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PROFESSIONAL ACTIVITIES OF MOTHER STATE OFFICIALS AND THE OVERALL MOTOR DEVELOPMENT OF 315 BENIN NEWBORNS DURING THEIR FIRST 14 MONTHS OF LIFE

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ABSTRACT

Background. Infant motor development is an early and sensitive indicator of neurological maturation and the quality of the care environment. While the World Health Organization (WHO) has established international normative windows for the acquisition of key motor milestones, several family and socio-professional factors, still poorly documented in Benin, could influence this timeline, particularly the mother's professional activity and childcare arrangements during working hours.

Method: This is a longitudinal study of 315 female civil servants and their newborns aged 1 to 7 days. The newborns were distributed according to the professional activity of the mother. and all the different data of the stages of the development of the overall motor were observed, noted and analyzed.

Results: Motor development varies according to the mother's professional activity. the motor development of newborns of female civil servants is lower than that of newborns of women not exercising any activity whatever the stage of motor development because all $p < 0.05$. the comparison of the trajectory of motor development in newborns is similar to those of the control group during the period of maternity leave because $p > 0.05$. And the comparison during the mother's labor period is lower than that of the control group because $p < 0.05$. There is a strong correlation between

the motor development of newborns and the professional activity of the mothers (Pearson's correlation r varies between 0.82 and 0.98).

Conclusion: The motor development of newborns depends on the socio-professional activity of the mother.

Keywords: Newborns; Professional activities; Mother state officials; Motor development; Bénin

1 INTRODUCTION

Motor development according to Rigal [1], is the natural and continuous appearance and evolution of species-specific motor functions, by interaction between genetic and environmental factors. It is also the set of phenomena that participate in the progressive transformation of the human being from conception to adulthood [2]. This development is taking place through two laws. The first is the proximo-distal law and the second is the cephalo-caudal law. According to the proximi-distal law of development, voluntary motor control of muscle masses occurs from the muscle masses closest to the trunk to the most distant limbs. This is how the child will have motor control of the muscles of the arm before those of the forearm and hands. According to the law of cephalo-caudal development voluntary motor control takes place along the spine [3-4].

In Africa and more particularly in Benin, many are these women who work to meet their needs and those of the household. Others even represent the parent who bears nearly all of the household burdens. Among these women, there are those who work for themselves and others who work for the state. Women civil servants have work constraints (workload, work demands, etc.) and are constantly under stress. And it is under these conditions that they have the heavy responsibility of raising newborn babies. In addition, the period of maternity leave granted to them for some is insignificant enough to meet the childcare requirements of children.

According to several authors, environmental elements (parental attitudes, body care, etc.) can influence this motor development in infants. That is, how to dress them, transport them, bathe them, feed them and even put them to sleep [5,6]. However, in Benin, mothers already in the month of the baby's birth for some and two months after for others, must begin their socio-professional income-generating activities to meet their needs and those of their offspring. This state of affairs forces mothers to leave children to others during working time. This situation is more complicated among female civil servants because of the constraints and demands of the job. We then ask ourselves the question of whether the professional activities of mothers who are civil servants can significantly influence the motor development of newborns ?

To answer this question, we set ourselves the objective of studying the motor development of 315 Beninese newborns according to the professional activity of their mothers.

2 MATERIAL AND METHODS

This is a longitudinal study carried out in the departments of Atacora, Donga, Mono and Ouémé (Republic of Benin). This study began in March 2015 and ended in December 2019. The Biomechanics and Performance Laboratory of the National Institute of Youth, Physical Education and Sport (INJEPS), the health centers of Attakè, Comè, Dangbo, Birni, Chabi Kouma, Copargo, Ouaké and Sèmèrè served as a support framework for the experimentation which lasted fifteen (15) months. The departments and communes were chosen by the simple random technique, from the official list of Law No. 97-028 of January 15, 1999 on the organization of the territorial administration of the Republic of Benin. In the municipalities, the choice of health centers was made at random. Two health centers were chosen in each department except that of Mono where only one was retained.

For this study, we observed and recorded on a card all the motor behaviors of infants each month until the latter began to walk on their own. The recruitment of term newborns and the experiments were carried out simultaneously during the 58 months of the study.

The study concerned a group of 315 term newborns of one (1) to seven (7) days declared apparently healthy by the head doctors of these health centers, regularly vaccinated, having had a body mass at birth of between 2500 g and 3500 g, a birth size between 50 cm and 55 cm, whose parents living in these cities have accepted their participation in the study and exclusively fed on breast milk for 6 months according to the recommendations of the world organization of Health (WHO). Were not included in our study, all infants malnourished according to the standards of NCHS (National Center for Health Statistics), being in the alert zone or red zone of the WHO growth chart, suffering from a chronic disease or a genetic disorder, those who are not regularly vaccinated and finally those who are not exclusively breast-fed. Newborns with a malformation and those in which one of the parents suffers from hypertension, diabetes and any

other chronic illnesses were excluded. Also, infants whose parents moved departments for whatever reason, and those who refused to participate in the study despite being granted guarantor, were excluded.

The infants were divided according to the mother's professional activity. Thus, we selected 315 mothers (56 secondary school teachers; 72 primary school teachers; 48 health workers; 51 administrative secretaries; 24 department heads; 21-armed corps; 43 maintenance workers).

2.1 Variables studied

Independent variables:

- Body mass index, BMI = MC / T2 (in kg / m2);
- Age (years) of the infant;
- The mother's professional activity.

Dependent variables:

- Age of acquisition of the behavior "prone to prone, raise your head";
- Age of acquisition of the "prone, turn on the stomach" behavior;
- Age of acquisition of the "prone, stand up on hands" behavior;
- Age at which motor behavior was acquired "to sit alone";
- Age of acquisition of the "crawling" behavior;
- Age of acquisition of the "stand with assistance" behavior;
- Age of acquisition of the "stand without assistance" behavior;
- Age of acquisition of the "walking alone" behavior.

2.2 Ethical consideration

In these studies, we complied with the security arrangements provided for in these cases by the WHO for collecting anthropometric data. A preliminary sensitization session was organized to explain the experimental protocols, the objectives and the interest of the study to the chief physicians and the medical teams who had to help us with the data taking. Other sessions were done with the mothers of the newborns. Parents who agreed to participate in the studies then signed written informed consent forms. The confidentiality of the data collected has been guaranteed to the parents of the children concerned by the study, no name will appear in the final document. Only the data relating to the various variables are taken into account. No child was included in the sample without the written informed consent of their parents.

We received authorization from the departmental health directorate of the departments and the health zone coordinators of the various municipalities in the study.

The approvals of the Sectoral Scientific Committee of Sciences and Techniques of Physical and Sporting Activities (CSS / STAPS) of the National Institute of Youth, Physical Education and Sport (INJEPS).

2.3 Statistical analysis

The collected data was compiled and then analyzed using IBM SPSS version 21 software. For each variable, the normality of the distribution was verified, using the Kolmogorov-Smirnov test. Descriptive statistics: mean, standard deviation, were calculated.

The Wilcoxon rank test was adopted for comparing variables within a group at the start and end of the study. The significance level was set at $p < 0.05$.

The Kruskall-Wallis test was used to compare the variation in the periods of acquisition of motor behavior between the four groups.

Correlations were calculated with Pearson's test.

The significance level of the statistical tests was set at $p < 0.05$.

3 RESULTS

3.1 Motor development of the 315 newborns studied

Figure 1 shows the curves (start and end date; mean age of acquisition of motor behavior) of motor development in the 315 newborns studied.

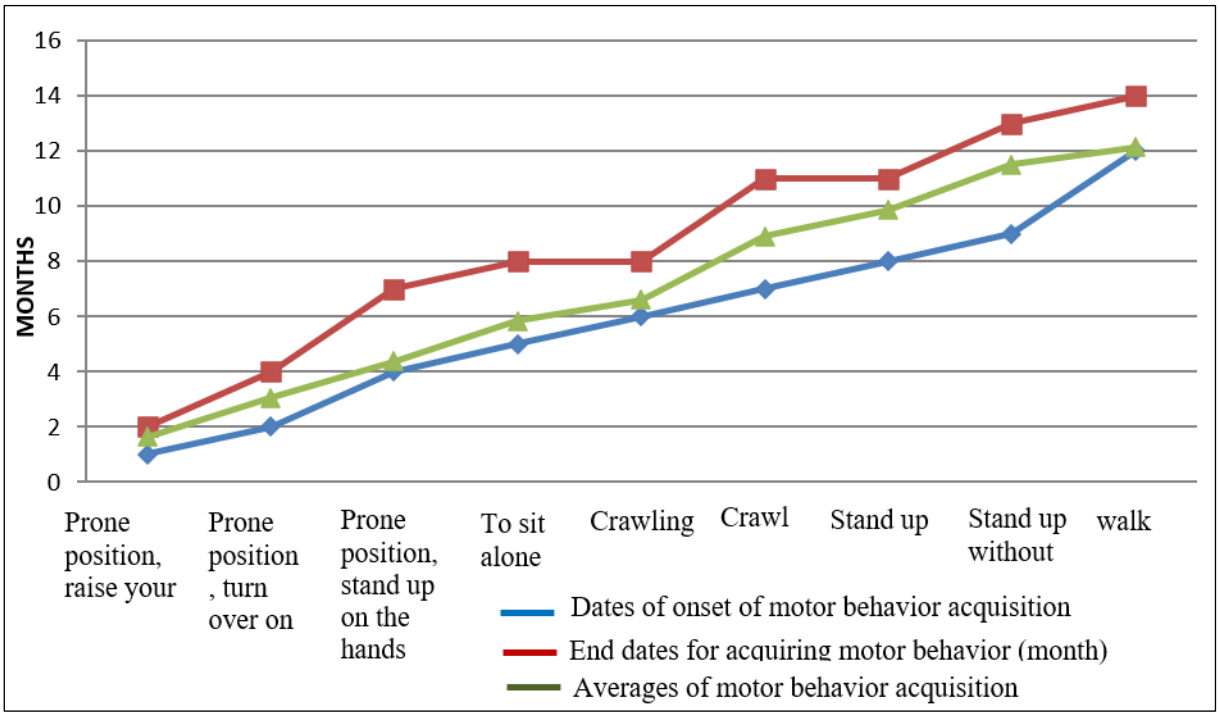

Figure 1: The motor development curves of the children of Beninese civil servant mothers studied

3.2 Comparison of children's motor development according to the mother's professional activity

To better understand the effects that professional activities could have on the motor development of infants, we have divided the subjects according to the profession of their mothers. Table II shows the mean values of the ages of acquisition of motor behavior of the subjects studied according to the mother's professional activity.

Table 1: Motor development of children according to the professional activity of the mother state civil servant

	Sit (months)	Crawling (months)	Crawl (month)	to stand with help (months)	to stand alone (months)	Walk (months)
Secondary teachers	5.77± 0.52	6.31± 0.88	8.40 ± 1.13	9.27 ± 1.22	10.82±0.75	12.05± 1.20
Teachers	5.43 ± 0.87	6.25 ± 0.69	8.83 ± 0.91	9.31 ± 0.94	11. 07± 1.16	11.88 ± 0.62
Health workers	5.31 ± 0.67	6.41 ± 0.91	8.65 ± 1.11	9.23 ± 0.81	10.69 ± 1.01	11.97 ± 0.85
Administrative secretaries	6.16 ± 0.91	6.72 ± 0.73	8.91 ± 0.89	10.01 ± 1.13	11.23 ± 1.05	12.06± 1.07
Heads of Services	6.27 ± 1.04	6.87 ± 1.25	8.93 ± 0.85	10.07 ± 1.17	11.45 ± 0.76	12.17 ± 0.91
Corps Weapons	5.61 ± 0.73	6.34 ± 0.70	9.11 ± 1.17	10.14 ± 1.42	11.58± 0.84	12.31 ± 1.13
Maintenance Agents	5.08 ± 0.46	6.22 ± 1.01	8.27 ± 0.74	9.18 ±0.81	10.73 ± 0.63	11.62 ± 0.75

*p< 0,05 ; ** p<0,01

Figure 2 shows the curves of the motor development of newborns according to each professional activity of mothers who are civil servants.

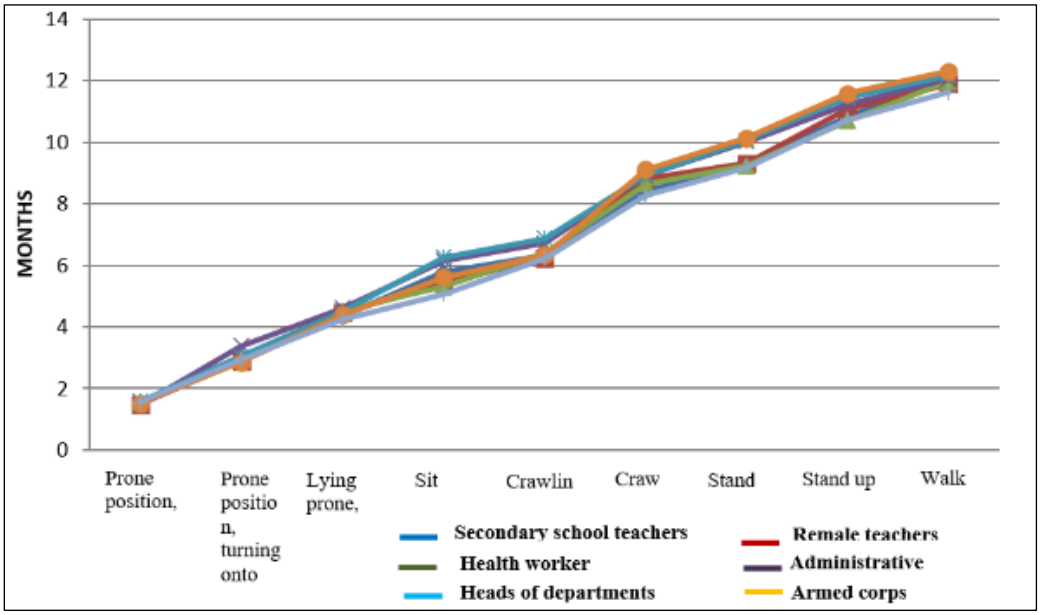

Figure 2: The motor development curves of children according to the professional activity of the functional mother

3.3 Motor development and people involved in taking care of children when mothers are in the service

Figure 3 presents the curves of the motor development of newborns as a function of the caretakers of the children when the mothers are in services.

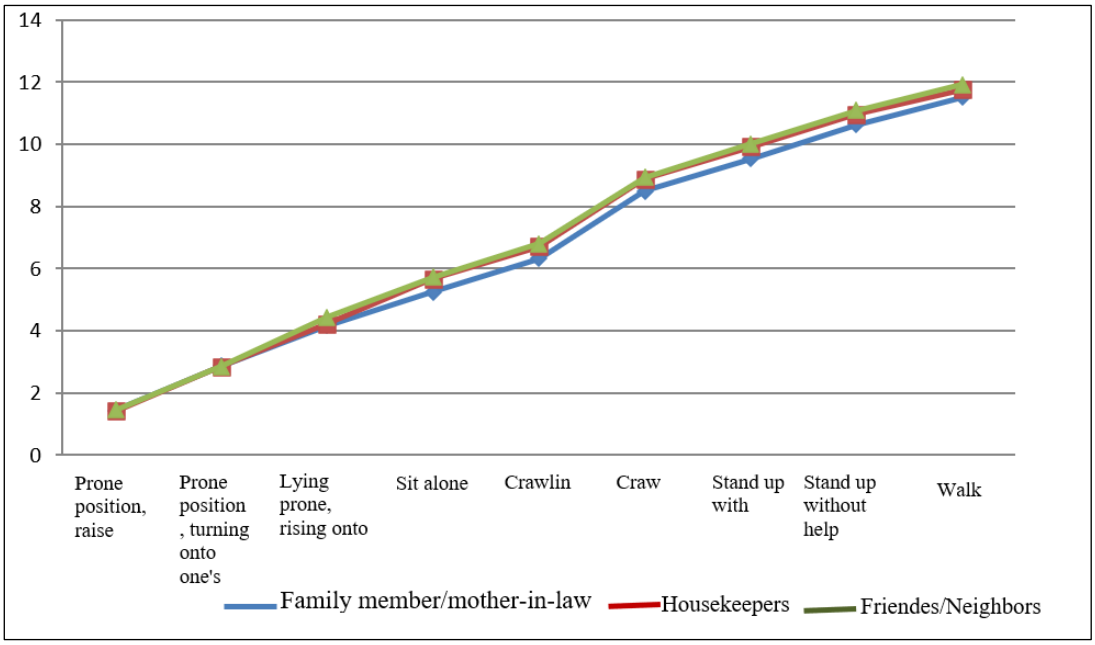

Figure 3: Motor development of newborns according to the people involved in caring for them

3.4 Comparison of the motor development of children between the group of civil servants and that of mothers not exercising any professional activity

Table 2 shows the p of comparisons of the groups of mothers with no professional activity and the other groups of mothers who are civil servants.

Table 2: Comparison of the motor development of children whose mothers do not exercise any income-generating activity and those of civil servant mothers

Group of mothers not engaged in any activity and:	Sit (months)	Crawl (month)	to stand alone (months)	Walk (months)
	p comparison between groups			
Secondary teachers	0.0308 *	0.0288*	0.0201*	0.0227*
Teachers	0.0312*	0.0172*	0.0105*	0.0208*
Health workers	0.0392*	0.0210*	0.0181*	0.0246*
Administrative secretaries	0.0016**	0.0180**	0.0045**	0.0175*
Heads of Services	0.0000**	0.0000**	0.0027**	0.0132*
Corps Weapons	0.0363*	0.0014*	0.0003**	0.0109*
Maintenance Agents	0.0415*	0.0320*	0.0217*	0.0392*

*p< 0,05 ; ** p<0,01

3.5 Correlation of motor development in children of civil servant mothers and those of mothers who do not have any income-generating function

The correlations between the group of mothers who do not exercise any socio-professional activity and the other groups (Table 3) are as follows:

Table 3: Correlation of motor development in children of civil servant mothers and those of mothers who do not have any income-generating function

Group of mothers not engaged in any activity and:	Sit (months)	Crawl (month)	to stand alone (months)	Walk (months)
	Pearson's r correlation			
Secondary teachers	0. 97	0. 92	0.84	0.89
Teachers	0. 94	0. 89	0.90	0.95
Health workers	0.96	0. 91	0.88	0.96
Administrative secretaries	0.92	0. 89	0.91	0.97
Heads of Services	0.89	0. 86	0.93	0.98
Corps Weapons	0.96	0. 85	0.98	0.94
Maintenance Agents	0. 98	0. 94	0.82	0.91

4 DISCUSSION

A study of 315 newborns of Beninese civil servant mothers described the infants' motor development curves (sitting, crawling, creeping, standing with support, standing alone, walking) and compared them according to the mother's occupation, the person responsible for the child during working hours, and a group of mothers without paid employment. The results show statistically significant differences between the occupational categories (Table I), significant differences between the group of mothers without paid employment and each of the categories of civil servant mothers (Table II, $p < 0.05$ to $p < 0.01$), but also very strong correlations ($r = 0.82$ to 0.98) between these same groups (Table III). These results warrant discussion based on data from the literature concerning infant motor development, maternal employment, and childcare arrangements.

4.1 Motor Development of Infants Studied in Relation to International Standards

The average ages of acquisition observed in our sample (sitting between 5 and 6.3 months; crawling between 6.2 and 6.9 months; standing unsupported between 10.7 and 11.6 months; walking between 11.6 and 12.3 months) generally fall within the acquisition windows established by the World Health Organization (WHO) multicentre reference growth study, which followed children in Ghana, India, Norway, Oman, and the United States [7,8]. This study showed that the

normal window (1st to 99th percentile) extends from 3.8 to 9.2 months for unsupported sitting and from 8.2 to 17.6 months for independent walking [7]. Our results are therefore rather in the early part of these international windows, which is consistent with classic observations made in sub-Saharan Africa. As early as 1991, a prospective study of 320 Nigerian children reported a more rapid acquisition of several motor skills (sitting unsupported, crawling, standing, and walking independently) compared to established norms in Western children [9,10].

This relative precocity, however, is not attributable to a fundamentally different neurological maturation. Super's seminal work, conducted in Kenya, showed that the earlier acquisition of sitting and walking by African infants is explained by specific practices of encouragement and postural training by mothers, and not by unstimulated behaviors, for which no advantage was observed [11]. Similarly, Bril and Sabatier's ethnographic study of Bambara infants in Mali documented a veritable scale of daily motor development. This research also reports that this development is linked to the practices of repeated manipulation and postural stimulation of the newborn's body by caregivers, which reveal the early acquisition of sitting and walking [12]. This work allows us to interpret the relative precocity recorded in our sample as the result of maternity practices and a motor stimulation environment, rather than as a simple biological effect.

4.2 Maternal Profession and the Pace of Motor Milestone Acquisition

A comparison between occupational categories (Table I) reveals differences in the motor development trajectory of infants. Children of mothers who are maintenance workers, teachers, or healthcare professionals tend to acquire most motor skills earlier, while children of mothers who are department heads, administrative secretaries, or members of the armed forces acquire them later. These differences in the infant developmental timeline have already been reported in several studies examining the effect of maternal socioeconomic status and education level on motor development. A Turkish study of over 2,000 preschool children showed that maternal education level significantly influenced several motor skills between 8 and 16 months, while the household's socioeconomic status had a greater influence between 10 and 60 months [13]. These authors emphasize, however, that the effect is not always linear. Indeed, in their sample, children of less educated mothers reached certain postural motor skills earlier, while children of mothers with higher education degrees sometimes reached more complex motor skills earlier, skills that typically appear after the age of one [13]. This finding suggests that the motor trajectories observed in our sample should not be interpreted as a simple effect of socio-professional level, but rather as a reflection of differences in the time available and the types of stimulation afforded by each profession. Positions with high levels of responsibility (department heads, military personnel) may have been associated with less availability for daily postural interactions with the infant.

4.3 Those Caring for the Child During Maternal Service Hours

Our results also show that motor development varies depending on who is caring for the child while the mother is at work. This finding is consistent with a body of recent work conducted in sub-Saharan Africa on the stimulation provided by different types of caregivers. A study conducted in northern Ghana showed that the associations between early stimulation activities and child development varied depending on whether these activities were carried out by the mother, the father, or other household members, with maternal stimulation being more strongly associated with the child's overall and socio-emotional development [14]. Convergently, a study of rural cohorts in Kenya and Zambia showed that maternal stimulation was the activity most strongly associated with the infant's overall motor development, more so than problem-solving or language [15]. These data suggest that the quality and nature of postural and motor stimulation provided by the caregiver (mother, grandmother, nanny, or other extended family member) can modulate the rate of acquisition of motor milestones, independently of the mother's employment status alone.

The use of extended family members (grandmothers in particular) as caregivers in the mother's absence is a widespread practice in sub-Saharan Africa, especially when the mother's socioeconomic status limits her alternative childcare options [15]. This family-based childcare arrangement can have ambivalent effects on child development. In a study conducted in Malawi and South Africa, maternal employment was associated with a lower level of psychosocial stimulation for the infant (measured by the number of toys, books, and play activities offered), suggesting a possible substitution effect between the mother's employment and the time devoted to direct stimulation of the child [17]. This result sheds light on the variability observed in our sample depending on the people in charge of the child.

4.4 Comparison between working mothers and mothers without paid employment

The comparison between the group of mothers without paid employment and all groups of mothers employed in the civil service (Table II) reveals statistically significant differences for the four motor skills studied (sitting, crawling, standing alone, walking), with significance levels reaching $p < 0.01$ for several categories (administrative secretaries, department heads, military personnel). This result corroborates studies showing that maternal employment can influence childcare and stimulation practices for young children. A study conducted in Ethiopia using cohort data showed that early maternal employment was associated with differences in children's motor development, while also highlighting that the use of non-maternal childcare was frequent among both employed and non-employed mothers in

this context [18]. These results suggest that the determining variable is probably not employment itself, but rather how families reorganize childcare arrangements. Furthermore, for each family, the mother's availability and the use of other caregivers determine the trajectory of infants' motor development.

4.5 Remarkable consistency despite the differences: the relative universality of the motor sequence

One of the most interesting results of this study is the coexistence, between the group of mothers not in employment and the groups of mothers employed by the civil service, of significant differences in mean age (Table 2) and extremely strong correlations in developmental structure (Table III), with Pearson coefficients ranging from 0.82 to 0.98 depending on the milestones and professional categories. These results suggest that factors related to maternal employment and childcare arrangements primarily modify the pace (speed) of motor progression, without disrupting the order or the overall structure of the developmental sequence. This finding is consistent with the conclusions of the WHO multicentre study, which showed that approximately 90% of children, regardless of their cultural background, acquire five of the six fundamental motor skills in a common sequence. Furthermore, only the crawling stage can be omitted or moved within the sequence [7,8]. In other words, the environmental and socio-professional determinants highlighted in our study appear to act as modulators of the timing of motor skill acquisition, within a developmental framework whose sequential organization remains largely preserved.

5 CONCLUSION

The infants in our sample exhibited generally early motor development compared to international reference standards, consistent with classic observations made in Africa. The mother's professional activity and, to a lesser extent, the identity of the person caring for the child in her absence, appear to be factors associated with the rate of motor skill acquisition, without, however, altering the overall structure of the developmental sequence, which remains strongly correlated between groups. These results argue for the inclusion, in maternal and child health policies, of the time constraints linked to certain professions and the arrangements for infant care during mothers' working hours.

However, several limitations must be highlighted. Our study did not examine the effect of certain factors such as actual working hours, work intensity, working conditions, and the existence of partial teleworking. These factors can influence the quality of the mother-infant relationship but can also influence the period of absence. Furthermore, the nature of childcare arrangements was not systematically cross-referenced with the mother's occupation, which limits the analysis of possible interactions between these two variables. Can working hours, the intensity of the mother's socio-professional activity, and childcare conditions influence the overall motor development of infants in Benin?

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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CRediT authorship contribution statement

- Gérard Sèmako DOSSOU: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Validation.
- Mohamed Mansourou LAWANI: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing, Validation.

- HOUETO Vignon Gratien: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Writing – review & editing, Validation.
- Lafiou YESSOUFOU: Conceptualization, Methodology, Investigation, Formal analysis, Writing – review & editing, Validation.

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