Neonatal Evaluation, Cerebral Palsy and Delayed Psychomotor Development in Children of Mexican Adolescent Mothers

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Abstract

Introduction: Adolescent pregnancy is a social problem not solved in developing countries or some developed countries. It has been demonstrated that maternal age represents a risk factor in neonates with an increase in the prevalence of perinatal complications and psychomotor delay.

Objectives: To compare neonatal neurological assessment and development in children born from adolescent mothers with those from non-adolescent mothers. To know their prenatal and perinatal history and to determine the frequency of cerebral palsy (CP) and delayed psychomotor development (DPD).

Methods: Multicenter, retrospective, analytical, comparative cohort study of newborns and infants. The sample was randomly selected from clinical charts of 75,951 mothers in the puerperium, and the files of their newborns were analyzed for their neonatal neurological assessments. In total, 2,739 mothers 12 to 27 years old were assessed, of which 1,274 had 12 to19 years old (adolescents), and 1,465 had 20 to 27 years old (non-adolescents). Their infants were assessed from 0 to 4 months corrected age (m) with Neo Neuro and Up (NN&Up), and at 6 to18 (m) with Hammersmith evaluation (HINE) over a four-year period.

Results: 1,274, (46.5%) were adolescent mothers (AM), and 1,465, (53.5%) were non-adolescent mothers (NAM). Initially, 2,739 NN&Up evaluations were performed in which 318 (11.6%) had abnormal results 10.9% in AM and 12.2% in NAM. At 6 to 18 m, 1161 HINE evaluations were performed, of which 2.7% were abnormal. 2.2% in AM, and 3.2% in NAM with clinical data of delayed psychomotor development. At the end of follow-up, 13 (0.47%) children were found to have DPD (0.23%) in AM and (0.68%) in NAM. At the end of study 13 (0.47%) children had DPD, 0.23% in AM and 0.68% in NAM. Moreover 9 children were diagnosed clinically and with neuroimaging with CP, 6 from AM and 3 from NAM.

Conclusions: Children of AM in public hospitals in northeastern Mexico are born in frank vulnerability, particularly those of teen mothers. Their developmental assessments show a higher frequency of delayed psychomotor development in children of NAM and a higher frequency in children with CP in AM.

Keywords: Adolescent; Pregnancy; Cerebral Palsy; Psychomotor

Introduction

Pregnancy in adolescence is a social problem not resolved in developing countries or some developed countries. Adolescent fertility has become the most accurate bio-demographic and health indicator of development.

In developing countries, it is expected that they follow the patterns of sexual behavior of developed countries without offering the levels of education and services to adolescents. The consequences are adolescent fertility and increased prevalence of sexually transmitted diseases (Molina, & González, 2012).

Ignorance about sexuality and reproduction of parents, teachers, and adolescents increases the early initiation of sexual relations and unwanted pregnancies. The social

consequences are incomplete education, difficulties in the maternal role, abandonment of the couple, economic problems, and lack of child protection (Molina, & González, 2012).

The primary prevention of pregnancy in adolescence is sexual education and access to contraception (McCracken, & Loveless, 2014). The proportion of daughters who are adolescent mothers (AM) is higher when their mothers were adolescents (Liu, et al., 2018). Frequently, they arrive late for prenatal care due to ignorance, fear, consequences, limited access, or stigma.

Maternal risks include pre-eclampsia, social isolation, delayed educational goals, and maternal depression. The chances of children are low birth weight, premature birth, and stillbirth (Leftwich, & Ortega, 2017).

The highest reported rates of AM have been in the United States, the former Soviet Union, Mexico, and Africa (Sedgh, et al., 2015).

The AMs have a higher risk of postpartum depression, school dropout, and poor socioeconomic status. Their children have a higher risk of prematurity and low birth weight, developmental delay, and behavioral disorders (Goossens, et al., 2015).

Teenage pregnancy is a global public health problem that affects the physical and emotional health, the educational and economic situation of future parents, and the product of the pregnancy. In most cases, it is an unplanned event and challenging for the couple to accept; Mothers can be attacked at home, at school or in society, giving rise to child abuse (Loredo-Abdalá, et al., 2017).

School programs have been a mainstay of teen pregnancy prevention efforts in the US, delayed sexual initiation, and contraceptive use have been shown (Marseille, et al., 2018).

Unwanted teenage pregnancies impose social burdens on parents and children, and costs to society (Lavin, & Cox, 2012). Effective strategies should focus on delaying sexual activity, and use contraception for those youth who are already, or plan to become, sexually active (Lavin, & Cox, 2012).

Policies that require abstinence-based sex education have shown no effect on teen birth or abortion rates (Carr, & Packham, 2017).

Factors showing associations in AM include: experiencing childhood abuse, engaging in criminal behavior, substance abuse, having a teen parent, severe family disorder, not living with parents, and Hispanic ethnicity (Fasula, et al., 2019).

The Centers for Disease Control and Prevention developed a pregnancy prevention strategy to reduce pregnancies and births in AM in the United States (Tevendale, et al., 2017).

Comprehensive sex education programs have demonstrated the ability to reduce teenage pregnancy and delay sexual initiation, it is already known that it is crucial to raise awareness, educate and involve the community in efforts to public health (Rabbitte, & Enriquez, 2019).

Regarding the conditions of the newborn (NB), in previous studies discrepancies have been found between the neonatal characteristics of their children (Lezcano, & Vallejos, 2005; La Rosa-Alfonso, 2015; Munguía-Mercado, et al., 2018; Saeteros, 2018) since currently the highest percentage of newborns with low birth weight (lower to 2500 grams), is found in the AM from 10 to 14 years, as well as Apgar <7 and cesarean delivery (Lezcano, & Vallejos, 2005).

However, in a study conducted in Peru, there was no difference between the complications of AM and NAM newborn (La Rosa-Alfonso, 2015).

Maternal age represents a risk factor in the newborn, such as an increase in the prevalence of perinatal complications, and a greater need for a Neonatal Intensive Care Unit (NICU) (Munguía-Mercado, et al., 2018) more significant neonatal morbidity such as respiratory failure and sepsis has been shown in AM, than in NAM (Saeteros, 2018). "Adolescent pregnancy is a health problem, so its recognition and importance imposes the need to devote more and more attention to it" (Fernández, et al., 2004).

Various tools such as the Neo Neuro & Up (NN&Up) and the Hammersmith Infant Neurological Examination (HINE) are used to assess the neurological status of neonates and child development (Sheridan-Perreira, Ellison, & Helgeson, 1991; Maitre, Chorna, & Guzzetta, 2016; Hidalgo-Robles, Merino, & Paleg, 2020).

The NN&Up is one of the most used instruments to carry out the neurological evaluation in the newborn. It has been validated in Spain, showing satisfactory performance, (Sheridan-Perreira, Ellison, & Helgeson, 1991) and the HINE, which is a suitable neurological examination for young children after the neonatal period and during early childhood, is used in research and clinical care (Maitre, Chorna, & Guzzetta, 2016; Hidalgo-Robles, Merino, & Paleg, 2020).

These evaluations' systematic and sequential application may constitute an option for early diagnosis of psychomotor delay and Cerebral Palsy (CP).

Nuevo Amanecer, a charitable association with more than 43 years of experience dedicated to improving the quality of life of children and young people with cerebral palsy, has sought new ways to create prevention strategies and improve care for children with CP and their families.

For this reason, it has designed and coordinated this clinical research, due to the lack of statistics in this field, to continue promoting public policies and strategic alliances to improve the quality of life of people with disabilities in the state of Nuevo León, Mexico.

Objectives

To compare the neonatal neurological evaluation in children of adolescent mothers with those of non-adolescent mothers.

To analyze the most frequent pre and perinatal complications in children of adolescent mothers.

To know the frequency of Cerebral Palsy and psychomotor delay in children of adolescent and non-adolescent mothers.

Methods

Study Design

Cohort, multicenter, retrospective, randomized, analytical, comparative study of AM aged 12 to 19 years, and NAM aged 20 to 27 years. Confidence level 95%, precision 1.5.

Environment

This study was coordinated by the Instituto Nuevo Amanecer ABP, with the participation of the Materno-Infantil, Metropolitano and Universitario public hospitals in the state of Nuevo León, where 40% of the children in this state are born annually.

Study Population

Proportion calculation sample of a cohort randomly captured with a research randomizer of 75,951 postpartum mothers and their newborns, obtained from the daily birth records of the three hospitals involved. The maternal age range was from 12 to 27 years old, a sample of 2,739 mothers, 1,274 from 12 to 19 years old, (AM) and 1,465 from 20 to 27 years old, of non-adolescent mothers (NAM). Study period: June 2017 to September 2021.

Methodology

Participating investigators were qualified neonatologists and pediatric neurologists with specific training in NN&Up assessments, and HINE. Complications of pregnancy and birth

were analyzed, as well as the evaluations of children, with NN&Up of 0-4 months of corrected age (m), and of HINE between 6-18 m, during a period of four years.

The diagnosis of DPD and CP was fundamentally clinical and carried out by peers, with reassessment by a pediatric neurologist with extensive experience in CP, performing neuroimaging studies in cases of abnormal evaluations (NN&Up <136, and/or HINE <70): transfontanellar ultrasound (TFUS) (0 to 6 m), computerized axial tomography (CAT) (7 to 12 m), or nuclear magnetic resonance (MRI) (12 to 18 m.).

An electronic research file (CRF) was used, to analyze the answers to the maternal questioning, verified with the hospital file on prenatal and perinatal history, neonatal and infant evaluations, and neuroimaging studies.

The diagnosis of CP and DPD was analyzed, which was predominantly clinical, verified with the neuroimaging findings, carried out in the hospitals where the children were born, and early care was carried out at the Instituto Nuevo Amanecer ABP.

Inclusion Criteria

NB from the three participating hospitals, from families residing in Nuevo León, Mexico.

Exclusion Criteria

NB of families from other states of Mexico. Criteria for elimination. death of the child.

Bioethical Aspects

This study was authorized by the Bioethics and Research Committees of the three participating hospitals, and the Universidad Autonoma de Nuevo León. The parents signed an informed consent letter.

Statistical Analysis

It was carried out with SPSS 24. Using inferential statistics, the frequencies of pre- and perinatal history, maternal, neonatal and child variables, and results of NN&Up 0-4 m, HINE 6-18 m were analyzed. Prenatal and perinatal complications were analyzed with univariate analysis, odds ratio, and confidence intervals, and $p < 0.05$ values were accepted as significant. PC and DPD frequencies were compared between AM and NAM.

Results

Of 2,739 mothers and their newborns, the distribution of the sample by hospitals was 1,115 (40.7%) Materno-Infantil Hospital, 917 (33.5%) University Hospital, and 707 (25.8%) Metropolitan Hospital.

Characteristics of the Mothers

Of 2,739, 1,274 (46.5%) were AM, and 1,465 (53.5%) were NAM. Marital status, Cohabiting couples 76.8% in AM and 74.5% in NAM, single 20.0% in AM and 10.4% in NAM (Table 1).

Table 1. Marital status of the mothers

	Cohabiting couples	%	Single	%	Married	%	Divorced	%	Widow	%	Total
General	2070	75.57	407	14.85	248	9.05	11	0.40	3	0.10	2739
Adolescents	979	**76.80**	255	**20.01**	36	2.82	3	0.23	1	0.07	1274
Non Adolescents	1091	74.47	152	10.37	212	14.47	8	0.54	2	0.13	1465

Educational level, primary education in 12.3% of AM and 10.3 of NAM, and secondary education in 67.3% and 58.2% respectively (Table 2).

Table 2. Mothers' educational level

	None	%	Elementary	%	Junior high	%	High school	%	Professional	%	Total
General	23	0.83	308	11.24	1707	62.32	600	21.95	101	3.68	2739
Adolescents	8	0.63	157	**12.32**	854	**67.03**	240	18.83	15	1.17	1274
Non Adolescents	15	1.02	151	10.30	853	58.20	360	24.57	86	5.86	1465

Characteristics of Newborns

Of 2,739 patients, 1,380 (50.4%) were the product of the first pregnancy, of the total 1,320 (48.2%) were female, and 1,419 (51.8%) were male. The mean weight of the newborns was 3,123 Kg. (SD 517.47), mean for height 49.91, (SD 3.064).

Gestational age range 26-41 weeks, mean 38.4 (Table 3).

Table 3. Distribution of newborns according to gestational age

	Mothers	Term pregnancy 37-41 W	%	Preterm pregnancy 26-36 W	%	Total
General	2739	2508	91.59%	231	8.40%	2739
Adolescents	1274	1165	91.44%	109	**8.55%**	1274
Non Adolescents	1465	1343	91.67%	122	8.32%	1465

Preterm birth occurred in 231 mothers (8.4%) of the general sample, 109 (8.6%) in AM, and 122 (8.3%) in NAM (Table 3). Vaginal birth in 1,592 (58.1%) mothers, eutocic birth in 1,496 (54.6%), and dystocic birth in 96 (3.5%). Of these 49 (1.8%) in AM and 47 (1.7%) in NAM. Cesarean delivery in 1147 (41.9%), 492 (17.9%) in AM and 655 (23.9%) in NAM. Urgent cesarean section in 468 (17.1%), and of these 232 (8.5%) in AM and 236 (8.6%) in NAM.

Of the total sample, 151 (5.5%) children with acute fetal distress were confirmed, 140 (5.1%) of these 69 (2.5%) in AM, and 71 (2.6%) in NAM. The comparison of head circumference is established in Table 4.

Table 4. Comparative analysis of head circumference in newborns

	22-31 cm	%	32-37 cm	%	38-40 cm	%	Total	%
General	182	**6.69**	2525	**92.15**	32	**1.15**	2739	**100**
Non Adolescents	87	5.93	1357	92.62	21	1.43	1465	100
Adolescents	95	**7.45**	1168	91.67	11	0.86	1274	100

The percentage of prenatal and perinatal complications or risk factors according to the AM (1274) and NAM (1465) subgroups (Table 5).

Table 5. Pre and perinatal history of mothers and newborns

General		Adolescents	%	No adolescents	%	p	OR	CI	
2739		**1274**		**1465**					
PRENATAL BACKGROUND									
Pregnancy care visits <7	1273	606	**47.56%**	667	45.52%	0.286	0.216	0.712	1.080
Vaginal bleeding prenatal	70	33	**2.59%**	37	2.52%	0.501	0.903	0.67	1.216
Antenatal urinary tract infection	900	444	**34.85%**	456	31.12%	**0.035**	**1.188**	**1.012**	**1.396**
Preeclampsia/ Eclampsia	191	87	6.82%	104	7.09%	0.782	0.959	0.714	1.289
PERINATAL BACKGOUND									
Apgar 5 min <7	14	12	**0.94%**	2	0.13%	0.286	0.216	0.712	1.080
Preterm	231	109	**8.60%**	122	8.30%	0.830	1.03	0.786	1.349
Acute fetal distress	151	69	5.40%	82	5.60%	0.836	0.966	0.695	1.343
Low birth weight	1326	634	**49.76%**	692	47.20%	0.186	1.107	0.952	1.286
Cerebral haemorrhage	10	6	**0.47%**	4	0.27%	0.392	1.728	0.487	6.138
Neonatal sepsis	28	22	**1.72%**	6	0.47%	**0.001**	**4.273**	**1.727**	**10.570**
Neonatal acidemia	19	15	**1.17%**	4	0.27%	**0.004**	**4.352**	**1.441**	**13.140**
Isquémic encephalopaty	7	5	**0.39%**	2	0.13%	0.186	2.882	0.558	14.880

A higher percentage of pre and perinatal risk factors was found in AM than in NAM in prenatal appointments <7, Prenatal transvaginal bleeding, prenatal urinary infection, Apgar 5 min <7, preterm birth, low birth weight, cerebral hemorrhage, sepsis and neonatal acidosis, and hypoxic-ischemic encephalopathy (Table 5).

On the other hand, 130 (4.7%) NBs required hospitalization in the NICU, 71 (5.5%) children of AM and 59 (4.0%) of NAM

In addition, statistical significance was found between AM and 3 risk factors: prenatal urinary tract infection (p 0.035, OR 1.188, CI 1.012-1.396), neonatal sepsis (p 0.001, OR 4.273, CI 1.727-10.570), and neonatal acidosis (p 0.04, OR 4.352, CI 1.441-13.140). The initial evaluation with abnormal NN&Up was 318 (11.6%), of these 10.9% in children of AM and 12.2% in children of NAM (Table 6). Abnormal HINE follow-up evaluations were 75 (2.7%), of these, (2.2%) in children of AM and (3.2%) in children of NAM (Table 6).

Table 6. Developmental assessments and diagnosis

Evaluations	Abnormal results 2739		Adolescents mothers 1274		Non Adolescents mothers 1465		p
Neo neuro abnormal	318	11.60%	139	10.90%	179	12.21%	0.001
HINE abnormal	75	2.73%	28	2.19%	47	3.20%	0.001
Diagnosis							
Cerebral Palsy	9	0.32%	6	0.47%	3	0.20%	0.015
DPD 6-9 m	75	2.73%	28	2.19%	47	3.21%	0.847
DPD 12-18 m	13	0.47%	3	0.23%	10	0.68%	0.903

Note. DPD: Dealy psychomotor development

Of the children who presented DPD between 6 and 9 m, 58.3% normalized their evaluation between 12 and 18 m. In this age range, only 13 (0.47%) children had DPD, (0.23%) children of AM and (0.68%) of NAM. (Table 6). In addition, 9 (0.32%) children were diagnosed clinically and with neuroimaging with CP, 6 (0.47%) with AM, and 3 (0.20%) with NAM (Table 6).

Statistical significance was found between children of AM and abnormal evaluation of NN&Up and HINE, (p 0.001 respectively), as well as with Cerebral Palsy (p 0.015) (Table 6). In summary, the diagnosis of DPD was greater in NAM, and that of PC in children of NAM (Table 6). In children with abnormal NN&Up or HINE assessments, 187 UTSF studies, 20 (10.7%) abnormal, 13 (6.9%) of them in AM. In 34 CT scans, 7 (20.6%) were abnormal, 2 (28.6%) in children of AM, and 5 (71.4%) of NAM. In 13 MRIs, 11 (84.6%) were abnormal, 8 (72.7%) in children of AM, and 3 (27.2%) of NAM. At least, abnormal USTF and MRI were more frequent in children of AM than in NAM.

Discussion

In a previous study, when analyzing the characteristics of AM NBs, their average age was 17.5 years (Salazar, & Solangel, 2017) and 17.4 in our study. The term gestational age in AM was 83 - 93% (Fernández, et al., 2004; Salazar, & Solangel, 2017) in previous studies, 90.9% in our study.

Previously, the NB weight of AM was more significant than 2500 gr. in 88 - 92%, 97.4% in our study (Fernández, et al., 2004; Sheridan-Perreira, Ellison, & Helgeson, 1991).

The normal Apgar at a minute in percentages 95 - 98% (19,23) and 95.8% in our study, the Apgar at 5 min in 98%, (Fernández, et al., 2004) 99.1% in ours.

The findings of previous studies mention a higher frequency of complications such as low birth weight and lower Apgar among the children of AM (Lezcano, & Vallejos, 2005), a greater need to stay in the NICU (Munguía-Mercado, Gutiérrez-Padilla, Gutiérrez-González, et al. 2018) and a higher frequency of respiratory failure and sepsis (Saeteros, 2018). In our study, a higher frequency of low birth weight, low Apgar score at birth, neonatal sepsis and NICU stay were also documented.

It has been documented that the most common conditions that cause morbidity in children of AM were jaundice, respiratory diseases and sepsis (Fernández, et al., 2004), which were <3.3% in our study, the most frequent being low birth weight and infection.

Prenatal urinary tract infection coincides with what was reported in another study where it is mentioned that among the risk factors of AM, urinary tract infections have been reported more frequently (34.9% in our study), as well as premature rupture of membrane (Naranjo, & Vera, 2019) (8.1% in our study).

On the other hand, mothers of children with CP, whose children show motor compromise, are vulnerable to family stress, in whom paid work contributes to reducing stress (Ribeiro, et al., 2014). However, in our study, the low educational level prevailed, since only 20% had high school or professional studies, limiting their professional development. For these children, the mother constitutes the main link in their stimulation. However, they have low resilience, a medium level of self-esteem, and low levels of emotional intelligence (Molina, et al., 2019). Therefore, the support programs for the Mexican AMs represent a significant challenge in their attention.

In a study carried out to evaluate the knowledge of AMs on early stimulation and psychomotor development of infants, 18.8% of AMs were found to have a good level of knowledge (Laguna, & Zenaida, 2018). In underdeveloped and developing countries, it is urgent to promote knowledge of educational resources and care for AM, since the child's sensory-motor development is influenced by maternal inexperience (Esparza, & Chimbo-

Macas, 2019). In our study, 79.3% of the AMs had a primary or secondary educational level, so their education in early care being a priority.

In newborns and infants, reliable and systematically applied clinical assessment instruments such as the NN&Up and HINE (Sheridan-Perreira, Ellison, & Helgeson, 1991; Maitre, Chorna, & Guzzetta, 2016; Hidalgo-Robles, Merino, & Paleg, 2020) are a practice accessible to the environments of underdeveloped and developing countries of development, whose results can support neuroimaging studies, early diagnosis, and timely referral.

Conclusions

MA children from northeastern Mexico, who are born in public hospitals, are born in frank vulnerability; most of their mothers are living as cohabiting couples or single, with a primary or secondary education level. They attend fewer prenatal appointments and have a higher frequency of urinary tract infections (UTI) in pregnancy.

Their children are more frequently born preterm, by dystocic delivery or urgent cesarean section, with smaller head circumference, lower Apgar evaluation, lower birth weight, and a higher frequency of cerebral hemorrhage and hypoxic-ischemic encephalopathy than those of NAM.

In AM, UTI has statistical significance for the development of CP, as well as sepsis and neonatal acidosis in their children, their neuroimaging studies show abnormalities in more than half of the cases, and their children, although they have a lower frequency of DPD, develop higher percentages of PC.

There is no doubt that if the public health challenge for the comprehensive care of pregnant patients is a priority, it is crucial in the case of AM.

They must know the risk factors for their children to present disorders in their development, the importance of medical evaluations, and the warning signs of child development.

The facilitation of local resources for early intervention is essential to know where, when and how children can be cared for, facilitating their specialized follow-up, and improving their functional prognosis and quality of life.

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