General Hospital Psychiatry 36 (2014) 105–112

Contents lists available at ScienceDirect

General Hospital Psychiatry

journal homepage: http://www.ghpjournal.com

Introducing depression and developmental screenings into the National Programme on Immunization (NPI) in southeast Nigeria: an experimental cross-sectional assessment☆,☆☆,★

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ARTICLE INFO

Article history:
Received 20 May 2013
Revised 12 September 2013
Accepted 14 September 2013

Keywords:
Postpartum depression
Infants' growth
Screening
Immunization

ABSTRACT

Objectives: This study investigates the possibility of introducing depression and developmental screening tools into the National Programme on Immunization (NPI) in southeast Nigeria. The specific objectives were to determine the prevalence of postpartum depression (PPD) among mothers attending immunization clinics and to assess the association of maternal PPD and infant growth in relation to World Health Organization (WHO) recommendations.
Methods: Four hundred and eight (408) mothers completed the sociodemographic questionnaire and the self-report Edinburgh Postnatal Depression Scale (EPDS). The weights, lengths and head circumferences of their infants were recorded, while the WHO recommended equivalents at 50th percentiles were also recorded for each child. The mothers were then interviewed with the major depressive episode module of Mini International Neuropsychiatric Interview (M.I.N.I.) to make diagnosis of depression.
Results: About 24.8% and 15.2% of the mothers were found to be depressed using EPDS and major depressive episode module of M.I.N.I., respectively. It was found that maternal PPD is significantly associated with the growth parameters of weights and lengths of the infants studied but not their head circumference.
Conclusions: NPI may provide appropriate forum for early screening of mothers for PPD and interventions in Nigeria. The NPI would also serve a useful avenue of screening for developmental concerns in Nigerian children.

1. Introduction

The postnatal period is well established as an increased time of risk for the development of serious mood disorders. Postpartum mood disorders are generally divided into three categories: the blues (baby blues and maternity blues), postpartum (or postnatal) depression (PPD) and puerperal (postpartum or postnatal) psychosis. Each category is a distinct postpartum state and differs in its prevalence, clinical presentation and management [1].

Postpartum nonpsychotic depression is the most common complication of childbearing [2]. A meta-analysis of 59 studies from North America, Europe, Australasia and Japan ($n = 12{,}810$) found an overall prevalence rate of PPD of 13% [3]. In developing countries, studies suggest rates of PPD of 15 to 28% in Africa and Asia [4], 50% in Bangladesh [5], 35 to 47% in Latin America [6], 11% in Tamil Nadu, India [7], 18.7% among Moroccan mothers [8], 16% in Arab women [9], 10.15% among Spanish mothers [10], and <5% in one study in Nepal [11]. In Nigeria, prevalence rates of 10.7 to 23% were recorded in different groups of women [12–16]. In a controlled study done in western Nigeria, depressive disorder was diagnosed in 14.6% of the postpartum women and 6.3% of the nonpostpartum women, and the difference was found to be significant [17]. It has been reported that 40% to 90% of PPD cases occur within 3 months of delivery [18,19] with duration frequently dependent on severity [20] and the time of onset of treatment [21].

The signs and symptoms of PPD are generally the same as those associated with major depression occurring at other times, including depressed mood, anhedonia and low energy. Reports of suicidal ideation

☆ Financial Disclosure: None.
☆☆ Authors' Contribution: All Authors contributed to the conception of the study. MOB and JOO participated in statistical analysis, wrote the first draft and participated in the final review of the manuscript. JTO participated in statistical analysis and final review of the manuscript. All Authors read and approved the final draft of the manuscript.
★ Competing Interests: Authors have declared no competing interests.
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http://dx.doi.org/10.1016/j.genhosppsych.2013.09.005

are common. Frequently, women may experience low self-esteem, an inability to cope, feelings of incompetence and social isolation [22].

Research consistently suggests that PPD may lead to impaired maternal–infant interactions and negative perceptions of normal infant behavior [23–25]. There is evidence from developed countries that a compromised mother–infant relationship adversely affects the child's cognitive, social, behavioral and emotional development [26,27]. Infants of mothers with PPD are more likely to be abused and neglected [28] and diagnosed with failure to thrive and hospitalized for poor health [29,30]. In addition, at any time within the first year of delivery, depressed women have a greater tendency to discontinue breastfeeding than do women who have not developed depression [31]. Previous studies using underweight or nonorganic failure to thrive as indicators of poor physical growth have suggested an association between maternal depression and inadequate growth [32–34]. Studies in India [35], Bangladesh [36] and Brazil [37] have shown an association between maternal depressive symptoms and child stunting, while studies in United States [38] and Europe [39] have shown no significant influence of maternal depressive symptoms on children's growth. In Nigeria, only one study has examined an association between maternal depression and poor physical growth of infants, but the study was done in a postnatal clinic in southwest Nigeria [40].

Despite multiple contacts with medical professionals during the postpartum period, PPD is frequently undetected, and many women go without treatment. If such depression is not treated, up to 50% of mothers will remain depressed 1 year following childbirth [41]. Early detection of symptoms and prompt intervention can greatly reduce adverse consequences [42].

Most research into the determinants of women's perinatal mental health and into its consequences for child survival, health and development has taken place in developed countries; only a small proportion has taken place in developing countries with the impact of PPD on the physical growth of children receiving even less attention.

The Federal Government of Nigeria in 1999 introduced the National Programme on Immunization (NPI) to replace the existing Expanded Programme on Immunization that was initiated in 1979. The NPI was established with a key focus to provide support to the implementation of the state and local government area immunization programs [43]. NPI clinics serve as media for interacting with both mother and child in Nigeria and could present the best opportunity to screen for maternal PPD and assess any developmental concerns in the infant. This study investigates the possibility of introducing depression and developmental screening tools into the NPI in southeastern Nigeria.

The specific objectives of this study were the following:

- To determine the prevalence of PPD using major depressive episode module of Mini International Neuropsychiatric Interview (M.I.N.I.) [44] and Edinburgh Postnatal Depression Scale (EPDS) [45].
- To determine the performance (sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of EPDS at a recommended cutoff point of nine and above [12] using major depressive episode module of M.I.N.I. as a gold standard.
- To determine any deviation in infant growth parameters from the World Health Organization (WHO) recommendations at 50th percentile using infants' weight, length and head circumference (HC) [46].
- To assess the association of PPD with infant growth parameters, that is, weight, length and HC in relation to WHO recommendations at 50th percentile [46].

Acknowledging that the utility of screening for depression without adequate facilities for further assessment and interventions is limited and may be unethical; the present study provided a referral link at Federal Neuropsychiatric Hospital, Enugu, Nigeria, where mothers that were screened positive on EPDS and Mini International Neuropsychiatric Interview (MINI) were referred for further evaluation and management. This present study is serving as an assessment of readiness to scale up the procedure when adequate training facilities are available to provide assessment and interventions for mothers with PPD at NPI clinics using WHO mental health GAP Action Programme (mhGAP) recommendations [47] as guide at this level of healthcare. We believe that these preliminary data will form a platform to justify grant funding that can be employed to train NPI staff to provide assessment and interventions for both mothers and their infants at NPI clinics.

2. Methods and materials

2.1. Location

This study was carried out at infant-immunization clinics of Enugu State University of Science and Technology (ESUT) Teaching Hospital, Parklane, and University of Nigeria Teaching Hospital (UNTH) located in Enugu metropolis. These constitute the two main university teaching hospitals in Enugu State, southeastern Nigeria, and accessed by mothers from different locations within the state. These two institutions also provide the primary care of immunization under the NPI.

2.2. Participants

Participants were mothers bringing their children for routine immunization schedules in the above two centers. The inclusion criterion is a given informed consent to participate in the study. While the exclusion criteria are mothers who did not give informed consent; mothers with previous history of mental illness; mothers with multiple births, for example, mothers of twins and triplets, because the children are likely to have a low birth weight and preterm infants who are also likely to have low birth weight.

2.3. Sample size calculation

The sample size calculation was done using the formula:

$$N = \left(Z^2 pq\right)/d^2$$

Where: N=represents the sample size

Z=represents standard normal distribution corresponding to a specific confidence level of 1.96

p=represents the prevalence

d=Represents degree of confidence = 0.05

q = 1−p

Using prevalence of 14.6% (0.146) as obtained in a Nigerian study[13],

On substitution,

$$\text{Sample size } N = \left(Z^2 pq\right)/d^2 = \left[1.96^2 \times 0.146 \times (1[m1] - 0.146)\right] /0.05^2$$

$$= \frac{1.96 \times 1.96 \times 0.146 \times 0.854}{0.05 \times 0.05} = 192 \text{ Participants}$$

The minimum sample size required was 192 participants. However, a total of 408 consecutive mothers and their infants attending the immunization clinics were eventually interviewed and assessed.

2.4. Ethical issues

Approval to conduct the study was obtained from the ethical committees of ESUT Teaching Hospital, Parklane, Enugu, and UNTH,

Enugu. Informed consent was obtained from the participants after explaining the objectives of the study to them. Those women screened positive for depression were referred to Federal Neuropsychiatric Hospital, Enugu, Nigeria, for further evaluation and management.

3. Materials

3.1. Sociodemographic questionnaire

Sociodemographic questionnaire was used to elicit mothers' and infants' information such as age, marital status, religion, educational level, occupation, parity, number of children, mode of delivery, as well as child-related questions like age, birth weight, feeding method and history of any physical illnesses. The measured weight (Mwt), length and HC of each infant as well as the equivalents (in relation to WHO recommendations) were recorded in this questionnaire.

3.2. EPDS [45]

The EPDS is a 10-item self-report questionnaire (developed at health centers in Livingstone and Edinburgh) in which women were asked to rate how they had felt in the previous 7 days. Each question has four possible responses that are scored 0 to 3 (for a total score range of 0 to 30). In Nigeria, the EPDS has been translated into three local languages and validated in two of these languages [12,14,17]. It has been translated and validated in southeastern Nigeria against a structured interview schedule that was adapted from the depression section of the Composite International Diagnostic Interview (CIDI) and affective module of the International Classification of Diseases, 10th Edition (ICD - 10) symptom checklist as gold standard with the best cutoff score found to be 9 and above with sensitivity of 0.75 and specificity of 0.97 [12]. Screening positive on EPDS does not imply diagnosis of depression. It rather signifies the need for further assessment and evaluation towards definitive diagnosis and interventions.

3.3. M.I.N.I. [44]

The M.I.N.I. is designed as a brief structured interview for the Major Axis I psychiatric disorders in Diagnostic and Statistical Manual of Mental Disorders, 4th Edition and ICD-10. Validation and reliability studies have been done comparing the M.I.N.I. to the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, 3rd Edition, Revised and the CIDI, a structured interview developed by the WHO for lay interviewers based on ICD-10 criteria. The results of these studies show that the M.I.N.I. has acceptable validity and reliability. Its advantage over other diagnostic instruments is its brevity and that it can be administered in a much shorter period of time. It is divided into different diagnostic modules and for this study; major depressive episode module was used. At the beginning of the diagnostic module for major depression, screening questions corresponding to the main criteria of depression are presented. At the end, diagnostic boxes permit the clinician to indicate whether diagnostic criteria for depression were met or not.

3.4. WHO Standard growth charts [46]

Growth charts are visible displays of a child's physical growth and development. WHO standard growth charts have two reference curves for both sexes in relation to weight for age, length for age and HC for age. Normal variations are assumed to include two standard deviations above and below the mean, that is, 3rd and 97th percentile. Recordings below the 3rd percentile would be said to be an indication of delayed growth. For this study, the weight for age, length for age and HC for age charts for both sexes were used. For the purpose of this study, weight for age, length for age and HC for age at 50th percentile on the growth charts were used as reference points of comparison to the parameters that were obtained from the infants studied.

3.5. Procedure

Participants were consecutively selected from the infant-immunization clinics of ESUT, Teaching Hospital, Parklane and UNTH. Consenting mothers were required to complete the EPDS, which is a self-report questionnaire. Then, we administered the major depressive episode module of M.I.N.I. to the mothers. The infants of the mothers had their anthropometric measurements (weights, lengths and HC) taken as follows:

For weight measurement, infants were weighed in nude using a calibrated beam scale (Mechanical Baby Scale manufactured by Zhejiang Conqueror Weighing Apparatus Co. Ltd). The infants were placed at the center of the tray without being held, and the scale was read at eye level. The weights were recorded to the nearest 10 g.

For the length measurement, the infants' lengths were measured using a calibrated length board (Seca 416 Mechanical Infantometer), which had a fixed headpiece and a moveable foot piece perpendicular to the surface of the board. The infants were placed in a recumbent (lying down) position on the board after their shoes and hair pieces have been removed. An assistant (nurse) held the child still with legs straightened, and the moveable foot piece was adjusted in order to record the lengths. The lengths were recorded to the nearest 0.1 cm.

For the HC measurement, flexible nonstretchable tapes (manufactured by The Perfect Measuring Tape Company) were used to measure the HCs of the infants. The tapes were securely wrapped around the widest possible circumference of the infants' head, which is over the most prominent part of the occiput and just above the supraorbital ridges. Measurements were recorded to the nearest 0.1 cm. The results of these anthropometric measurements obtained from the infants were compared to the WHO growth charts recommendation using 50th percentiles as reference point of comparison to identify whether there were growth deviations from the WHO recommendations [46].

3.6. Data analyses

Data analyses were carried out using the Statistical Package for Social Sciences Version 16 for windows. The participants who scored 9 and above on the EPDS and those who met diagnostic criteria, using major depressive episode module of M.I.N.I., were classified as having PPD. Sensitivity, specificity, PPV and NPV of EPDS were determined using major depressive episode module of M.I.N.I. as a gold standard. Continuous variables were analyzed using the *t* test, correlation and linear regression statistics as appropriate. Categorical variables were analyzed with chi-square statistics.

4. Results

Over a 6-week period, a total of 446 mothers were consecutively approached for the study. Out of this total, 408 mothers met the inclusion criteria and consented to participate in the study, while 38 mothers did not. Consequently, a total of 408 mothers and their infants eventually participated in the study.

4.1. Sociodemographic variables of the mothers (Table 1)

The mean age of the mothers was 28.16 ± 5.07 years (range = 15–47). Most (97.8%) of the mothers were married, 1.5% of them were single while 0.7% were widowed. Among the mothers interviewed, 44.6% had either completed their tertiary education or were still undergraduates, 42.4% attained secondary school education, while 13.0% had attained only primary school education. Over half (60.8%) of the mothers were employed, and only 9.3% of them had more than four children.

Table 1
Socio-demographic variables of the mothers

Variables	*n* (%)
Age (years)	
Range	15–47
Mean	28.2 ± 5.1
Marital status	
Single	6 (1.5)
Married	399 (97.8)
Widowed	3 (0.7)
Educational level	
No formal education	0 (0.0)
Primary school	53 (13.0)
Secondary school	173 (42.4)
Tertiary school	182 (44.6)
Employment status	
Employed	248 (60.8)
Full-time housewives	80 (19.6)
Students	56 (13.7)
Unemployed	24 (5.9)
Number of children	
1	126 (30.9)
2	100 (24.5)
3	88 (21.6)
4	56 (13.7)
>4	38 (9.3)

4.2. Sociodemographic variables of the Infants

The age of the infants were recorded in months (30 days = 1 month). The mean age of the infants was 3.56 ± 3.21 months (range = 0.03–12). Their mean birth weight was 3.36 ± 0.58 kg (range = 1.6–5.6). Over half (52.2%) of the infants were males while the rest (47.8%) were females. Out of the 408 infants studied, 93 (22.8%) of them had a recent or ongoing illness. This constituted 84 (24%) infants of nondepressed mothers and 9 (14.5%) infants of depressed mothers. The difference was however not statistically significant ($\chi^2 = 3.100$, $df = 1$, $p = .078$).

4.3. Prevalence of PPD among the mothers

Out of the 408 mothers that participated in the study, a total of 101 (24.8%) had an EPDS score of 9 and above and were classified as depressed. However, using major depressive episode module of MINI, 62 (15.2%) of the mothers were found to be depressed.

4.4. Sociodemographic variables of depressed and nondepressed mothers (Table 2)

The mean age of the depressed mothers was 28.08 ± 5.39 years while that of nondepressed mothers was 28.18 ± 5.01 years. The difference in the mean ages was not statistically significant ($t = 0.141$, $df = 406$, $p = .888$). Out of the 248 (100%) mothers who were employed, 25 (10.1%) were depressed while the rest were not, and of the 160 (100%) mothers who were unemployed, 37 (23.1%) of them were found to be depressed while the remaining were not. The difference in the prevalence of depression between those who were employed and those who were not was statistically significant with those without employment more likely to be depressed ($\chi^2 = 11.849$, $df = 1$, $p = .001$). Other sociodemographic variables did not show any significant association with prevalence of depression (Table 2).

Table 2
Sociodemographic variables of depressed and nondepressed mothers

MINI diagnosis	Age (years)		Statistics
Mean			
Depressed	28.08 ± 5.39		$t = 0.141$, $df = 406$
Nondepressed	28.18 ± 5.01		$p = .888$
Marital status, *n* (%)			
	Married	Unmarried	
Depressed	60 (15%)	2 (22.2%)	$\chi^2 = 0.015$, $df = 1$
Nondepressed	339 (85%)	7 (77.8%)	$p = .901$
Employment status, *n* (%)			
	Employed	Unemployed	
Depressed	25 (10.1%)	37 (23.1%)	$\chi^2 = 11.849$, $df = 1$
Nondepressed	223 (89.9%)	123 (76.9%)	$p = .001$
Number of children			
	Less than children	More than 4 children	
Depressed	60 (16.2%)	2 (5.3%)	$\chi^2 = 2.414$, $df = 1$
Nondepressed	310 (83.8%)	36 (94.7%)	$p = .120$

4.5. Performance of EPDS as a screening tool for PPD in the study population (Table 3)

Table 3 showed the sensitivity, specificity, PPV and NPV of EPDS at the recommended cutoff point of 9 and above [12] using major depressive episode module of M.I.N.I. as a gold standard.

Sensitivity = TP/(TP + FN) × 100 = 46/(46 + 16) × 100 = **74.19%**

Specificity = TN/(TN + FP) × 100 = 291/(291 + 55) × 100 = **84.10%**

PPV = TP/(TP + FP) × 100 = 46/(46 + 55) × 100 = **45.54%**

NPV = TN/(TN + FN) × 100 = 291/(291 + 16) × 100 = 94.79%

4.6. Deviation of measured infants growth parameters from WHO recommendations for age at 50th percentile (Fig. 1)

4.6.1. Infants' weight

The mean for the Mwts of the infants was 5.78 ± 1.86 kg (range = 2.00 kg to 10.50 kg), while the mean for the WHO recommended weight for age at 50th percentile was 5.93 ± 1.76 kg (3.20 kg to 9.60 kg). The goodness of fit (R^2) = 0.828. This difference in the two mean values was found to be statistically significant ($t = 3.88$, df=407 and $p = .000$), implying that the mean Mwt of the infants studied was significantly lower than the mean WHO recommended weight for age at 50th percentile (negative deviation) (Table 4). However, there was a positive correlation between the mean Mwt and mean WHO recommended weight for age at 50th percentile ($r = 0.91$, $p = .000$).

4.6.2. Infants' length (Fig. 2)

The mean for the measured lengths (Mlents) of the infants studied was 58.25 ± 7.81 cm (range = 36 to 85 cm), while the mean for WHO recommended length for age at 50th percentile was 60.12 ± 7.15 cm (range = 34 to 76 cm). The goodness of fit is (R^2) = 0.812. The difference in the two mean values was found to be statistically significant ($t = 11.18$, $df = 407$, $p = .000$), implying that the mean for Mlents of the infants was significantly lower than the mean for WHO recommended length for age at 50th percentile (negative deviation). However, there was a positive correlation between the mean Mlent of the infants studied and the mean WHO recommended length for age at 50th percentile ($r = 0.90$, $p = .000$).

Table 3
Performance of EPDS as a screening tool for PPD at a cutoff of ≥9

EPDS	MINI		
	Positive	Negative	Total (EPDS, cutoff ≥9)
Positive	TP	FP	
N (%)	46 (11.27%)	55 (13.48%)	101 (24.75%)
Negative	FN	TN	
N (%)	16 (3.92%)	291 (71.32%)	307 (75.25%)
Total (MINI)			
N (%)	62 (15.20%)	346 (84.80%)	408 (100%)

TP=true positive; FP=false positive; FN=false negative; TN=true negative.

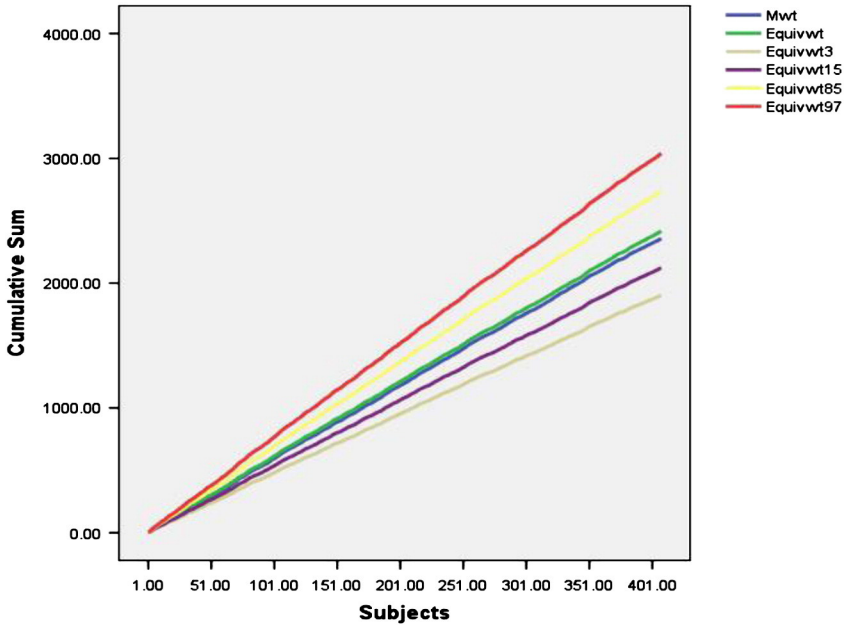

Fig. 1. Linear graph plots of Mwt and WHO recommended weight for age at the 97th, 85th, 50th, 15th and 3rd percentiles. Equivwt=WHO recommended weight for age at 50th percentile; Equivwt3, Equivwt15, Equivwt85, Equivwt97=WHO recommended weight for age at 3rd, 15th, 85th and 97th percentile, respectively.

4.6.3. Infants' HC (Fig. 3)

The mean for the measured HCs (MHCs) of the infants studied was 40.40 ± 3.59 cm (range = 31.50 to 51.00 cm), while the mean for the WHO recommended HC for age at 50th percentile was 39.67 ± 3.22 cm (range = 34.00 to 48.00 cm). The goodness of fit is (R^2) = 0.684. The difference in the two mean values was found to be statistically significant ($t = 7.26$, $df = 407$, $p = .000$), implying that the measured mean HC was significantly greater than the WHO recommended mean HC at 50th percentile (positive deviation). There was a positive correlation between the mean MHC and the WHO recommended mean HC at 50th percentile ($r = 0.83$, $p = .000$).

4.7. Association between PPD and Infants' Growth in relation to the WHO Recommendation at 50th Percentile (Table 5)

4.7.1. Infants' weight

For infants of depressed mothers, goodness of fit is (R^2) = 0.759, which implies that the mean Mwt for age of infants of depressed mothers are relatively approximate to WHO standards at the 50th percentile. For infants of nondepressed mothers, goodness of fit is (R^2)=0.841, which implies that the mean Mwt for age of infants of nondepressed mothers are also relatively approximate to WHO standards at the 50th percentile, with the goodness of fit better for infants of nondepressed mothers (R^2=0.841) compared to infants of depressed mothers (R^2=0.759), implying that the degree of stunting is higher among the infants of depressed mothers. See Table 5.

Table 4
Deviation of measured infant growth parameters from the WHO recommendation for age at the 50th percentile

Demographics	Range	Mean	Correlation Statistics	*T* test Statistics
Weight				
Mwt (kg)	2.00–10.50	5.78 ± 1.86	$r = 0.91$	$t = 3.88$
WHO weight (50th)	3.20–9.60	5.93 ± 1.76	$p = .000$	$df = 407$
				$p = .000$
Length				
Mlent (cm)	36–85	58.00 ± 7.81	$r = 0.90$	$t = 11.18$
WHO length (50th)	34–76	60.12 ± 7.15	$p = .000$	$df = 407$
				$p = .000$
HC				
MHC (cm)	31.50–51.00	40.40 ± 3.59	$r = .83$	$t = 7.26$
WHO HC (50th)	34.00–48.00	39.67 ± 3.22	$p = .000$	$df = 407$
				$p = .000$

4.7.2. Infants' length

For infants of depressed mothers, goodness of fit is (R^2) = 0.733, which implies that the mean Mlent for age for the infants of depressed mothers are relatively approximate to WHO standards at the 50th percentile. For infants of nondepressed mothers, goodness of fit is (R^2) = 0.826, which implies that the mean Mlent for age of infants of nondepressed mothers are also relatively approximate to WHO standards at the 50th percentile, with the goodness of fit better for infants of nondepressed mothers (R^2 = 0.826) compared to the infants of depressed mothers (R^2 = 0.733), signifying that the degree of stunting was higher among the infants of depressed mothers. See Table 5.

4.7.3. Infants' HC

For infants of depressed mothers, goodness of fit is (R^2) = 0.724, which implies that the mean MHC for age of the infants of depressed mothers are relatively approximate to WHO standards at the 50th percentile. For infants of nondepressed mothers, goodness of fit is (R^2) = 0.680, which implies that the mean MHC for age of infants of nondepressed mothers are also relatively approximate to WHO standards at the 50th percentile with the goodness of fit better for infants of depressed mothers. See Table 5.

5. Discussion

5.1. Main findings

We found it feasible introducing these two short screening and diagnostic instruments into NPI. The brevity of these instruments conferred the necessary advantage of easy and quick administration.

The prevalence of PPD amongst mothers who visited the immunization clinics studied in Enugu metropolis was 15.2% using the major depressive episode module of M.I.N.I. The prevalence of PPD

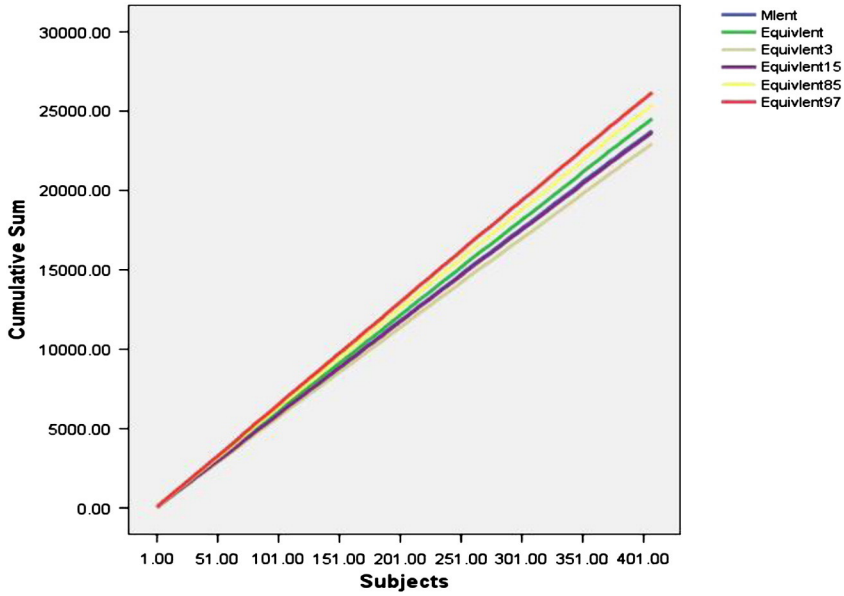

Fig. 2. Linear graph plots of Mlent and WHO recommended length for age at 97th, 85th, 50th, 15th and 3rd percentiles. Equivlent=WHO recommended length at 50th percentile; Equivlent3, Equivlent15, Equivlent85, Equivlent97=WHO recommended length at 3rd, 15th, 85th and 97th percentiles, respectively.

amongst mothers who visited the immunization clinics in Enugu metropolis was 24.8% using the EPDS at a cut off of 9 and above [12]. EPDS performed fairly well at a cut off score of ≥9 with a sensitivity of 74.19%, specificity of 84.10%, PPV of 45.54% and NPV of 94.79%, when compared to major depressive episode module of M.I.N.I. as a gold standard. The measured mean weight of the infants studied was negatively deviated from the mean WHO recommended standard at 50th percentile. The measured mean length of the infants studied was also negatively deviated from the mean WHO recommended standards at 50th percentile. The measured mean HC of the infants studied was positively deviated from the WHO recommended standard at 50th percentile. Negative associations were observed between PPD and the growth parameters of length and weight of the infants. The inference that can be drawn from this association is limited because the study is cross-sectional in design and the influences of other confounding factors were not controlled for.

5.2. Prevalence of PPD

The prevalence rate of PPD in this study using the EPDS was 24.8%. This is in agreement with the prevalence of 23% [15] found in western Nigeria using EPDS. In this study as well as in other studies, unemployment constituted a risk factor for the development of PPD when the sociodemographic correlates of depressed mothers was compared with nondepressed mothers. However, in other Nigerian studies, rates of 10.7 to 18.6% had been documented using the EPDS [12–14,16]. This study found 15.2% of the postpartum mothers assessed with major depressive episode module of MINI to be

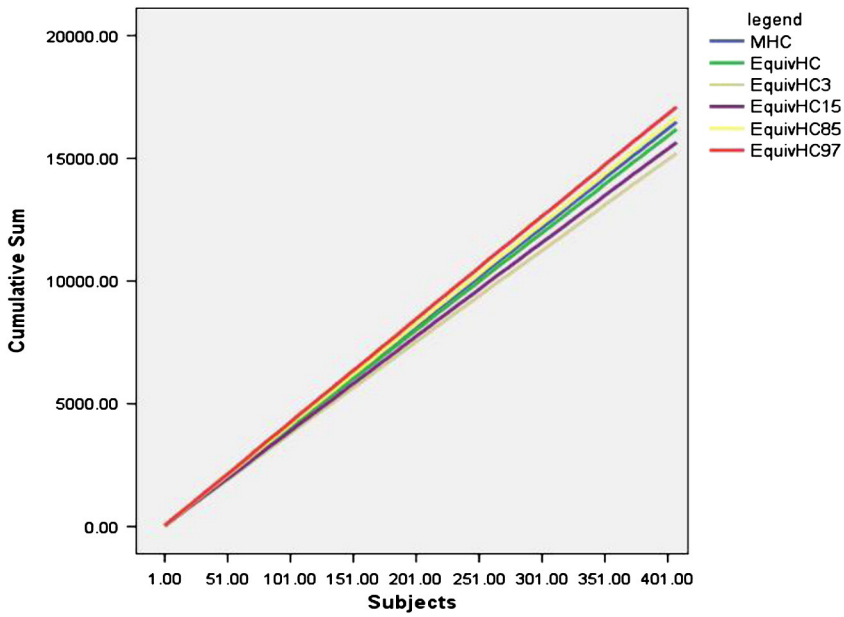

Fig. 3. Linear graph plots of MHC and WHO recommended HCs for age at 97th, 85th, 50th, 15th and 3rd percentiles. EquivHC=WHO recommended HC for age at 50th percentile; EquivHC3, EquivHC15, EquivHC85, EquivHC97=WHO recommended HC at 3rd, 15th, 85th, and 97th percentiles, respectively.

Table 5
Association between PPD and measured growth parameters in relation to WHO recommended equivalents at 50th percentile

Variables	*n* (%)	Mean measured parameter	Mean WHO parameters (50th percentile)	*T* test statistics	Goodness of fit
Weight					
Depressed	62 (15.2)	5.48 ± 1.71	5.82 ± 1.73	$t = 3.07$, $df = 61$, $p = .003$	$R^2 = 0.759$
Nondepressed	346 (84.8)	5.83 ± 1.88	5.95 ± 1.77	$t = 2.83$, $df = 345$, $p = .005$	$R^2 = 0.841$*
Length					
Depressed	62 (15.2)	57.06 ± 7.37	59.75 ± 6.85	$t = 5.28$, $df = 61$, $p = .000$	$R^2 = 0.733$
Nondepressed	346 (84.8)	58.46 ± 7.87	60.19 ± 7.21	$t = 9.78$, $df = 345$, $p = .000$	$R^2 = 0.826$*
HC					
Depressed	62 (15.2)	40.20 ± 3.44	39.59 ± 3015	$t = 2.63$, $df = 61$, $p = .11$	$R^2 = 0.724$*
Nondepressed	346 (84.8)	40.44 ± 3.62	39.69 ± 3.24	$t = 6.76$, $df = 345$, $p = .000$	$R^2 = 0.680$

* Better goodness of fit.

depressed. This finding is comparable to that obtained in a study of Moroccan mothers also using major depressive episode of MINI where 18.7% of them were found to have PPD [8]. When the performance of EPDS at a cutoff score of ≥9 was determined using the major depressive episode of M.I.N.I. as a gold standard, EPDS performed fairly well in screening for maternal PPD.

5.3. Deviation of studied infants' growth parameters from WHO recommended growth parameters for age at 50th percentile

The mean Mwt of the infants studied was found to be significantly lower than the WHO recommended mean weight for age at 50th percentile. In addition, the mean Mlent of the infants was found to be significantly lower than the WHO recommended mean length for age at 50th percentile. The negative deviation of Mwt and length of the infants from the WHO recommended equivalents at the 50th percentile may be explained by a myriad of factors peculiar to low-resource countries. These include poverty, diseases and poor nutrition among others. The presence of recent illness in some of the infants of both depressed and nondepressed mothers could have also contributed to the negative deviation obtained in Mwt and length from the WHO recommendations at the 50th percentile.

The mean MHC of the infants was found to be significantly higher than the WHO recommended mean HC for age at the 50th percentile, which suggests a positive deviation. This possibly means that the infants studied were likely to have higher values in terms of HCs when compared to the values recommended by WHO, especially using the 50th percentile as a reference. This finding is comparable to that recorded in a study done in the US using the electronic health records of more than 75,000 patients in the Children's Hospital Primary Care Network between August 2001 and January 2008, which revealed that the use of WHO growth curves would cause an excess of children to be labeled as having large heads at all ages [48]. For this reason, a new growth chart was developed from the data of the study to reduce unnecessary follow-up tests and specialty referrals as well as to prevent unnecessary worry by parents of healthy children [48]. While it may be suggested that the studied infants were stunted at the reference point of WHO recommended growth parameters at the 50th percentile in the aspects of weight and length, the reverse is the case for the HC of these infants.

5.4. Association between PPD and growth parameters of the studied infants

The mean Mwt and length of infants of depressed and non-depressed mothers were significantly lower than the WHO recommended mean weight and length at the 50th percentile. However, infants of depressed mothers showed more marked significant reduction in mean Mwt and length when compared to infants of nondepressed mothers in relation to the WHO recommendation at the 50th percentile. It can be deduced that stunted growth in the parameters of weight and length is associated with maternal postpartum. However, this does not imply causation as earlier highlighted. This finding is comparable to that of another Nigerian study done in a postnatal clinic in southwest Nigeria, which showed that infants of depressed mothers had poorer physical growth than infants of nondepressed mothers [40]. Studies in India, Pakistan and Jamaica [35,49–52] have also shown a similar association between maternal depressive symptoms and poor growth in infants.

The mean MHCs of infants of depressed and nondepressed mothers were found to be significantly higher than the WHO recommended mean HC for age at the 50th percentile. However, WHO Standard Growth Chart for HC had been noted to present with some challenges of comparison in a previous study done in the US [47] and this present study.

6. Limitation

The main limitation of this study is that the design is cross-sectional and hence the growth parameters of the infants studied were measured only once. There was no follow up of the cases to monitor the growth trend of the infants over time and to see whether resolution of maternal PPD over time would reverse the negative association observed in the growth parameters of the infants. This is an area where future wider implementation of this idea needs attention. It is necessary to incorporate intervention services for the mothers and their infants within the NPI and do prognostic follow up of the mothers and their infants. Future ideas that were not captured in this study should focus on developing screening protocol for NPI that can assess socioeconomic status, nutritional status of the infants, diseases and other maternal well-being.

7. Conclusions

In a developing country like Nigeria, there are many factors that may be working against the optimal development of children. Such factors included poverty, diseases, inadequate housing and overcrowding among others. With the additional factor of maternal PPD, child underdevelopment may worsen. The achievement of the Millennium Development Goals to improve maternal health, reduce child mortality, promote gender equality, empower women, achieve universal primary education and eradicate extreme poverty and hunger cannot be achieved unless there is a specific focus on maternal and child mental health. Therefore, addressing maternal PPD through early detection and interventions may improve optimal development of children in low-resource countries like Nigeria. NPI would provide the best forum for early screening of mothers for PPD and interventions in Nigeria. NPI would also serve a useful avenue of screening for developmental concerns in Nigerian infants and children.

Acknowledgments

Special thanks to all the nurses and staff working in the immunization clinics of ESUT Teaching Hospital Parklane and UNTH, Enugu, for all their assistance while conducting the study.

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