05
Review completed : 19-03-06
Accepted : 10-10-06
PubMed ID :
J Postgrad Med 2007;53:27-33

ABSTRACT

Context: The confluence theory of intelligence by Zajonc and Markus emphasizes that individual intellectual difference of children manifests itself in the context of family configuration. Instead of assuming its generalizability, careful scientific work is required before applying the model to South Asian cultures where, predominantly, an extended family type exists. **Aims:** To assess the role of extended family configuration on the child's intellectual development in a South Asian setting. **Settings and Design:** A cross-sectional study was conducted on 4-5-year-old preschool children residing in Karachi, Pakistan. **Materials and Methods:** Three hundred and forty-two child and mother dyads were assessed through a validated cognitive psychometric tool and through a structured questionnaire. Children who were registered at the main Mother and Child Health Centres (MCH) of the Aga Khan Health Services, Pakistan (AKHSP) Karachi and who were born between July 1st 1993-June 30th 1994 with traceable birth records at the maternity homes, were considered for this study. **Statistical Analysis:** Multivariate linear regression models were used to identify the individual effect of family configuration on the intellectual scores. **Results:** Family configuration variables such as number of co-residents ($P < 0.05$) and the number of siblings ($P < 0.01$) in the house were significantly correlated with the psychometric score. Even after controlling for gender, socio-economic status, birth order and birth intervals, significant differentials were observed in favor of an extended family system on a child's intellectual development. **Conclusion:** The findings suggest the positive role of co-residents of an extended family environment on the intellectual development in early childhood.

KEY WORDS: Child development, cognition, early childhood, extended family system, family configuration, intelligence

Social environment plays an important role in the mental development of a child.[1-4] Issues pertaining to a child's cognitive development have largely been ignored in South Asian countries and factors identified as an impediment to development have mostly been identified in western contexts.[5] Due to a lack of indigenous models, Western models and theories relating to child cognitive development have been adopted[6] in South Asian countries including Pakistan, despite the unique social circumstances prevalent in these countries.

Child development has been studied with various conceptual frameworks and strategies.[7-9] The confluence theory of intelligence[10-12] offers a unique perspective among them as it states that the intellectual growth of every member of a family is interdependent and an individual's growth rate is a function of the family configuration. The mean of the absolute intellectual or mental age level of all the family members indicates intellectual environment at home. The theory proposes a cyclical relationship with the intellectual environment at home affecting the intellectual development

of each child, which in turn affects the mean intellectual level of the family. The child's intellectual development is dependent upon family size, inter-sibling interval and birth order as a function of time. As mature members leave or are added to a family, pronounced changes occur in the intellectual environment. Birth order does not act independently but as a confounding variable for mediating the effects of family size and inter-sibling interval differences. The family size increases with short inter-sibling intervals, resulting in the mean intellectual environment decreasing for younger children.[11,13,14] The underlying assumption of this theory is that the influence of family members is mediated through social interactions at home. Another premise is that social interactions are conducive to the development of a child's intelligence. Although this theory does not consider the nature of these interactions or even genetic contributions directly, numerous inferences have been drawn and empirically validated, which contribute to an understanding of child cognitive development.[15] Almost all of this research has been conducted in developed countries and the main findings are: family size is inversely associated with the intellectual development of children, with the association being more prominent in disadvantaged compared to privileged economical groups; family size affects verbal more than the nonverbal aspect of the cognitive development; close birth spacing among children has an unfavorable affect on IQ irrespective of birth order.[16-18]

The generality of these conclusions for other cultures with different family structures cannot be assumed and careful scientific work is required.[12,17-19] Family size is a significant component of the theory, but family composition changes with change in the socio-cultural settings. Developed countries have a predominantly nuclear family type; literature on the child ecosystem based on the confluence theory may not be readily generalized to the developing world without scientific evaluation. In contrast to the nuclear family trend in developed countries that resulted from the rapid industrialization and urbanization in the latter half of the 20th century, the majority of the populations in developing countries, particularly in Asia, continue to follow the pattern of extended family households.[20-22] Interestingly, nuclear family is not a unique phenomenon in the West anymore; the proportion of extended family setup is on the rise due to various social and economic reasons.[22] Extended household includes other kin in addition to the members of the nuclear family hereafter called as co-residents pre-empts a systematic evaluation of its influence in the context of confluence theory in a developing world setting.

The specific objectives of this study were to evaluate the propositions related to the theory of confluence of intelligence in a Pakistani setting, primarily to assess the role of the extended family in the intellectual development of the child. In addition, cultural differences such as gender differentials during child rearing and access to family resources are important to control for while evaluating the role of the extended family system. Moreover, the potential effects of the inter-sibling birth interval and birth order should also be controlled for while assessing the role of the extended family system configuration on the child's intellectual development. It has been shown that the effects of family size are independent of economic status.[10] However, features of poverty of Western families may not be necessarily comparable to an environment in which a child grows up with relatively few resources.[23] Hence socio-economic status also needs to be controlled for in the analysis.

Materials and Methods

Participants

This research is part of a larger cross-sectional study designed to assess factors associated with the cognitive competence of children between four to five years of age in Karachi, Pakistan. The study was conducted in the area served by the Aga Khan Health Services of Pakistan (AKHSP), as there is a well-established and organized health delivery system which serves a conglomeration of diverse racial and ethnic populations such as Sindhis, Punjabis, Gilgitis and related, as well as immigrants from India, mostly Gujaratis.

Children who were registered at the main Mother and Child Health Centres (MCH) of the AKHSP Karachi and were born between July 1st 1993-June 30th 1994 with traceable birth records at the maternity homes, were considered for this study. Children having an incomplete address on the MCH records were excluded. Twins, adopted children or those diagnosed as severely mentally retarded were also excluded. Refusal rate was negligible (0.06%) and the required information was collected on 342 children.

Study apparatus

Background of the psychometric test used for cognitive assessment

Children of ages four to five years were evaluated by the "test of intellectual development for Pakistani preschool children" devised and validated by the National Institute of Psychology Islamabad, Pakistan.[24] The validation consisted of selecting the subtests of intellectual development on the basis of an extensive literature search focusing on the Bailey Scales of Infant Development and Piagetian concepts and cultural relevance. They carried out further selection of subtests in three phases. First tryout study consisting of 13 subtests was conducted on 20 children; subtests having high or low facility were dropped. The second tryout study consisted of 11 subtests and was conducted on 100 children to find out the psychometric characteristics of the subtests. The final tryout study was conducted on about 1000 children to establish the reliability and validity of the test and also to develop the norms. The finalized test has eight subtests: Color naming, reasoning, seriation, verbal memory, pictorial memory, perceptual motor skills, one to one correspondence and conversation. Each subtest contains different test items. For example, the materials required for the "reasoning" subset are seven standardized pictures, each having three to four objects which differ in use, size and classification. The first two pictures are used for demonstration and are not scored. Each picture is individually presented to the child, who is required to point to the picture, that doesn't belong to the others or is different from the rest. Each picture is scored as 0 or 1, resulting in total score=5. The maximum score for each subtest is "5", except for the "conversation" where the maximum score is "10". The possible score of the intellectual evaluation

range is between "0" and "45". This is the first research-based article using this instrument.

In the original test, the scaling was done on the basis of percentile ranks for 3 monthly age groups. The test was developed and validated for Pakistani children, but normative ranking was developed in a different region of Pakistan as compared to the study site. Therefore for this study, we have used original scores rather than the normative scores while controlling for age. Higher score means better intellectual status of the child.

Questionnaire for maternal interview

A structured questionnaire in Urdu was used to collect information on family configuration and socio-economic status as well as other potential factors associated with the intellectual development of the child. Pretesting of the questionnaire was done at the pediatric ward and clinics of the Aga Khan University Hospital (AKUH).

The variables considered for the assessment of family configuration included the total number of family members and siblings, birth order and inter-sibling birth intervals. Family type was considered as 'nuclear' or 'extended' on the basis of the configuration of its members. A nuclear family was defined as parents and siblings of the index child, while any additional members would make it an extended family. These members in the family, as stated earlier, are termed co-residents for the purpose of this study.

Procedure

Based on the information provided by the staff at the main MCH centers, it was estimated that it would be possible to locate about 300-400 registered children during the study period. All children who fulfilled the inclusion criteria were included in the study. Information was collected from the mother and the child dyad. The assessors underwent three weeks of intensive training on the theoretical and practical aspects of the study. Data collection was done in the following sequence:

Eligible children were contacted at their residences, verbal consent was obtained from mothers after providing information regarding the objectives of the proposed study, mothers and children were requested to come to respective MCH centers at specified times.

In the MCH centre, one assessor took the psychometric test and the second assessor collected information from the mother. Mostly, the mother and child were assessed simultaneously to prevent prompting or any other help from the mother. The principal investigator supervised the data collection and monitored over 90% of the interviews. Assessors followed standardized instructions to maintain the uniformity of procedures. Furthermore, to minimize intra-observer variability, interviewers were trained, cross-examined and briefed about the details of procedure on a weekly basis.

Statistical analyses

Descriptive statistics were used to summarize the demographic and socio-economic characteristics of our sample. All associations between the dependent variable and the family configuration and socio-economic status were analyzed, controlling for effect of age of the index child on the actual test scores.

Multivariate linear regression models were used to identify the individual effect of the family configuration and socio-economic status on the intellectual scores. Multicollinearity and interactions were duly checked. Finally, two models were fitted to test the theory of confluence in our setting. Statistical tests were performed at 5% level of significance. EpiInfo 6.0 and SPSS 11.0 were used for data analysis.

Reliability and validation of psychometric measurements

Content validity of the instrument is adequate as it was based on well-established literature, cultural relevance and was scientifically validated in Pakistan. Table 1 shows economic status, gender and age variables that were used for concurrent validation of the psychometric measurements based on our study sample. There were no significant gender differences in terms of the mean intellectual scores. In addition, the mean intellectual scores demonstrated an upward trend as age increased. The results shown in Table 1 support the concurrent validity of the psychometric measurements. The predictive validity could not be established due to an absence of a uniform national standard for annual assessment of these preschool children.

The reliability of cognitive assessment was estimated by examining the internal consistency of the items as shown in Table 2. Almost all the correlation coefficients between pairs of subsets are significantly associated, while the Cronbach's alpha for the overall test was 0.70.

Results

The mean age of the study sample was 55.34 months. Boys comprised 48% of our sample. The cognitive scores of the children had an approximate normal distribution with a mean of 24.36 and standard deviation of 6.37 (median: 25, mode:

Table 1: Concurrent validity: Psychometric assessment scores of the children's intellectual status

Variables	N (%)	Mean score	*SD**	*P value*
Per capita income (Rs.)				
I (166-1200)	26.4	22.17	7.31	<0.001
II (1201-2000)	27.0	24.28	6.14	
III (2001-3333)	25.2	24.79	6.89	
IV (3333-83333)	21.4	26.50	7.16	
Gender				
Boys	48.0	26.85	7.07	0.09
Girls	52.0	24.98	6.85	
Age (months)				
48-51	18.4	19.87	7.13	<0.001
52-54	20.5	22.19	6.43	
55-57	21.5	24.71	5.44	
58-60	24.3	27.48	6.08	
61-63	15.2	27.27	7.04	

*Standard deviation

Table 2: Inter-correlation coefficients between subtests and the total test scores of the children's intellectual status

Subtests	T1	T2	T3	T4	T5	T6	T7	T8
T1 Color naming								
T2 Reasoning	.25*							
T3 Seriation	.13*	.21*						
T4 Verbal memory	.14*	.25*	.15*					
T5 Pictorial memory	.11*	.13*	.09	.09				
T6 Perceptual motor tasks	.30*	.33*	.25*	.22*	.16*			
T7 1-1 correspondence	.17*	.23*	.11*	.14*	.07	.25*		
T8 Conversation	.42*	.47*	.24*	.31*	.16*	.40*	.20*	
Total test	.57*	.64*	.48*	.45*	.35*	.65*	.50*	.78*

*Correlation is significant at the 0.05 level (2-tailed), Cronbach's alpha for the overall test was 0.70.

27). Description of the key features of the family background and configuration are summarized in Tables 3a and 3b respectively.

Table 4 shows that among the family configuration variables, number of co-residents ($P < 0.05$) and the number of siblings, ($P < 0.01$), were significantly correlated with the intellectual scores. Socio-economic variables such as maternal education ($P < 0.01$) and father's occupation ($P < 0.01$), were significantly

Table 3a: Descriptive analysis of the family background variables

Family back ground	
Mother's education	
Up to 5 years (primary)	26 (8.20)
6-8 years (middle)	36 (10.50)
9-10 years (matric)	95 (27.80)
11 years and above (inter and above)	183 (53.50)
Working status of the mother	
Professional	47 (13.70)
Administration	7 (2.1)
Production	21 (6.10)
Housewife	262 (76.60)
Others	5 (1.5)
Father's education	
Up to 5 years (primary)	28.7(7.00)
6-8 years (middle)	25 (7.30)
9-10 years (matric)	104 (30.40)
11 years and above (inter and above)	189 (55.3.00)
Father's occupation	
Professional	35 (10.20)
Administration	77 (22.50)
Production	23 (6.70)
Sale	185 (54.10)
Others	22 (6.4)
House ownership	
No	80 (23.40)
Yes	262 (76.60)
Mode of transport	
Public	166 (48.50)
Private	174 (50.90)
Low per capita income*	
<Rs. 1500	123 (34.40)
≥Rs. 1500	227 (65.40)

*Based on the GNP i.e., 400$ per year or 1500 Pak Rupees per capita monthly income

Table 3b: Descriptive analysis of the home configuration variables

Variable	Mean	SD*
Household members	5.75	2.35
Number of siblings	1.35	0.81
Rank of the index child	1.93	0.90
Adjacent siblings birth interval in years	1.78	1.0

*Standard deviation

associated with the intellectual scores. Significant associations were also found between the poor economic class ($P<0.01$), house ownership ($P<0.01$), mode of family transport ($P<0.01$) and psychometric scores of the children.

Finally, the effects of family configuration on the intellectual score, while adjusting for socio-economic status, were assessed using multiple linear regression models [Table 5]. In the first model, child's sex, age, maternal education and the socio-economic status of the family were controlled. The effect of the number of siblings showed a significant negative association with the child's intellectual score, while the association between the number of co-residents and the intellectual scores was also statistically significant but positive. In the next model, when rank of the index child and birth interval between the index child and adjacent siblings were also introduced in the model, the effect of the number of co-residents and the number of siblings on the child's intellectual scores remained significant, showing robustness.

Discussion

The main finding observed in our study is that a direct association exists between the intellectual development of children and the number of co-residents in the family. To the best of our knowledge, the role of the extended family system on the cognitive development of children in the context of the theory of confluence of intelligence has not been investigated elsewhere.

The extended family setup in South Asia, commonly referred to as the "joint family" has a patri-focal ideology, as co-residents in the family are mainly paternal relatives; propinquity is not only physical, but also at a functional and emotional level.[20,25] These households are characterized by a high level of intergenerational-shared residence and exchange of knowledge and practice. The co-residents' role is central in terms of the availability of additional valuable support and assistance for the child's wellbeing in the family. For the most part, relatively younger members (aunts, cousins) are involved in the provision of extensive help and direct care of the child, while relatively older members (grandparents, uncles) are primarily of indirect help by providing affection to the child and giving relevant advice to the parents.[20] They have more free time to interact with the child resulting in emotional support, sensory stimulation and various learning experiences.[26-30]

As an additional support to this finding, most of the literature in South Asia reports mental health problems to be significantly

Table 4: Independent effect of various variables on the intellectual psychometric scores while controlling for the age of the child

Independent Variable	Effect of age	Effect of the independent variable	Adjusted R^2	*P*-value
Family size	0.70	0.14	0.17	0.36
Number of co–residents	0.70	0.32	0.18	0.04
Number of siblings	0.70	-1.29	0.19	0.00
Rank of the index child	0.69	-0.66	0.17	0.06
Birth interval between the index child and the adjacent elder child	0.73	0.17	0.17	0.48
Sex of the adjacent elder child	0.72	-0.72	0.17	0.44
Birth interval between the index child and the adjacent younger child	0.60	0.35	0.12	0.55
Sex of the adjacent younger child	0.63	-1.13	0.12	0.33
Mother's education				
Up to primary	0.70	-5.08	0.23	< 0.005
Middle		-4.31		< 0.005
Matric		-2.32		< 0.005
(ref = Inter and above)		1		
Maternal employment	0.69	-0.86	0.17	0.28
(ref = no)		1		
Mother's occupation				
Housewife	0.71	-2.57	0.19	0.01
Blue-collar job		-4.11		0.01
(ref = white-collar job)		*1*		
Father's education	0.72		0.20	
Up to primary		-3.93		0.01
Middle		-1.98		0.14
Matric		-1.94		0.12
(ref = Inter and above)		1		
Father's occupation				
Blue-collar job	0.70	-2.04	0.19	< 0.005
(ref = white-collar job)		1		
House ownership	0.69	-2.04	0.18	0.01
(ref = yes)		1		
Transport				
Public	0.71	-1.92	0.18	< 0.005
(ref = private)		1		
Poor economic class	0.69	-2.47	0.20	< 0.005
(ref = non poor)		1		

Table 5: Multivariate linear regression models relating the child's intellectual score against family configuration variables

Variables	Model 1*			Model 2**		
	Effect	95% CI	*P*-value	Effect	95% CI	*P*-value
Constant	-10.98	-17.33, -4.04	0.00	-12.27	-19.83,-6.67	0.00
Child's age	0.69	0.55, 0.85	0.00	0.71	0.55, 0.87	0.00
No. of co-residents	0. 37	0.06, 0.67	0.02	0.44	0.10, 0.71	0.01
No. of siblings	-0.92	-1.75, -0.08	0.03	-2.39	-3.29, -1.54	0.05

*Adjusted for child's sex and age, income class and mother's education, **Adjusted for child's sex and age, income class and mother's education, birth order of child and adjacent sibling birth intervals

less common in the extended family than in the nuclear family.[31,32] But it is important to note that there have been negative effects reported on the mental health of the mothers in extended family systems.[33]

Birth order showed a marginally significant effect ($P = 0.06$) on the intellectual development of a child in the bivariate analysis. When birth order was introduced in the multivariate model, this effect was diminished in the presence of age, socio-economic status and birth interval. However, the effect of the number of co-residents remained consistently positive for the cognitive status of the child. In literature, there are conflicting observations regarding the role of birth order on the intellectual status of the child.[10,12,34-36] Zajonc and Markus' confluence theory of intelligence argues that birth order effects are mediated through inter-sibling birth intervals and family size. If family size increases with decreasing inter-sibling intervals, then average intellectual environment decreases for children of later birth order and vice versa. The average family size in our study was 5.75 persons with a mean birth interval of 1.78 years. We have evaluated this potential interactive effect by including the relevant interaction term between the birth order

and other variables in the model but none of these interactions were found statistically significant. However, this could be due to large family sizes and relatively small immediate inter-sibling differences.

Our finding of an inverse relation between the intellectual development and the number of siblings, persistently demonstrated in the statistical models, is consistent with other studies.[37-41] It is interesting to note that number of children consistently has the opposite effect on the child cognitive development as compared to the number of co-residents. Additional children in a family might limit the amount of resources available. Furthermore, an increase in the number of children would also limit the amount of interactions with the adults. This could result in less sensory stimulation being available through interaction with mature family members. It seems that the number of siblings is a better variable for extended family configuration for predicting children's intellectual status as compared to the birth order and the inter-sibling interval. In addition, the effect of the number of siblings is markedly increased when confounding effect of the other two is controlled.

The child's home environment is influenced by the socio-economic status, which has many facets such as parental education, parental occupation and family income. Our finding of an association between the economic class and intellectual status of the child is consistent with other studies,[42-44] which argue that perhaps it translate into the provision of more intellectually stimulating materials for a child at home.[45] Being significant confounders for our primary hypothesis, these variables were controlled in all the three statistical models.

In summary, the purpose of this study was to apply and expand the theory of confluence of intelligence in a different setting; findings support that the theory is by and large valid in the extended family configuration. This relates to the important implication that since the proportion of mothers expected to join the labor force is increasing, the role of co-residents in providing an intact family social system of care for all members, especially children is expected to increase.[46] Currently, even in the West, extensive involvement of co-residents, in care-giving to the child, is a frequent observable phenomenon irrespective of the ethnicity or socio-economic differentials. Such significant demographic transition and socio-cultural change needs further exploration, especially in relation to elder co-residents and child development.[47]

Confluence theory does not address the interactions between the co-residents directly, consequently such evaluation was beyond the scope of the study. However, the study findings certainly provide impetus to the fact that the complex network of relationships and social bonds among the co-residents, index child, parents and siblings should be qualitatively explored in the context of the extended family system.[17,48] In addition, the quality of childcare provided by co-residents as compared to parental care requires further investigation.

It should also be kept in mind that our study was based on a cross-sectional design. Therefore, one should be careful in drawing inferences regarding the causality or temporality of the associations reported for which panel studies are more relevant. There are also certain assumptions and limitations in using the multivariate regression analysis in predicting a fleeting glance of a child's intellectual development, which is a constantly dynamic process,[12] while intellectual maturation takes a sigmoid function overtime.[14]

Acknowledgments

This research was supported by the Aga Khan University, Karachi, Pakistan and International Maternal and Child Health Research Training program from the Fogarty International Centre, USA. We take this opportunity to specially thank Dr. Camer W. Vellani (Distinguished Professor, The Aga Khan University), Dr. Thomas Martin (Professor, Department of Obstetrics and Gynaecology), Bushra Khan (Lecturer, University of Karachi), Dr. Riffat Moazzam Zaman (Associate Professor, Department of Psychiatry, The Aga Khan University), Dr. Saima Akhund (Fellow in Public Health, The Aga Khan University) and all other faculty and staff who have supported us in this research study.

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Conflict of Interest: None declared.