

Explanatory factors of the psychomotor development of infants aged 1-24 months in N'Djamena (Chad)

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Abstract

Introduction: Psychomotor development (PMD) reflects the cerebral maturation through sensory, motor and psychological acquisitions of an individual. Its evaluation allows an early diagnosis of delays in order to take care of them. The objective of this study was to determine the profile and explanatory factors of PMD of infants in N'Djamena.

Methods: This was a cross-sectional study conducted at the “Notre Dame des Apôtres” Hospital in N'Djamena. It involved 428 infants aged 1 to 24 months received in preventive consultation between October 2017 and June 2018. The Denver II scale was used for the assessment of PMD. Data were analyzed with SPSS 21.0 software.

Results: the sex ratio was 1.06. The most represented age group was under 3 months (35.5%). The items of gross motor skills were 95% completed, fine motor skills 93.8%, language 84.6% and sociability 68.8% at the 90th percentile. Development was advanced in 56.8% normal in 32.1% and delayed in 2.1%. Statistically significant differences in PMD were observed according to age group ($p= 0.000$), vaccination status ($p= 0.002$), feeding mode ($p= 0.000$), maternal exchange ($p= 0.000$) and pregnancy follow-up ($p= 0.03$).

Conclusion: The psychomotor development of N'Djamenese infants is similar to that of other African children, although some variations are noted. It is influenced by certain factors related to the infant and the mother.

Keywords: Psychomotor development; Infant; Explanatory factors; N'Djamena - Chad

1. Introduction

Psychomotor development (DPM) is the cerebral maturation of the brain through sensory, motor and psychological acquisitions of an individual. This process begins at conception in utero and continues beyond birth through specific stages [1]. For its follow-up throughout the child's growth to determine the normal psychomotor development evolution and to detect the related delays at an earlier stage, several evaluation tools have been set up, including that of Denver II tool [2]. It is Easy to use and has been proposed and adopted by many countries. Thus, many African authors have used it to evaluate the PMD of African children [1, 3, 4]. Data on the psychomotricity of the Chadian children are rare.

PMD varies from child to another, from one socio-cultural condition to another. The living environment and culture have an impact on psychomotor development [5-7]. It is influenced by intrinsic factors (brain maturation, genetics,

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endocrine) and by extrinsic factors (nutritional and psycho-affective) [8]. Knowing the profile of the PMD of the infants as well as the explanatory factors will improve psychomotricity by and early management of delays, hence the present study which aims to determine the profile and explanatory factors of PMD of the infants from 1 to 24 months in preventive consultation in N'Djamena.

2. Material and methods

2.1. Study design and study population

The study was conducted in the preventive consultation unit of the “Notre Dame des Apôtres” Hospital in N'Djamena in the N'Djamena South health district . This was a cross-sectional study conducted over the period from October 2017 to June 2018. It concerned infants aged 1 to 24 months received in preventive consultation within the health facility during the study period. Infants born at full term, to Chadian parents, with a birth weight of at least 2500g whose parent agreed to participate in the study were included in the survey . Those with a progressive pathology or having a history of perinatal asphyxia, meningitis, cerebral trauma, low birth weight were not included.

All infants meeting the inclusion criteria were recruited consecutively during the study period. A corresponding sample of 428 infants was thus obtained at the end of the survey.

2.2. Collection of data

The data were collected on a pre-established collection form which included the variables related to the infant (age in months determined from the exact date of birth, sex, vaccination status, mode of care, mode of feeding), variables related to the mother (profession, level of education, marital status, maternal exchange, prenatal consultation), variables related to the infant's psychomotor development. They were obtained from the questioning of the mother and from the infant's punctual examination as regards psychomotor development. In order to control the memorization bias, previous acquisitions were not searched. The psychomotor development of the infant was evaluated using the Denver II criteria comprising 125 items, 65 of which correspond to the age range of 1 to 24 months divided into four axes: gross motor skills, fine motor skills, language and social contact [6, 9]. The assessment was carried out by the same person using the Denver II technique according to the child's age.

2.3. Ethics

The favourable opinion of the ethics committee of the Faculty of Human Health Sciences of the University of N'Djamena, the authorization of the management of the “ Notre Dame des Apôtres” hospital and the verbal consent of the mothers have been obtained for the study . The data collected remained confidential.

2.4. Statistical analyzes

The collected data was entered and analyzed using SPSS version 21.0 software. For each psychomotor development item, the proportion of children passing the item, the mean age of acquisition and 95% confidence interval were calculated. This age was compared to that defined by the Denver II tool. Differences were defined by a Denver II baseline age above (advanced) or below (delayed) the bounds of the 95% confidence interval. For the search for explanatory factors, the chi-square test was used to compare the proportions of the different groups defined by child and maternal characteristics with a significance level $p < 0.05$.

3. Results

Of the 428 infants evaluated, 51.6% were male and 48.4% were female. The sex ratio was 1.06. The vaccination schedule was up to date in 91.4% of cases. The age group of 1 to 3 months was the most represented (35.5%) ; breastfeeding represented 62.8% of feeding methods ; the mother was the primary caregiver of the infant (74.8%) and the maternal exchange was represented mainly by play (54%) (Table 1).

Mothers were married in 94.6% of cases, divorced in 3.1% of cases and single in 2.3% of cases. They were uneducated in 8.1% of cases, primary school in 9.7%, secondary school in 47.6% and higher education in 36.6% of cases. Among them, pupils and students represented 37.6%, housewives 36.2%, civil servants 16.4%, shopkeepers 6.5% and hairdressers 3.3%.

Table 1 Characteristics of infants assessed (N = 428)

Characteristics	n	%
Age range (months)		
[1-3]	152	35.5
[3-5]	108	25.2
[5-8]	42	9.8
[8-11]	60	14.1
[11-13]	16	3.7
[13-19]	29	6.8
[10-25]	21	4.9
Supply mode		
Exclusive breast milk	7	1.6
Milk substitute	2	0.5
Mixed breastfeeding	269	62.8
Diversification	121	28.3
Family meal	29	6.8
Child care		
Mother	320	74.8
Grandma	38	8.9
Nurse	29	6.8
Daycare	10	2.3
Other	31	7.2
Maternal exchange		
No	4	0.9
Grimace	44	10.3
Cuddle	106	24.8
Game	231	54
Smile	26	6
Songs	17	4

3.1. Profile of psychomotor development

The 428 infants assessed achieved 95% on gross motor skills, 93.8% on fine motor skills, 84.6% on language and 68.8% on social skills at the 90th percentile. Fifty-six point eight percent (56.8%) were advanced, 32.1% were normal, and 2.1% were delayed. The average ages of acquisition of the various items are presented in Tables 2 and 3.

Table 2 Distribution of infants by mean age of acquisition of gross motor and fine motor items of the 90th percentile

Gross motor skills	Age	Fine motor skills	Age
Raise head	1.4	Follow at 90°	0.68
Head at 90°	1.24	Exceeding 90°	0.76
Pull to sit	3.57	Palpated hands	3.22
Prone, leaning forward	3.62	Follow at 180°	2.93
Sitting with a stable head	3.2	Catches rattle	2.93
Rolls on itself	3.55	Look pastille	3.04
Sitting on leg	4.03	Trying to catch an object	6.00
Sitting without support	6.5	Passes from one hand to another	6.03
Standing with support	9.56	Take to cubes together	7.07

Rises	7.94	Thumb finger pliers	8.26
Sits down	8.7	Tap to cubes together	10.23
Stand up for a few moment	9.84	Pinch grip	9.92
Standing without support	10.31	Tour of two cubes	20.16
Bends over, straightens up	9.07	Demonstration tablet	18.55
Walk well	13.47	Scribbler	21.11
Walking backwards	16.15	Tower of four cubes	23.6
Climb stairs	20.08		
Run	17.72		
Shoot ball	21.79		
Throw the ball	22.79		

Table 3 Distribution of infants by mean age of acquisition of language and sociability items at the 90th percentile

Language	Age	Sociability	Age
Reacts to the bell	1.24	Stare	1.26
Vocalise	2.29	Answer smile	2.29
Laught	2.93	Spontaneous smile	3.56
Chirp	2.93	Eat cookie alone	5.85
Turns to a voice	2.94	Fetches an object out of waiting	8.61
Daddy mommy non-specific	8.82	Hello there	9.27
Jargon	8.82	Opposes the removal of an object	10.94
Daddy specific mommy	13.11	Shy with stranger	10.91
3 other words	16.77	Does well	14.45
Shows body part	18.33	Indicates what they want	13.25
Match two words	20.33	Plays ball with examiner	16.41
Shows picture	22.87	Drinks from a cup	16.64
Follows simple order	22.91	Imitates simple housekeeping gesture	15.07
		Takes off clothes	19.50
		Uses spoon properly	22.07
		Simple household help	20.07

3.2. Explanatory factors of psychomotor development

Statistically significant differences in PMD were observed for some characteristics of the study population: age groups ($p = 0.000$), vaccination status ($p = 0.002$), feeding mode ($p = 0.000$), maternal exchange ($p = 0.000$) and pregnancy follow-up ($p = 0.03$). There were no significant differences by infant sex, education, marital status or maternal occupation. The main results are presented in Tables 4 and 5.

Table 4 Psychomotor skills of infants by main characteristics

Characteristics	PMD			p
	Advanced	Normal	Delay	
Sex				
Male	135 (61.1%)	81 (36.6%)	5 (2.3%)	>0.05
Female	132 (63.8%)	70 (33.8%)	5 (2.4%)	
Age range (months)				
[1-3[	73 (48%)	79 (52%)	0	0.000
[3-5[	87 (80.5%)	21 (19.5%)	0	
[5-8[	33 (78.5%)	9 (21.5%)	0	
[8-11[	49 (81.8%)	7 (11,6%)	4 (6.6%)	
[11-13[	9 (56.2%)	4 (25%)	3 (18.8%)	
[13-19[	13 (44.8%)	13 (44.8%)	3 (10.4%)	
[10-25[	3 (14.3%)	18 (85.7%)	0	
Vaccination schedule				
Not up to date	21 (56.8%)	12 (32.4%)	4 (10.8%)	0.002
Up to date	246 (63%)	139 (35.5%)	6 (1.5%)	
Supply mode				
Exclusive breast milk	5 (71.4%)	2 (28.6%)	0	
Milk substitute	0	2 (100%)	0	
Mixed breastfeeding	170 (63.2%)	99 (36.8%)	0	
Diversification	86 (71%)	25 (20.7%)	10 (8.3%)	
Family meal	6 (20.7%)	23 (79.3%)	0	
Child care				
Mother	196 (61.8%)	116 (36.3%)	8 (2.5%)	>0.05
Grandma	30 (79%)	7 (18.4%)	1 (2.6%)	
Nurse	17 (58.6%)	11 (38%)	1 (3.4%)	
Daycare	2 (20%)	8 (80%)	0	
Other	22 (71%)	9 (29%)	0	
Maternal exchange				
No	2 (50%)	1 (25%)	1 (25%)	0,000
Grimace	30 (68.2%)	14 (31.8%)	0	
Cuddle	46 (43.4%)	60 (56.6%)	0	
Game	154 (66.6%)	69 (29.9%)	8(3.5%)	
Smile	21 (80.8%)	5 (19.2%)	0	
Songs	14 (82.3%)	2 (11.8%)	1 (5.9%)	

Table 5 Psychomotor skills of infants by maternal characteristics (N = 428)

Caracteristics	PMD			p
	Advanced	Normal	Delay	
Mother's occupation				>0.05
Civil servant	46 (65.7%)	23 (32.9%)	1 (1.4%)	
Shopkeeper	15 (53.6%)	13 (46.4%)	0	
Housewife	98 (63.2%)	49 (31.6%)	8 (5.2%)	
Students	99 (61.5%)	61 (37.9%)	1 (0.6%)	
Hairdresser	9 (64.3%)	5 (35.7%)	0	
Level of education				>0.05
Uneducated	18 (51.4%)	14 (40%)	3 (8.6%)	
Primary	26 (63.4%)	15 (36.6%)	0	
Secondary	124 (60.8%)	76 (37.2%)	4 (2%)	
Higher	99 (66.9%)	46 (31.1%)	3 (2%)	
				>0.05
Marital status				
Single	6 (60%)	4 (40%)	0	
Married	254 (62.7%)	141 (34.8%)	10 (2.5%)	
Divorced	7 (53.8%)	6 (46.2%)	0	
Pregnancy follow-up				0.03
No	20 (58.8%)	11 (32.4%)	3 (8.8%)	
Yes	247 (62.7%)	140 (35.5%)	7 (1.8%)	

4. Discussion

The Denver II scale was used to determine the age of acquisition of the 65 items along the four developmental axes. The infants evaluated achieved gross motor skills items at 95%, fine motor skills at 93.75%, language at 84.61% and sociability at 68.75% at the 90th percentile. PMD was advanced in 56.8%, normal in 32.1%, and delayed in 2.1% of cases.

The gross motor and fine motor skills items were performed before the age defined by Denver II. Of the 20 gross motor skills items, only supported standing was performed 1.06 months behind the Denver II subjects. The Infants sat with their head steady at 3.2 months; they stood without support at 10.31 months. An advance was also observed compared to the results obtained by Gonzales in Mexico with regard to sitting with a stable head and standing without support [10]. Our results are close to those reported by Nguéfac and al with an advance over the standing item without support and a delay in running [4]. Sylla and al. in Mali in 2007 had shown that Malian infants sat with a stable head at 3.1 months, sat without support at 6.6 months, and stood alone at 9.1 months [1]. The precocity of the motor skills of the African subject evoked by Falade in Senegal in 1955 [3] and Geber in 1958 [1 1] could explain the results observed in the present study. This precocity is would be due to an advance in neurological maturation from birth [12], a large family which would participate in psychomotricity , kinesthetic stimulation favoured by massage and by carrying on the back [5, 13].

In terms of language, the N'Djamense infants were ahead of those in Mexico and Cameroon [4, 10]. They laughed at 2.93 months, pronouncing mum and dad non-specifically at 8.82 months, and mum and dad specifically at 13.11 months.

Our results are similar to those of Sylla and al in Mali who had early language [1]. Our results as those of other African researchers could be explained by the importance of language in African culture underlined by Brill [5].

With regard to sociability, N'Djamense infants smiled spontaneously at 3.56 months of age, waved at 14.45 months and said what they wanted at 13.25 months. They lag behind Denver II standards where subjects were smiled at 2.1 months, nodded at 12.9 months, and said what they wanted at 14 months. Our results also differ from those of Gonzalez and al (2013) for whom, infants doing bravo at 13.5 months and indicating what they wanted at 12.8 months [10]. They are also late compared to those in Cameroon who did well at 10.5 months and indicated what they wanted at 12.6 months [4].

some factors related to both mother and infant have a significant influence on the infant's psychomotor skills, while in other cases, the statistical difference is not significant as reported by other authors. In the present study, the sex of the infant has no influence on psychomotricity as reported by Bryant and al in England who proved that there is no difference between the 2 sexes in PMD of infants from 2 weeks to 12 months [14]. Delayed PMD was observed in some infants from 8 months of age with a significant difference compared to other age groups. Bryant and al in England had shown that before 18 months English infants could show a delay in gross and fine motor skills [14]. In our context, this difference could be explained by the age of dietary diversification and probably by other associated factors. Infant's immunization status, feeding mode, and maternal exchange were other explanatory factors for difference in PMD found in the present study. Delayed PMD was observed in 10.8% of infants with out-of-date immunization schedule and all delays were observed only in infants under dietary diversification. This could be explained by a poor conduct of the infant's food diversification while his digestive tract is not mature as mentioned by Brill [5] as well as Sylla and al [1]. The importance of games and exchanges in psychomotricity mentioned by Brill et al [5] was also highlighted in the present study.

No significant difference in DPM was observed according to the mode of care of the infant. The same is true for the mother's occupation, her level of education and her marital status as reported by other authors [1]. In England, Argentina, and Mexico it has been shown that before the age of two years the profession of the mother does not influence the PMD because the children are treated in the same way [10, 14, 15]. In Tehran, some authors state that there is no clinically proven difference between gross motor skills and maternal education level [16]. In Cameroon, the lower the level of education, the more infants performed on fine motor skills items [4]. From the age of 3, Duimazlar and al in Turkey reported that the high level of education of mothers promotes language acquisition [17].

Another factor that may explain the differences in PMD in the present study is the non-monitoring of pregnancy.

5. Conclusion

The N'Djamense infants have psychomotor skills that meet international standards. Their development was normal or advanced in the majority of cases. The infant's age, mode of feeding, vaccination status, maternal exchange and the follow-up of the pregnancy have a significant influence on their psychomotor skills. There is no significant difference in psychomotricity according to the infant's sex, the mother's education level, the mother's occupation and the childcare mode.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

There are no conflicts of interest in connection with this paper.

Statement of ethical approval

The favorable opinion of the ethics committee of the Faculty of Human Health Sciences of the University of N'Djamena, the authorization of the management of the "Notre Dame des Apôtres" hospital have been obtained.

Statement of informed consent

Informed parental consent was obtained for all participants included in this study.

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