Prevalence and Factors Associated with Developmental Delays among Preschool Children in Saudi Arabia

Mokhtar M. Shatla [1,3 ¥]**, Reda A. Goweda** [2,3]

[1] Department of Family Medicine, Faculty of Medicine, Menoufia University, Menoufia, Egypt
[2] Department of Family Medicine, Faculty of Medicine, Suez Canal University, Ismailia, Egypt
[3] Department of Community Medicine, Faculty of Medicine, Umm Al-Qura University, Makkah, Saudi Arabia

Abstract

Background: Developmental delays (DDs) are increasing in prevalence and necessitate routine screening of young children for early recognition and management.

Objective(s): To estimate the prevalence of DDs among pre-school children and determine the risk factors associated with DDs in Makkah, Saudi Arabia.

Methods: This cross-sectional study involved a total of 948 children at the ages 36, 48, and 60 months. Data were collected using a modified Arabic version of the Ages and Stages Questionnaires, Third Edition (ASQ-3) to assess five domains of development (Gross Motor, Fine Motor, Language and Communication, Problem-Solving and Adaptive Behavior, and Personal and Social Performance). Parents' characteristics and risk factors related to DDs were included. The *p*-value was set at 0.05.

Results: Overall prevalence of children with DDs was 16.4%. The most prevailing DDs were the communication, problem solving, and personal/social skills (5.6%, 5.5% & 4.6% respectively). Lower rates of DDs were identified for fine motor, and gross motor milestones (1.9%, and 1.5% respectively). Binary logistic regression analysis revealed that artificial/complementary feeding before 6 months of age, narrow spacing between children (<3 years), preterm delivery, number of household children (>3), and lower level of maternal education were the most determining risk factors associated with DDs (OR=3.378; *p*=0.001, OR=2.554, *p*=0.018, OR=2.451; *p*=0.004, OR=2.074; *p*=0.037, and OR=1.832; *p*=0.016, respectively).

Conclusion: The study recognized a high prevalence of DDs especially for communication, problem solving, and personal/social skills. It spotted a number of modifiable risk factors, and recommended early screening of preschool children for prompt recognition and timely intervention.

Keywords: Developmental delays, pre-school children, prevalence, risk factors, KSA

INTRODUCTION

Generally, developmental delays (DDs) is a term used to describe a child who does not achieve normal milestones of developmental at the expected age, rather there is a delay in achievement of these milestones at a later age. A prevalence of 5 to 10% of the pediatric population with developmental delays has been estimated.[1]

There is an increasing need to identify children with DDs at an earlier age, with the current emphasis on young children.[2] In 2014, it was estimated that as low as 3% of child population received public intervention services by age below three years.[3] Risk factors for DDs include child male sex, perinatal problems, lower maternal education, and low family socioeconomic status.[4]

Delayed development can be limited to one domain of development (single milestone) or involving two or more domains.[5] The domains of development can be classified into four principal areas (Motor, Language and Communicative, Adaptive or Cognitive and Personal or Social).[5] In absence of routine screening, as low as 19% of children with DDs were recognized in their preschool age.[6] A recent randomized controlled trial identified that children who experienced routine developmental screening were more likely to have DDs recognized (23% to 26% vs. 13% of children not routinely screened; *p*<0.001) and received earlier assessment and intervention.[7]

Early detection of DDs and their risk factors is predominantly important for children who have risk factors, and permits for the timely application of interventions and management plans specific to the defect.[8]

The American Academy of Pediatrics (AAP) recommends screening for DDs (using standardized questionnaires) at each well child visit, and at least at three specific child ages (at nine, 18, and 24 or 30 months of age).[9] According to a report from the Centers for Disease Control and Prevention in 2011, less than half of pediatricians were utilizing a standardized development screening tool in their practice, half of parents assumed they were asked about their child's development, and only 21% of parents stated filling out a questionnaire.[10]

Apart from a study of the domain of language and social development on pre-school children in Eastern Saudi Arabia[11], and a recent, small, retrospective study including 134 children aged 1-9 years old, diagnosed with DDs to identify the risk factors for DDs[12], not much data is available about the DDs in the Gulf or Saudi populations. This study was conducted to estimate the prevalence of DDs among pre-school children living in Makkah, Saudi Arabia, and to determine the risk factors associated with DDs.

METHODS

This was a cross-sectional study conducted in Makkah, Saudi Arabia during the period from September to November 2019. A total of 948 children at the ages of 36, 48, and 60 months (±1 month) were included in the study. Children with chronic diseases, chronic use of cortisone, and those with serious pre-natal, natal, and/or post-natal medical problems that necessitated neonatal incubation in the intensive care unit (NICU) were excluded. Children incubated outside NICU e.g. for physiologic jaundice, were included in the study.

A sample size of 195 was calculated for each of the three age groups in the study (a sum of 585 for the three ages) using an appropriate statistical formula for estimating the minimum sample size in descriptive health studies [$n = Z2pq/d2$][13], where n= sample size, Z= confidence interval (CI), p=prevalence rate (in %), q=1-p, d=degree of precision. A confidence interval of 95%, and degree of precision set at 5% was used for calculation of the sample of the current study. The prevalence of developmental delay is expected at 10% to 15%, and the sample was calculated based on a prevalence of 15% for every age group in the study.[1] However, a total sample of 948 was included, distributed almost equally between the three age groups in the study, as described in table 1.

Situation of data collection

Attending parents were interviewed by standardized trained interviewers (undergraduate medical students) during their waiting for routine medical care at family medicine and well-baby clinics of 10 randomly selected primary care centers out of 79 in Makkah. An average of 100 questionnaires were collected from each primary care center. To ensure reliability of the answers of the questionnaire items, attending parent interview was the only method for data collection, as they are the care givers and intimate contacts of their children. Data for only one child per family were collected to allow for broader variability of parental factors.

Study tool

A modified Arabic version of the Ages and Stages Questionnaires, Third Edition (ASQ-3) was used.[14] The ASQ-3 includes 21 age-specific questionnaires that determine developmental progress in children between the ages of one month to 5 ½ years. Five domains of development were assessed (Gross Motor, Fine Motor, Language and Communication, Problem-Solving and Adaptive Behavior, and Personal and Social Performance). Each individual domain had six sub-domain items to evaluate specific skills. Each domain item was assessed in a pass/fail score, and an overall pass/fail score for the whole domain.[15]

The questionnaires also included a section of 9-questions to assess general parental variables including: maternal age, education, work, and father's education, and age, socioeconomic status of the family (monthly family income below average Saudi income of <14800 SR[16], and education at or below high school were classified as low socioeconomic status, while family income at or above average Saudi income of ≥14800 SR, and/or education higher than high schools were classified as moderate/high socioeconomic status), residency, presence of parental social conflict (divorce, separation without divorce, frequent apparent marital conflicts at home), spacing between children and number of household children.[13]

Review of literature revealed a set of variables that could relate to DDs.[4, 17] These have been added to the questionnaire and included: mode of delivery of the child (normal vaginal versus caesarian section), term of delivery (full term versus pre-term), post-natal incubation outside NICU, feeding (breast feeding versus artificial or complementary feeding), and child spending longer time daily on television and/or smart phones. A pilot study on 100 participants (10 participants from each primary care center involved in the study) was performed to ensure validity of the questionnaire items, through modification of the language of poorly and difficulty understood items and then re-introduced. The process continued until all items were readily understood by responders. The time needed for the questionnaire was 10 to 15 minutes for parents to complete, and one to three minutes for analysis and scoring.[13]

Statistical analysis

Data were analyzed using IBM advanced SPSS statistical package version 20. Numerical data were expressed in numbers and percentages. Chi-square test (Fisher's exact test) was used to examine the relation between qualitative variables. Binary logistic regression analysis was

performed to predict the odds of developing DDs based on the values of the independent variables the values of the independent variables(risk factors for DDs). The level of significance for all statistical tests was set at $p<0.05$.

Ethical considerations

The study was conducted after getting informed consent from child's parent after explaining the purpose of study. Current work researchers' contact information (phone numbers, and emails) were available to the participants who wish to return at any time for feedback. All data were solely used in the proposed research and confidentiality

was assured. The study was approved by the Medical Ethics and Research Committee of Umm Al-Qura Faculty of Medicine. Parents with children identified as having DDs were informed and advised to consult a specialist in the field of delay.

RESULTS

The present study included a total of 948 children distributed as follows: 310 (32.7%) at age 36 months, 302 (31.9%) at age 48 months, and 336 (35.4%) at age 60 months. There was 489 (51.6%) females, and 450 (48.4%) males (Table 1).

Table 1: Description of studied pre-school children

Variable		Pre-school children (n=948)
		No. (%)
Child characteristics		
Age (months)	36	310 (32.7)
	48	302 (31.9)
	60	336 (35.4)
Sex	Male	450 (47.5)
	Female	498 (52.5)
Child's term at delivery	Full term	671 (70.8)
	Preterm	277 (29.2)
Child's mode of delivery	Normal vaginal	588 (62)
	Caesarian	360 (38)
Post-natal incubation	Incubated	298 (31.4)
	Not incubated	650 (68.6)
Feeding first 6 months of life	Breast feeding	391 (41.2)
	Artificial/complementary	557 (58.8)
Spacing between children	≥3 years	309 (32.6)
	<3 years	639 (67.4)
Number of household children	≥3	464 (48.9)
	<3	484 (51.1)
Time spent on television/ smart phones	<1 hour/day	309 (32.6)
	≥1 hour/day	639 (67.4)
Parents characteristics		
Socioeconomic status of parents	Moderate/High	624 (65.8
	Low	324 (34.2
Residency	Urban	595 (62.8)
	Rural	353 (37.2)
Mother's age	<20	309 (32.6)
	≥20	639 (67.4)
Father's age	≥40	494 (52.1)
	<40	454 (47.9)
Father's education	University or equal	522 (55.1)
	Below university	426 (44.9)
Mother's education	University or equal	460 (48.5)
	Below university	488 (51.5)
Mother's work	Working	506 (53.4)
	House wife	442 (46.6)
Social conflict between parents	Yes	640 (67.5)
	No	308 (32.5)

As shown in table 2, the overall prevalence of DDs was 16.4%. The most prevailing DDs recognized by the current study were the communication, problem solving, and personal/social skills with rate of 5.6%, 5.5%, and 4.6% respectively. Lower rates of DDs were detected for fine motor, and gross motor milestones (1.9%, and 1.5% respectively). Out of the overall prevalence of DDs, combined developmental delays occurred in 2.7% of children as follows: 1.1% for communication and problem solving, 0.9% for problem solving and personal/social, and 0.7% for communication and personal/social development.

As demonstrated in table 3, 67 (21.6%) of children at age 36 months had DDs, representing the highest prevalence of DDs among studied ages, while 42 (13.9%) of children at age 48 months had DDs, and 46 (13.7%) of children at age 60 months had DDs. Table 3 as well reveals the significant statistical association between DDs and the following factors: younger mother's age below 20 years ($p<0.001$), lower maternal education ($p=0.019$), lower family socioeconomic status ($p=0.006$), rural residency ($p=0.041$), narrow spacing between children below 3 years ($p<0.001$), number of household children > three ($p=0.021$), pre-term

delivery ($p<0.001$), post-natal incubation ($p<0.001$), early artificial or complementary feeding ($p<0.001$), presence of social conflicts within the family ($p<0.001$), and spending >one hour daily on television or smart phones ($p<0.001$), while there was no association between male child sex, mother's work, father's age and education and the presence of DDs ($p=0.045$, $p=0.354$, $p=0.507$, and $p=0.345$ respectively).

Table 2: Prevalence of different developmental delays among pre-school children

Domains	Developmental delays among pre-school children (n= 948)
	No. (%)
Communication & Language	36 (3.8)
Problem Solving	33 (3.5)
Personal/Social	28 (3)
Fine Motor	18 (1.9)
Gross Motor	14 (1.5)
Communication & Language + Problem Solving	10 (1.1)
Problem Solving + Personal/Social	9 (0.9)
Communication + Personal/ Social	7 (0.7)
Overall developmental delays	155 (16.4)

Table 3: Distribution of developmental delays of pre-school children according to child's and parents' characteristics

		Developmental Delay		Total	p value
		Yes No. (%)	No No. (%)		
Child characteristics					
Age (months)	36	67 (21.6)	243 (78.4)	310	0.009
	48	42 (13.9)%	260 (86.1)	302	
	60	46 (13.7%)	290 (86.3)	336	
Sex	Male	85 (18.9)	365 (81.1)	450	0.045
	Female	70 (14.1)	428 (85.9)	498	
Child's term at delivery	Full term	52 (7.7)	619 (92.3)	671	0.001
	Preterm	103 (37.2)	174 (62.8)	277	
Child's mode of delivery	Normal vaginal	51 (8.7)	537 (91.3)	588	0.001
	Caesarian	104 (28.9)	256 (71.1)	360	
Post-natal incubation	Incubated	106 (35.6)	192 (64.4)	298	0.001
	Not incubated	49 (7.5)	601 (92.5)	650	
Feeding first 6 months of life (artificial/ complementary feeding)	Breast feeding	24 (6.1)	367 (93.9)	391	0.001
	Artificial/complementary	131 (23.5)	426 (76.5)	557	
Spacing between children	<3 years	107 (34.6)	202 (65.4)	309	0.001
	≥3 years	48 (7.5)	591 (92.5)	639	
Number of household children	≥3	89 (19.2)	375 (80.8)	464	0.021
	<3	66 (13.6)	418 (86.4)	484	
Time spent on television/ smart phones	<1 hour/day	107 (34.6)	202 (65.4)	309	0.001
	≥1 hour/day	48 (7.5)	591 (92.5)	639	
Parents characteristics:					
Socioeconomic status of parents	Moderate/High	85 (13.6)	539 (86.4)	624	0.002
	Low	70 (21.6)	254 (78.4)	324	
Residency	Urban	42 (11.9)	311 (88.1)	353	0.004
	Rural	113 (19.0)	482 (81.0)	595	
Mother's age	<20	48 (7.5)	591(92.5)	591	0.001
	≥20	107 (34.6)	202 (65.4)	309	
Father's age	≥40	78 (17.2)	376 (82.8)	454	0.507
	<40	77 (15.6)	417 (84.4)	494	
Father's education	University or equal	80 (15.3)	442 (84.7)	522	0.345
	Below university	75 (17.6)	351 (82.4)	426	
Mother's education	University or equal	62 (13.4)	394 (80.9)	487	0.019
	Below university	93 (19.1)	399 (86.6)	461	
Mother's work	Working	88 (17.4)	418 (82.6)	506	0.354
	House wife	67 (15.2)	375 (84.8)	442	
Social conflict between parents	Yes	87 (28.2)	221 (71.8)	308	0.001
	No	68 (10.6)	572 (89.4)	640	

Table 4 shows the logistic regression analysis of the factors associated with DDs. It revealed that artificial/complementary feeding before 6 months of age, narrow spacing between children (<3 years), preterm delivery, number of household children (>3), and lower level of maternal education were the most determining risk factors associated with DDs (OR=3.378; p=0.001, OR=2.554, p=0.018, OR=2.451; p=0.004, OR=2.074; p=0.037, and OR=1.832; p=0.016, respectively). Lower socioeconomic status

of parents and child male sex were associated with recognizable risk for DDs (OR=1.195; p=0.001, OR=1.050; p=0.032, respectively). Younger children, at the age of 36 months, were at higher risk for DDs compared to older children, at the age of 60 months (OR=0.891; p=0.041). Delivery by caesarian section, post-natal incubation, mother's age and work, father's age and work, and social conflict between parents were not associated with increased risk for DDs (p>0.05).

Table 4: Logistic regression analysis of the risk factors for developmental delays among pre-school children

Factor		Odds Ratio	p-value	95% Confidence Interval (C.I.)	
				Lower limit	Upper limit
Child factors:					
Child's age	36 months	0.891	0.041	1.035	5.737
	48 months	0.007	0.987	0.438	2.313
Child's sex (male)		1.050	0.032	0.854	1.586
Child's term at delivery (preterm)		2.451	0.004	0.722	86.556
Child's mode of delivery (caesarian section)		4.305	0.084	0.001	0.245
Post-natal incubation		0.614	0.469	0.351	9.739
Feeding first 6 months of life (artificial/ complementary feeding)		3.378	0.001	10.144	84.710
Spacing between children (<3 years)		2.554	0.018	0.368	8.683
Number of household children (>3)		2.074	0.037	22.258	98.652
Time spent on television/ smart phones >1 hours/ day		1.011	0.026	28.236	72.578
Parents factors:					
Mother's age (<20 years)		2.193	0.21	4.236	18.409
Father's age (>40)		1.471	0.191	0.025	2.084
Socioeconomic status of parents (low)		1.195	0.001	0.161	0.568
Residency (rural)		0.430	0.031	0.492	4.804
Mother's education (low)		1.832	0.016	0.009	0.073
Father's education (low)		0.276	0.322	0.763	2.277
Mother's work		1.021	0.113	0.787	9.594
Social conflict between parents		19.895	0.997	0.624	29.346

DISCUSSION

The prevalence of children with DDs in the present study was 16.4%. A wide variation in the prevalence of DDs throughout the world ranging from 1.5% to 19.8% has been reported.[18-20] This could be attributed to the use of diverse tools for evaluating development, and studies being led in different societies. In the United States, the prevalence of any type of DDs is estimated at 15%.[21]

The World Health Organization (WHO) reported a prevalence of 17% in Senegal, 15% in Nigeria, 13% in India and 24% in Brazil.[22] Other studies reported prevalence of 11.8% and 16.2%.[23, 24] In the current study, among developmental domains, most evolutionary fields were related to the areas of communication/language, problem solving, and personal/social skills, with percentages of 5.6%, 5.5%, and 4.6% respectively. A high prevalence of communication/language, and personal/social delay was demonstrated by a recent cross sectional study in the eastern province, Saudi Arabia.[11] The higher percentages of DDs in these domains might be due the superficial exposure and contact of children with

others because of the nature of conservative society. This finding is in agreement with another study[24] which found that most DDs were related to the areas of problem solving and fine motor. In Iraq, Darreh et al., studied the development of children below the age five with history of admission to neonatal intensive care unit (NICU). They used ASQ2 in 5 domains of development (communication, fine motor, gross motor, problem solving and personal-social skills), respectively, 20.2%, 19.3%, 17.5%, 8.8% and 16.7% of children with DDs were detected.[25] The presenting study excluded children with history of pre-natal, natal, and post-natal problems necessitating NICU admissions.

A study by Zhang et al., revealed that rural children under 3 years of age had 35.7% suspected DDs, and among children in the first year of life, 17%–20% of them had delay in the communication, problem-solving, personal-social and gross motor domains, and almost as high as 30% of them had delay in fine motor development.[26] Despite similarities between their study and the current study as regard the increased risk for DDs among rural children, and children at younger ages, the big

difference regarding the higher overall rate of DDs is that they conducted their study exclusively in rural area and involved children under the age of 36 months. Results from a study by Sharma et al., indicated that cognitive delay has been detected in 20% of children, while social delay was detected in (8.9%) of children. A possible explanation of these findings might be that the study was conducted in a rural area, where parent's education and socio-economic level is low, and they do not possess sufficient awareness about the importance of cognitive skills, rendering them with limited ability to induce learning skills in their children.[18]

The literature review revealed that the risk factors for DDs include male sex, lower socioeconomic status, and lower level of maternal education.[4, 27] Premature birth (<37 gestation weeks) in the current study was associated with DDs in agreement with other studies that reported DDs among preterm children and the risk increases with a decreasing gestational age.[28, 29] However, prematurity was not a risk factor in a study by Yaghini et al.,[24] Children at age 36 months, and child male sex were identified as significant risk factors for DDs by the current study, similar to findings revealed by Al-Fadhli, and Al-Bunaian in the Eastern Province, Saudi Arabia.[11]

On looking for the other factors associated with DDs, the present study is in contrary of previous work[30-32] that stated no relationship between sex and DDs. However, other studies[28, 33, 34], in agreement with our findings, have identified male sex as a risk factor of having DDs. In the current study, mother's lower education was significantly associated with DDs, in agreement with previous studies.[35-37] However, the findings of Valla et. al. are in contradiction with these results.[38] It has been evidenced that parent's education and mother's vocabulary are among the strong predictors for cognitive development in children.[39, 40]

Having children more than three in the family poses a higher risk of developing social and cognitive delay in the current study which was supported by the work of Alvik and colleague[41] that reported a significant association between increased number of children in the family and delayed fine motor skills and children with older siblings having low intelligent question (IQ) scores. Similar finding was reported by a cross sectional study in Al-Madinah, Saudi Arabia.[42] The reason might be that parents were unable to focus on one child completely.

The current study revealed that mode of delivery, caesarian section compared to normal vaginal delivery, was not associated with increased risk for DDs, a finding consistent with previous studies.[43, 44]

On evaluation of breastfeeding factor which was demonstrated as the most determining factor for DDs by the current study, many literature described the protective effect of two fatty acids present in breast milk; the docosahexaenoic acid and arachidonic acid, on the development of nerves, brain, and retina.[45] Breast feeding was demonstrated as promoting normal oral-facial development, and improves coordination of the mouth, lips, and tongue and jaw muscles.[46, 47, 48]

In the present study, parents with a higher level of education and a higher socioeconomic level had a positive effect on child development. Former studies have examined associations between socio-demographic characters of parents and child development, e.g. a cohort study in Brazil and a population-based study in Argentina revealed that parental poverty and lower maternal education level were significantly associated with later achievement of specific developmental milestones, and delayed cognitive and motor development.[49, 50] Similar findings were reported by a cross sectional study in Al-Madinah, Saudi Arabia.[42]

The present study showed an increased risk for DDs among rural compared to urban children, a finding reported by previous studies.[18, 26] Children lasting long on smartphones, electronic tablets and television were at a significant risk for developing DDs in the current study, parallel to a finding in a recent study in Saudi Arabia.[11] Fathers' educational level was not associated with increased risk for DDs in the current study, in contrast to a significant risk reported in another study.[24]

CONCLUSION AND RECOMMENDATIONS

The current study revealed 16.4% prevalence of developmental delays among pre-school children, where the communication, problem solving and personal/social developmental domains were the mostly affected milestones. A number of modifiable risk factors for DDs have been recognized including early artificial/complementary feeding, narrow spacing between children, higher number of household children and lower maternal level of education. The study recommended early screening of children using standardized assessment tools to assess development and identify those children with DDs for early intervention and timely management.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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