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Cognitive Dysfunction Among *Primi gravidae* Attending an *Ante Natal* Clinic in Kano, Northwest Nigeria

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Summary: Cognitive deficits among pregnant women have been reported, though the evidence is equivocal. Cognitive dysfunction during pregnancy may have negative consequences on maternal and child health. Yet, very little is known about cognitive function of pregnant women in general and *primi gravidae* in particular in the area under study. This study aimed to evaluate cognitive function among *primi gravidae*. About 120 *primi gravidae* were studied in a large urban hospital in Kano. Mini-Mental State Examination (MMSE) was used to evaluate cognitive function; socio-demographic and clinical data were obtained. Data were processed using IBM SPSS statistics version 20.0. Significant values of *P* were those < 0.05. The median age of the *primi gravidae* was 20.0 (3) years; 80 % of them had secondary school education, 88.3 % were in their third trimester of pregnancy and 42.5 % did not have any medical complaints at the time of presentation. The median MMSE score of the *primi gravidae* was 22.00 (19.0), indicating mild cognitive impairment. Majority of the women (88.3%) had either mild (58.3%) or severe (30%) cognitive dysfunction. The cognitive dysfunction was influenced by level of education (X^2 = 11.961, P = 0.003) and type of presenting complaints (X^2 = 13.514, P = 0.036). There was significant association between the mild cognitive impairment and level of education (X^2 = 11.426, P = 0.022). This study concluded that the *primi gravidae* had mild cognitive impairment; with majority (88.3%) of them having cognitive dysfunction, which was significantly associated with level of educational attainment and was influenced by the level of education and presenting complaints.

Keywords*:* cognitive impairment, cognition, *primi gravidae*, pregnancy, Kano, Nigeria.

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INTRODUCTION

Cognition (or cognitive function) is the process of consciously using one's brain. It involves higher brain functions such as learning, memory, attention, executive function, problem solving and thought. Pregnancy is a period in a female's life from conception to delivery of an offspring. Pregnancy has been associated with cognitive slips during the activities of daily living of the pregnant woman (Crawley *et al.,* 2008). Indeed, there is fairly well documented scientific evidence behind this observation. The pregnant woman comes under the influence of an array of physical, physiological, psychological changes and socio-cultural events occurring during the pregnancy; and these changes may have negative consequences on cognitive function.

Buckwalter *et al*. (1999) reported cognitive changes and related them to hormonal levels during pregnancy. Other studies also reported cognitive deficits among pregnant women (Casey *et al.*, 1999; Christensen *et al.*, 2010). Pregnant women are at risk of depression (Parcells, 2010). In fact, specific types of cognitive dysfunction due to depression in pregnancy and post-partum period have been reported (Larry, 2017). Despite this, the evidence of cognitive dysfunction among pregnant women is equivocal and little is known about how these deficits progress with time (De Groot *et al.,* 2006).

Logically, the changes occurring during pregnancy would be even more obvious in women having their pregnancy for the first time (*primi gravidae*). *Primi gravidae* reported significant sleep disruptions which was a significant predictor of their memory changes (Janes *et al.,* 2009). Parson *et al*. (2004) suggested that first-time mothers had worse cognitive deficit than women who have previously had children.

Cognitive dysfunction during pregnancy may have negative consequences on maternal and child health with consequent poor pregnancy outcome and poor health status of the offspring. Yet, very little is known about cognitive function in pregnant women in general, and *primi gravidae* in particular in the

environment under study. Based on previous reports, we hypothesize that *primi gravidae* in this environment will have significant cognitive dysfunction. It is pertinent, therefore, to study the nature and magnitude of cognitive dysfunction among *primi gravidae*. This study aimed to evaluate cognitive function among *primi gravidae* attending an antenatal clinic in Kano. Knowledge about cognitive changes during pregnancy may lead to better understanding and development of effective management strategies.

MATERIALS AND METHODS

Study setting and ethical considerations: The study area was Murtala Mohammed Specialist Hospital, a 250-bed capacity hospital located in the city of Kano, Nigeria. It offers services at all levels of healthcare and runs antenatal clinic which attends to about 1000 pregnant women per week, out of which about 60 are *primi gravidae*. Ethical approval for the study was given by the Health Research Ethics committee, Kano State Ministry of Health (Ref.: MOH/Off/797/T.I/464; dated 31/07/2017). Each participant voluntarily consented to the study and signed informed consent form before the commencement of the study. The study conformed to the provisions of the declaration of Helsinki 1995 (as reviewed in Tokyo in 2004).

Study population and sampling: The study population comprised of about 240 *primi gravidae* attending the antenatal clinic per month, out of which 120 were selected for this cross-sectional study using systematic sampling.

Eligibility and exclusion criteria: All the *primi gravidae* attending the *ante natal* clinic were eligible for inclusion in the study. However, those with on-going fever, diarrhea and respiratory tract infection, presence or history of mental illness or any chronic disease not related to pregnancy such as hypertension or diabetes were excluded from the study.

Data collection: Socio-demographic, anthropometric and clinical data were obtained during an interview and physical examination and recorded into a data capture form specially designed for this study. Mini-Mental State Examination (MMSE) was used to evaluate cognitive function. The cognitive assessment was conducted by a health personnel (rater) who was specially trained for that purpose.

Briefly, the MMSE measured orientation to time and place, immediate recall, short-term verbal memory, calculation, language, and construct ability. Each area tested has a designated point value, with the maximum possible score on the MMSE being 30/30. Levels of cognitive dysfunction were classified as: severe (0 – 17), mild (18- 23) and normal (24- 30). The MMSE was originally introduced by (Folstein *et al.*, 1975), in order to differentiate organic from functional psychiatric patients and incorporated tests which were in use prior to its publication. The standard MMSE form which is currently published by Psychological Assessment Resources is based on its original 1975 conceptualization, with minor subsequent modifications by the authors.

Statistical Analyses: Data were processed using IBM SPSS statistics version 20.0 (SPSS Inc., IL., USA). Values were summarized using frequencies (and percentages) or median (and interquartile range). Cognitive function was compared between categories of socio-demographic and clinical characteristics using Kruskal-Wallis test, while the relationship of cognitive function with these characteristics was evaluated using Chi-square test for (categorical variables) or Kendall's tau b (numerical variables). Values of $P < 0.05$ were considered significant

RESULTS

Socio-demographic characteristics of the participants: The median age of the *primi gravidae* was 20.0 (3) and 90% of them were within the age range of 16 – 25 years (Table 1). Most of them were urban-dwelling (75.8%), unemployed (68.3%) fulltime house-wives who were educated up to the secondary school level (80%), with family income above the poverty line (2 USD/day) for about 98 % of them.

Clinical characteristics of the participants: Most of the women studied were in their third trimester of pregnancy (88.3%) with singleton fetus (72.5%) and 42.5% did not have any medical complaints at the time of presentation (Table 2).

Table 1: Influence of socio- demographic characteristics on cognitive function among *primi gravidae*

Characteristics	MMSE Score	N (%)	Test of Significance
Age			
16- 25	22.00 (5.5)	108 (90)	$X^2 = 0.065$
26- 35	22.00 (7.5)	12 (10)	df = 1
36-45	0	0 (0)	$P = 0.799$
Level of Education			
Primary	20.00 (4.5)	17 (14.2)	$X^2 = 11.961$
Secondary	23.00 (5.9)	96 (80)	df = 2
Post- Secondary	26.50 (7.5)	7 (5.8)	$P = 0.003$
Occupation			
Fulltime housewives	22.00 (6.5)	82 (68.3)	$X^2 = 1.116$
Self- employed	22.50 (4.3)	34 (28.3)	df = 2
Civil Servant	23.50 (7.9)	4 (3.3)	$P = 0.572$
Income (per month)			
≤ ₦10,999 (30 USD)	0	0 (0)	$X^2 = 4.048$
₦11,000- ₦21,999	19.75	2 (1.7)	df = 2
₦22,000- ₦43,999	21.50 (6.9)	76 (63.3)	$P = 0.132$
≥ 44,000	23.00 (4.1)	42 (35)	
Area of Residence			
Urban	23.00 (5)	91 (75.8)	$X^2 = 1.118$
Semi-urban	21.25 (7.6)	24 (20)	df = 2
Rural	20.00 (4.3)	5 (4.2)	$P = 0.572$

Table 2: Influence of clinical characteristics on cognitive function among *primi gravidae*

Characteristics	MMSE Score	N (%)	Test of Significance
Weight (kg)			
40 - 49.9	23.00 (8.8)	17 (14.2)	$X^2 = 3.822$
50 - 59.9	23.00 (6.5)	55 (45.8)	df = 4
60 - 69.9	21.00 (6.5)	31 (25.8)	$P = 0.353$
70 - 79.9	23.00 (3.3)	12 (10.0)	
80 - 89.9	20.00 (7.0)	5 (4.2)	
Height (m)			
1.4 - 1.49	22.00 (7.5)	4 (3.3)	$X^2 = 0.502$
1.5 - 1.59	21.5 (4.5)	39 (32.5)	df = 2
1.6 - 1.7	23.00 (6.5)	77 (64.2)	$P = 0.302$
BMI (kg/m^2)			
< 18.5	32.00 (9.0)	7 (5.8)	$X^2 = 1.861$
18.5 - 24.9	22.00 (7.3)	90 (75.0)	df = 3
25.0 - 29.9	20.50 (3.5)	16 (13.3)	$P = 0.602$
≥ 30	22.00 (4.5)	7 (5.8)	
Gestational age			
1st trimester	21.25	2 (1.7)	$X^2 = 0.604$
2ndtrimester	23.50 (6.9)	12 (10)	df = 2
3rd trimester	22.00 (5.6)	106 (88.3)	$P = 0.739$
Number of fetuses			
Unknown	22.75 (6.6)	30 (25)	$X^2 = 3.785$
Singleton	22.00 (5.0)	87 (72.5)	df = 2
Twin	27.00	3 (2.5)	$P = 0.151$
Presenting complaints*			
Nil	23.00 (5.5)	51 (42.5)	$X^2 = 13.514$
Nausea	21.00 (8.0)	7 (5.8)	df = 6
Vomiting	18.50 (4.5)	7 (5.8)	$P = 0.036$
Fatigue	26.00 (6.5)	9 (7.5)	
Tiredness	22.00 (9.5)	12 (10)	
Others	19.50 (5.6)	6 (5)	
More than one complaint	21.25 (4.3)	28 (23)	

*Significant difference between the categories

Table 3: Relationship of cognitive function with socio-demographic and clinical characteristics of *primi gravidae*

Characteristics	Test of Relationship	
Socio-demographic	Chi-square	*P*
Age	0.397	0.820
Level of Education	11.426	0.022*
Occupation	2.979	0.561
Family Income	34.625	0.181
Area of Residence	3.931	0.415
Pregnancy		
Gestational age	4.76	0.313
Number of Fetuses	2.181	0.703
Presenting Complaints	19.056	0.087
Anthropometric	Kendall's tau-b	*P*
Weight	-0.068	0.290
Height	0.046	0.477
BMI	-0.090	0.154

*Significant difference between the categories

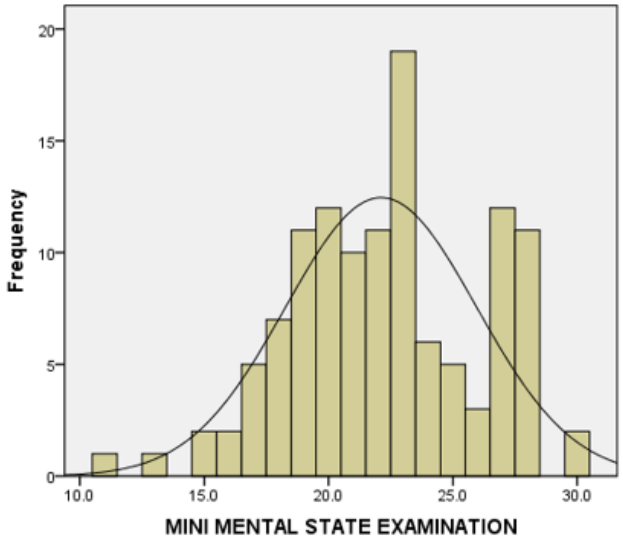

Figure 1: Frequency distribution of MMSE scores of *primi gravidae*

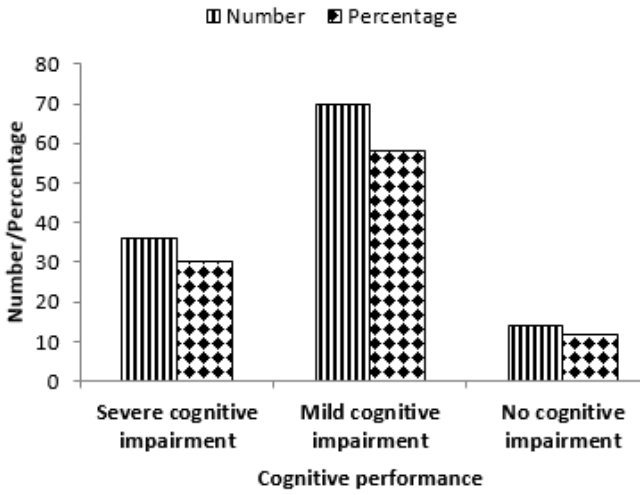

Figure 2: Distribution of cognitive function among *primi gravidae*

Cognitive function of the participants: The median MMSE score of the *primi gravidae* was 22.00 (19.0), indicating mild cognitive impairment and this variable had skewed distribution (Kalmagorov-Smirnov statistic = 0.232, $P = 0.001$) (Fig. 1). Only 11.7% of the women had normal cognitive function, while the majority of them (88.3%) had either mild (58.3%) or severe (30%) cognitive dysfunction (Fig. 2). The cognitive performance of the participants was influenced by their level of education (X^2=11.961, $P = 0.003$) and nature of presenting complaints ($X^2 = 13.514$, $P = 0.036$) with vomiting accounting for the lowest cognitive performance (Table 2). Weight, height, BMI, gestational age and number of fetuses did not significantly influence cognitive function ($P > 0.05$). There was significant association between the mild cognitive impairment and level of education ($X^2 = 11.426$, $P = 0.022$). However, there was no association between the cognitive impairment observed and any socio-demographic or clinical characteristics of the participants (Table 3).

DISCUSSION

This study assessed cognitive function among 120 *primi gravidae* attending antenatal clinic in an urban hospital. It was found that 88.3% of the *primi gravidae* had cognitive dysfunction, either mild (58.3%) or severe (30%).

Cognitive dysfunction refers to deficits in attention, verbal and non-verbal learning, short-term and working memory, visual and auditory processing, problem solving, processing speed, and motor functioning (Raymond *et al.,* 2014). The reported cognitive dysfunction could be due to stress of pregnancy and influence of hormonal changes during pregnancy as reported earlier (Jessica *et al.,* 2012). During pregnancy, levels of some steroid hormones such as estradiol and progesterone increase by up to 30- and 70-fold, respectively, in comparison to non-pregnant levels (Tulchinsky *et al.,* 1972).

During pregnancy, a considerable number of women experience some degree of cognitive changes that has come to be colloquially called pregnancy brain (Casey *et al*., 1999). The symptoms most frequently reported by women are forgetfulness and memory disturbances (Casey *et al.,* 1999), poor concentration, increased absentmindedness and difficulty reading (Parsons *et al*., 1991).

The result of this study agrees with previous reports which have shown that *primi gravidae* demonstrated impairment in selective abilities such as verbal free recall and working memory (Henry and Rendell, 2007). Evidence from prospective studies also supports the idea that changes in cognitive function occur during pregnancy, but it is unclear when the impairments occur (De Groot *et al.,* 2006). Performance on paragraph recall (Keenan *et al.,* 1998) and cognitive speed task (Chris *et al*., 2010) was worse in the third trimester. This is also in agreement with the present study since majority (88.3%) of the women studied, who also had PSS-10 score of 22 (within the range of impairment) were in their third trimester.

Previous studies conducted in the same locality with the present study have reported normal cognitive function in apparently healthy non-pregnant females and males (Yarube *et al*., 2019); and impaired cognition among diabetes mellitus (Yarube and Mukhtar, 2018; Yusuf *et al*., 2018) and post-stroke subjects (Hassan and Yarube, 2018). Contrary to the findings of this study, other studies have failed to find any differences in scores on objective measures of cognitive function during pregnancy (Christensen *et al.,* 1999; Casey, 2000; Crawley *et al.,* 2008).

In the present study, level of education of the participants showed a significant relationship with cognitive dysfunction. Moreover, the level of educational attainment had a significant influence on the cognitive performance, with those at the primary school level having the lowest performance and those at the post post-secondary level having not only the highest but also unimpaired performance. Similar findings were reported in previous studies (Yarube *et al*., 2019; Yusuf *et al*., 2018). The neurobiological mechanisms responsible for this association have not been fully elucidated. One possible explanation is that education impacts the rate at which plagues and tangles accumulate in the brain during memory formation and consolidation (Konstantinos *et al*., 2012). Education is considered to provide a cognitive and neurological reserve through neuronal changes or increased efficacy of processing networks (Stern, 1999). Individuals with higher levels of educational attainment tend to allocate more time and put forth more effort when engaging in intellectual complex activities (Parisi, 2010). As a result, the accumulated exposure to cognitively charged environments may have a direct beneficial effect on the brain structure and function, resulting in greater neurological development such as increase in synaptic density or efficient use of existing brain networks (Colcombe *et al.,* 2003; Park and Reuter-Lorenz, 2009). Higher educational attainment is associated with greater levels of cognitive performance as well as with a reduced risk of dementia (Bennett *et al.,* 2003). Educational experiences provide the foundation for continued intellectual stimulation across the life course, resulting in improved cognitive functioning (Stain *et al.,* 2002).

Presenting complaints significantly influenced cognitive dysfunction, with vomiting and fatigue accounting for the worst and best cognitive performances, respectively. Evidence of the cause of vomiting in pregnancy points to rapid changes in hormone levels (Suzanne, 2017) and emotional liability (Roger, 2017) observed during pregnancy.

Other socio-demographic and clinical characteristics were not significantly related to cognitive dysfunction of the participants. Consideration of the fact that the additional weight gain by a pregnant woman is as a result of her own weight gain and that of the conceptus (Mariana *et al.,* 2016) undermines the accuracy and utility of BMI in pregnancy. It's no surprise that no association was found between BMI and cognitive dysfunction. Also, age of the participants had no significant relationship with cognitive dysfunction. This is despite the known fact that measurable changes in cognition occur with normal aging (Daniel *et al.,* 2015). The absence of relationship might be due to the fact that 90% of the participants recruited were within one age range (of 16 – 25 years), which is also the youngest age category, leaving just 10% in one other category.

It will be interesting to find out the cognitive performance of non-pregnant women with similar age and some other characteristics as the participants of the present study, for comparison with what was reported in this study. This would have enabled us to more soundly conclude on the influence of pregnancy on

cognition. This is a limitation of this study and may be a good idea for another study.

This study concluded that the *primi gravidae* had mild cognitive impairment as evidenced by median MMSE score of 22.00 (19.0); majority (88.3%) of them had cognitive dysfunction either in the form of mild (58.3%) or severe (30%) cognitive impairment. This impairment was significantly associated with level of educational attainment and was influenced by the level of education and presenting complaints.

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