Rwanda Medical Journal RMJ

ORIGINAL ARTICLE Open Access

Determinants of The Utilization of Insecticidal Nets in Children with Severe Malaria at a Tertiary Health Facility in Northern Nigeria: A Cross-Sectional Study

Authors: O. R. Ibrahim[1,*]; T. I. Yusuf[1]; M. A. Alao[2,3]; M. I. Lawal[1]

Affiliations: *[1]Department of Paediatrics, Federal Medical Centre, Katsina, Nigeria; [2]Bowen University Teaching Hospital, Ogbomosho, Oyo State, Nigeria; [3]Bowen University College of Medicine, Iwo, Osun State, Nigeria.*

ABSTRACT

BACKGROUND: Malaria remains a leading public health issue in Nigeria, where it ranks among the leading cause of childhood morbidity and mortality. A key strategy for the control of malaria adopted by the country is the usage of a long-lasting insecticidal net (LLIN), the outcome of which has remained largely unknown among children with severe malaria.

This study's aim was to assess the determinants of the utilization of LLIN in children with severe malaria at a tertiary health facility in northern Nigeria.

METHODS: This was a cross-sectional descriptive study carried out from May to December 2018. We enrolled consecutive parents or caregivers with their children aged one month to 14 years who presented at the Emergency Pediatric Unit of the hospital with a diagnosis of severe malaria. A study proforma was used to obtain relevant information, including the level of utilization of LLINs.

RESULTS: A total of 253 children with severe malaria were recruited. The median age was four years (interquartile range, 2-6) with 127 (50%) males. There were 215 (85.0%) households with at least one LLIN. There was regular use of LLINs by 50% (127/253) of participants, infrequent usage by 13% and no usage by 37%. There was a significant correlation found between a patient's gender, a mother's age, and the use of LLIN. Logistic regression showed predictors of the usage of LLINs as the presence of a child under five years old (p=0.019), maternal age of 40 years and older (p=0.002), and poor knowledge of ITNs (p= 0.024).

CONCLUSION: In children with severe malaria, only one out of every two sleep under an LLIN regularly. The primary determinants of the usage of an LLIN have a child under five years old, older maternal age, and poor knowledge of LLINs. There is an urgent need to improve the level of utilization of LLIN among children.

Keywords: Malaria, Children, Utilization, Nigeria, Insecticidal Net

INTRODUCTION

Malaria is a parasitic disease with public health significance. It is caused by a plasmodium species, with an estimated 3.2 billion of the world population at risk [1,2]. Globally, there has been a

***Corresponding author:** Dr Olayinka Rasheed Ibrahim, Department of Paediatrics Federal Medical Centre, Along Jibya Bypass Road, Katsina State, Nigeria, Email: ibroplus@gmail.com; **Potential Conflicts of Interest (CoI):** All authors: no potential conflicts of interest disclosed; **Funding:** All authors: no funding was disclosed; **Academic Integrity.** All authors confirm that they have made substantial academic contributions to this manuscript as defined by the ICMJE; **Ethics of human subject participation:** The study was approved by the local Institutional Review Board. Informed consent was sought and gained where applicable; **Originality:** All authors: this manuscript is original has not been published elsewhere; **Review:** This manuscript was peer-reviewed by three reviewers in a double-blind review process; **Type-editor:** Cartledge (UK).

Received: 08st April 2020; **Initial decision given:** 01st December 2020; **Revised manuscript received:** 29th December 2020; **Accepted:** 26th April 2021.
 Publisher: Rwanda Biomedical Centre (RBC)/Rwanda Health Communication Center, P. O. Box 4586, Kigali. ISSN: 2079-097X (print); 2410-8626 (online)

Citation for this article: O. R. Ibrahim; T. I. Yusuf; M. A. Alao et al. Determinants of Utilization of Insecticidal Net in Children with Severe Malaria at a Tertiary Health Facility in Northern Nigeria. Rwanda Medical Journal, Vol. 78, no. 2, pp. 14-21, 2021.

gradual decline in the burden of disease, with 219 million cases in 2017, compared to 239 million cases in 2010 [3]. Similarly, deaths resulting from malaria were reduced from 607,000 in 2010 to 435,000 deaths in 2017 [3]. The improved indices of the control and elimination of malaria can be attributed to renewed global efforts of improving funding and multi-sectoral collaborations [4]. For instance, between 2000 and 2012, the increase in interventions led to a reduction in malaria incidence rates by 25% globally and by 31% in the World Health Organization (WHO) African Region [5].

Despite the recent progress regarding the global control and elimination of malaria, the years 2016 and 2017 witnessed a stall in the fight against this disease in high burden regions. Between 2016 and 2017, the WHO African region reported an increase of 3.5 million cases, with Nigeria, Madagascar, and the Democratic Republic of Congo taking the lead [3]. In the WHO African region, where more than 90% of malaria deaths occur, in 2017, 59 million children under the age of five years had malaria. Of the 435,000 deaths from Malaria in 2017, children less than five years accounted for two thirds. Additionally, Nigeria remains a leading contributor to the global burden of malaria. With an estimated 5.7 million cases and annual deaths of more than 100,000, the country has the largest burden globally [6]. Local researchers in Nigeria also showed that malaria is responsible for as high as 60% of outpatient visits and 30% of hospital admissions per year [7]. Data from Nigeria also showed that the significant burden of malaria occurred among the children, and the National Malaria Indicator Survey indicated a prevalence as high as 45% among children aged 6 to 59 months [7].

One of the critical strategies for the global control and elimination of malaria is the 'integrated vector control' [8]. The integrated vector approach involves the use of long-lasting insecticidal nets (LLIN), indoor residual spray, and larvicidal agents. Nigeria relies on the use of LLINs and less on indoor residual spray [9]. Hence, within the past few decades, periodic distribution of LLINs at all levels with a goal of universal coverage has been implemented with emphasis on the usage by children and pregnant women. The country set a target coverage of at least 80% of the population and aimed to achieve a distribution of one LLIN per two members of a household with a replacement every three years [9]. Although the achievement of the universal coverage of one net per two members of a household has yet to be reached, there has been some improvement in the household ownership of LLINs. A recent demographic health survey in 2018 indicated that 60% of the population has at least one LLIN per household, compared to only 8% in 2008 [7,10]. Furthermore, the National Malaria Indicator Survey (NMIS 2015) indicated higher LLIN coverage in Northwestern Nigeria, and Katsina State reached as high as 90% of households with at least one LLIN [7].

Although LLIN coverage has improved, available reports indicate low and varying levels of LLIN utilization across the country. For instance, the NMIS 2015 indicated a distribution of about 43 million LLINs, with the level of utilization varying from 33% to 59% across the country [7]. Though efforts are being made to ensure the target coverage of 80% of households with LLINs is reached, the report of resistance to LLINs may hamper their effectiveness [11]. Despite the report of developing resistance to LLINs, usage might continue to have benefits. A recent Cochrane review showed that when compared with households who do not use the insecticidal net, use of an LLIN led to a 17% reduction in child mortality, 50% reduction in the incidence of uncomplicated malaria, and a 44% reduction in the incidence of severe malaria episodes [12]. On the contrary, Zamawe et al. in Malawi suggested that resistance had an impact on the effectiveness of LLIN and that usage was not associated with a significant reduction in the burden of malaria among children [13].

In Nigeria, some studies that evaluated the household ownership and level of utilization of LLIN among children reported varying results [14,15,16,17]. The studies were limited to healthy children, children under five years old, and a community with the absence of severe malaria. Hence, the practice of LLIN among children with severe malaria remains largely unknown in Nigeria in spite of the challenges posed by the emergence of resistance to LLIN documented in some part of the country [18,19].

The present study, therefore, hypothesized that the level of utilization of LLIN among children with severe malaria was poor in Katsina, northwestern Nigeria. Thus, we aimed to investigate the ownership, level of utilization, and predictors of utilization of LLINs among children with severe malaria admitted in a tertiary health facility in northwest Nigeria.

METHODS

Study design: This study was a cross-sectional descriptive study carried out from May 1st to December 31st in 2018.

Location of the population: Katsina, northwestern Nigeria. Katsina is a state in the northwest part of Nigeria, and the inhabitants are predominantly peasant farmers and traders. Katsina has one of the highest poverty rates in Nigeria, with a poverty headcount of 56%.[20]

Study setting and location: The hospital is a public tertiary health facility, which receives referrals from primary and secondary health facilities from Katsina and the adjoining states in northwestern Nigeria. The hospital also admits children who are referred from the Paediatric outpatient unit of the hospital.

Sample size estimation: We estimated the minimum sample from the prevalence formula (equation n= Z2pq/d2), where Z was the corresponding deviate (1.96) at 95% confidence interval; p was prevalence (50.0%) obtained from the level of LLIN ownership in Kano, a closer state; q was 1-p, and the d was the allowable margin of error and was set at 7%. [21,22]

Participants: Enrolment of participants: We enrolled consecutive parent or caregiver and child pairs for the study. The children were aged one month to 14 years who presented at the Emergency Paediatric Unit of Federal Medical Centre, Katsina, northwestern Nigeria.

Inclusion criteria: The inclusion criteria were children with a diagnosis of severe malaria (defined as a positive result from a rapid diagnostic test for malaria) and had features of the severe form of the disease (defined according to WHO 2015 guidelines on the management of severe malaria) [23]. Diagnosis of malaria was made with a rapid diagnostic test kit (CareStart® Malaria HRP-Pf, AccessBio, USA). The test was positive if there were two strips present (test and control) and negative if only one bar was present (control). The institutional protocol includes the use of a rapid diagnostic test (RDT) kit for the diagnosis of malaria cases. However, cases with a strong suspicion of malaria with negative RDT are sent for microscopy to confirm the presence or otherwise of malaria parasites.

Exclusion criteria: This study excluded children with other forms of diagnoses, including those with confirmed meningitis (not including cerebral malaria), septicaemia, and pneumonia. Children with chronic kidney disease, sickle cell anemia, or hematoncology disorders were also excluded. They were excluded to minimize confounders.

The children were treated based on the WHO standard protocol for the management of severe malaria, which included the use of intravenous artesunate and the management of associated complications [23].

Data collection: Variables collection: We obtained relevant information, including possession and source of LLIN, duration of possession, frequency of usage, and socio-demographics from the parents or caregivers. We also obtained knowledge of malaria from the parents and caregivers. The Oyedeji's social classification, based on an average score representing the two parents' educational levels and occupations, was adapted and used to classify families into the upper, middle, and lower class [24].

Outcomes: The primary outcome was the level of utilization of LLIN, defined as 'regular' if the child had slept under the LLIN every day in the preceding seven days before presentation at the facility, 'in-frequent' if the child had slept under the LLIN between one and six days prior to presentation, and 'no utilization' if the child had not slept under the LLIN in the preceding week. The secondary outcomes were the variables predictive of regular usage of LLIN. For the referred cases, we took the duration of sleeping under the LLIN for the children at the point of presentation at the referral centers.

Data Management and Statistical analysis: The data were numerically coded and analyzed with SPSS® version 20 (IBM Corp., Armonk, New York, USA). The variables (age, number of LLIN, duration of ownership) were not normally distributed and presented as median with interquartile range (IQR). Frequency tables were used to summarize the sociodemographic variables, age, source and level of LLIN usage. A chi-square test was used to examine associations between sociodemographic variables and the usage of LLIN, while the odds ratio was used to express the strength of association. Binary logistic regression was used to evaluate the independent predictors of usage of LLINs. The level of statistical significance was defined as having a p-value less than 0.05.

Ethical considerations: The Ethical and Research Committee of the hospital gave ethical approval for the study (FMCNHREC N003/072012). We obtained informed consent from the parents and caregivers and assent obtained in children aged seven years and above, after a detailed explanation of what the study entails.

RESULTS

Demographic of the study children: Out of the 261 approached for the study, eight parents declined consent and were excluded. However, their non-participation in this study did not influence the cares their children received.

For the present study, we recruited 253 parents along with their children with severe malaria over eight months. The median age of the recruited children was four years (IQR 2-6), with a range of 0.8 to 14 years. The number of children younger than five years old came to 159 (62.8%). There were 127 (50.2%) males and 126 (49.8%) females (Table 1).

Table 2: Socio-demographic characteristic

Variable	Frequency	Percentage
Mothers' age group		
25 years and below	68	26.9
26 years to 40 years	163	64.4
41 years and above	22	8.7
Fathers' age group		
25 years and below	2	0.8
26 years to 40 years	94	37.2
41 years and above	157	62.0
Socioeconomic class[S]		
Upper Class	12	4.7
Middle Class	71	28.1
Lower Class	170	67.2

[S]Determined using Oyedeji's social classification [24]

24 months (IQR 12-48), with a minimum duration of one month and a maximum of 120 months. The most common source of LLINs was a collection from a health care facility (58.6%) (Table 3).

In the week preceding the presentation of malaria symptoms, the regular usage of LLINs was 50% (127/253), infrequent usage came to 13% (32/253), and 37% reported not using one (Table 3).

Table 1: Age distribution of children with severe malaria

Age group	Total 253 (100)	Males 127 (50.2)	Females 126 (49.8)
0-11 Months	11 (4.3)	7 (2.8)	4 (1.5)
12-23 Months	25 (9.9)	9 (3.6)	16 (6.3)
2-4 Years	119 (47.0)	58 (22.9)	61 (24.1)
5-9 Years	72 (28.5)	34 (13.4)	38 (15.1)
10-14 Years	26 (10.3)	19 (7.5)	7 (2.8)

Sociodemographic characteristic of the mothers and caregivers: Among the mothers of the recruited children, 68 (26.9%) were 25 years old or younger (Table 2). The majority of the children with severe malaria (n=170; 67.2%) were from a lower socioeconomic class (Table 2).

Source and level of utilization of LLIN: 215/253 (85.0%) had at least one LLIN per household, while 174 (68.8%) had two or more LLINs per household. The median number of ITNs possessed per household was two (IQR 2-4), with the maximum being 15. The median duration of possession was

Based on the period of usage within the year, 94 (43.7%) of participants used the LLIN all year round, while 70 (32.6%) used it only during the rainy season (Table 3). Predictors of LLIN usage: There was an association between age groups, socioeconomic status, gender, members of households, presence of children under five in the family, mothers' age group, knowledge of ITNs, and the usage of LLIN ($p < 0.05$) (Table 4). After controlling for confounders, the logistic regression showed the independent predictors of usage of LLINs among the children in the study as the presence of children under five years old (p=0.019), a maternal age of 40 years and

Table 3: Source and level of LLIN

Source of LLIN	Frequency (n=215)	Percentage
Purchase from Market	54	25.1
Health facility	126	58.6
During health campaign	24	11.2
Others	11	5.1
Period of LLIN Usage	**Frequency (n=215)**	**Percentage**
All year round	94	43.7
During raining season	70	32.6
During dry season	6	2.8
Occasional Usage	19	8.8
Unspecified	26	12.1
Level of Usage of LLIN	**Frequency (n=253)**	**Percentage**
Regular usage	127	50.2
Infrequent usage	32	12.6
No usage	94*	37.2

**38 of the participants reporting "No usage" did not own an LLIN*

older (p=0.002), and poor knowledge of ITNs (p= 0.024) (Table 4).

DISCUSSION

The use of LLINs is a crucial component of the malaria control and eradication program. Hence, the periodic mass distribution campaign in malaria-endemic countries, including Nigeria, with a goal of universal coverage for the population. The present study showed that 85% of the respondents had at least one LLIN per household. This high level of LLIN ownership affirmed the findings from the Nigeria malaria indicator survey, where Katsina State had one of the highest ownership rates in the country (90%) [7].
The high coverage is likely due to the continuous distribution of LLINs in the country, including the state within this study. The high ownership observed in this study is higher than that in Calabar, southeast Nigeria (71%) [25].

The difference observed in levels of ownership probably reflects a variation in the ownership observed across the country, with higher coverage in some northern states compared to southern states [7]. The level of utilization in the present study showed that only half of the children with severe malaria regularly slept in an LLIN.

The level of utilization obtained in this study is comparable to the level observed through a community survey in Kano State a decade ago (50%) (2009) [22]. In contrast, the level of utilization in the present study is lower compared to the 61.8% reported among children under five years old in Lagos from the general population, the 58% reported among children under five years old in Malawi, and the 85% in Ethiopia [26–28]. The similarities in the level of utilization obtained in this study compared to an earlier study in Kano State raises a question as to whether the improvement in the LLIN coverage observed in the country translated to an increase in the level of LLIN usage. The higher level of utilization found in the Lagos, Malawi, and Ethiopia studies could be due to the number of days used in the definition of 'utilization' regarding LLINs. The present study defined regular utilization of LLIN as the seven days preceding presentation at the health facility, while the other studies considered only the preceding night before their surveys, with a tendency for biased recall. Additionally, the differences in study subjects may also account for the variation in utilization levels. The present study involved children less than 14-years-of-age with severe malaria, while the other studies involved children under five years of age with uncomplicated malaria. Studies have also shown that children under five years old tend to use LLINs more [21,26]. The level of utilization of

Table 3: Source and level of LLIN

Variables	Households usage LLIN (n,%)	Unadjusted Odd ratio	Unadjusted 95% CI	Unadjusted p	Adjusted Odd ratio	Adjusted 95% CI	Adjusted p
Age							
0-11 Months	3 (1.9)	1			1		
12-23 Months	18 (11.3)	0.375	0.099, 1.414	0.147	1.314	0.160,10.768	0.799
2-4 Years	76 (47.8)	2.571	1.074, 6.156	0.034	1.491	0.413, 5.389	0.542
5-9 Years	47 (29.6)	1.767	1.216, 2.569	0.003	1.422	0.533, 3.793	0.481
10-14 Years	15 (9.4)	1.880	1.157, 3.054	0.011	1.709	0.606, 4.795	0.308
Gender							
Male	71 (44.7)	1			1		
Female	88 (55.3)	1.827	1.089, 3.064	0.022	0.589	0.314, 1.105	0.099
Socio-economic class							
Upper	9 (5.7)	1			1		
Middle	46 (28.9)	3.000	0.812,11.081	0.099	1.883	0.424, 8.371	0.405
Lower	104 (65.4)	1.840	1.131, 2.994	0.014	2.210	0.969, 5.039	0.059
Household numbers							
Six and below	145 (91.2)	1			1		
Greater than six	14 (8.8)	1.648	1.264, 2.147	<0.001	0.813	0.282, 2.346	0.702
Family members							
Under-five	150 (94.3)	1			1		
No under five	9 (5.7)	1.630	1.258,2.114	<0.001	0.121	0.021, 0.711	0.019
Mothers' age group							
25 years and younger	41 (25.8)	1			1		
26 to 39 years	110 (69.2)	1.519	0.934, 2.468	0.092	5.177	1.517,17.670	0.100
40 years and older	8 (5.0)	2.075	1.496, 2.880	<0.001	5.997	1.982, 18.147	0.002
Knowledge of ITN*							
Good	153 (96.2)	1			1		
Poor	6 (3.8)	2.593	1.920, 3.502	<0.001	3.790	1.190,12.072	0.024

(n=159).
**Mothers and caregivers' response (on complete responses)*

LLIN among the children with severe in this study is higher compared with the level of utilization (33.0%) from the general population [7]. The higher level of LLIN usage among the children in this study compared with the general population is not unexpected because most campaign distribution of LLIN is focused on children and pregnant women, who are the vulnerable groups. Besides, during routine immunization, further health educations on the benefits of LLIN are carried out by health care workers, and children who completed routine immunization sometimes receive LLIN in the country. The independent predictors regarding utilization of LLINs among children with severe malaria were an age of fewer than five years, maternal age greater than 40 years, and poor knowledge about LLINs. Similarly, other studies have also identified children under five years as a significant predictor of the utilization of LLINs [22,27,29]. This finding probably reflects the vulnerability of children, especially under-fives, to malaria infection, and thus, the parents' belief in the need to protect them. The present study identified older maternal age (40 years and older) as a significant predictor of the level of LLIN utilization. A study in Ethiopia [30] identified a maternal age of 49 years and younger to be associated with the utilization of LLINs, while a study in Nigeria [25] suggested that younger caregivers are less likely to have under-fives that will sleep under the LLINs. This finding of older maternal age as one of the primary predictors of LLIN utilization could be due to a parent's experience with previous children with malaria and an improved understanding of the role of LLINs in preventing malaria.

This study also showed that those with poor knowledge tend to use LLINs more. This opposes the observation that good knowledge of malaria and LLINs tends to improve utilization [26], and a study by Lagos showed no relationship between LLIN utilization and prior knowledge [26]. Although the findings seem unexpected, as previous studies report that good knowledge of LLINs tends to improve utilization, there may be some reasons for this observation. The literacy level for women in northern Nigeria appeared to be low, which may affect the comprehension of knowledge but still allow for adequate utilization [31].

The actual time the children spent under the net per day or night was not evaluated. Besides, the direct observation of the children sleeping under the LLN was also not evaluated. Instead, we asked the parents and caregivers how many times their children slept under an LLIN in the last 7 and 14 days, and there may be bias in the information provided. This study was cross-sectional that took place over eight months and may not represent the pattern of severe malaria, including behavior in the usage of LLIN throughout the year. This is because seasonality may be a factor that influences the usage of LLIN, which was not assessed in this study. Though the hospital is the only tertiary hospital in the state, some children with severe malaria may not present to the facility because of various reasons, including lack of access, seeking alternative care, and cost of care. Hence, the findings of this study may not be generalizable to the children in the state.

CONCLUSION

This study showed that among children with severe malaria, half were using LLINs regularly. Additionally, the primary determinants of LLIN usage were children under-five, older maternal age, and poor knowledge. Despite the high ownership, which affirmed the improved distribution of LLIN in the country, the state inclusive, the level of regular among the children is about one in two. These findings call for the urgent need to improve strategies to enhance regular usage among the children who are vulnerable to malaria and account for a greater burden of deaths.

REFERENCES

1. A.M. Siega-Riz, M. Miswanathan, M.K, et al. A systematic review of outcomes of maternal weight gain according to the Institute of Medicine Recommendations: birth weight, fetal growth and postpartum weight retention. Am J Obstet Gynecol. vol. 201, no. 4, p.339: e1-339.e14, Oct. 2009.
2. J.M. Crane, J. White, P. Murphy, et al. The effect of gestational weight gain by body mass index on maternal and neonatal outcomes. J Obstet Gynaecol Can. vol. 31, no.1, p.28-35, Jan. 2009.
3. C.B Rudra, I.O. Frederick, M.A.Williams. Pre-pregnancy body mass index and weight gain during pregnancy in relation to preterm delivery subtypes. Acta Obstet Gynecol Scand. vol. 87, no. 5, p. 510-7, May 2008.
4. G.K. Davis, A.D. Newsome, N.B. Ojeda, et al. Effects of intrauterine growth restriction and female sex on future blood pressure and cardiovascular disease. Curr Hypertens Rep. vol.19, no. 2, p.13, Feb. 2017.
5. D.J. Barker, C. Osmond, J. Golding, et al. Growth in utero, blood pressure in childhood and adult life, and mortality from cardiovascular disease. BMJ. vol. 298, no. 6673, p. 564–7, March 1989.
6. Z. Zadik. Maternal nutrition, fetal weight, body composition and disease in later life. J Endocrinol Invest. vol. 26, no. 9, p. 941-5, Sept. 2003.
7. L.A. Gilmore, M. Klempel-Donchenko, L.M. Redman. Pregnancy as a window to future health: Excessive gestational weight gain and obesity. Semin Perinatol. vol. 39, no. 4, p. 296-303, June 2015.
8. K.M. Rasmussen, et al, Eds. Institute of Medicine: Weight Gain During Pregnancy: Reexamining the Guidelines. Washington DC: National Academy of Sciences, May 28, 2009. Accessed January 20, 2019. Available at: www.

iom.edu/en/Reports/2009/Weight-Gain-During-Pregnancy-Reexamining-the-Guidelines.aspx.
9. I.H. Tsai, C.P. Chen, F.J. Sun, et al. Associations of the pre-pregnancy body mass index and gestational weight gain with pregnancy outcomes in Taiwanese women. Asia Pac J Clin Nutr. vol. 21, no. 1, p.82-87, Mar. 2012.
10. A.P Sato, E. Fujimori. Nutritional status and weight gain in pregnant women. Rev Lat Am Enfermagem. vol. 20, no. 3, p. 462-8, May 2012.
11. U. Ramakrishnan, F. Grant, T. Goldenberg, et al. Effect of women's nutrition before and during early pregnancy on maternal and infant outcomes: A systematic review. Paediatr Perinat Epidemiol. vol. 26, Suppl. 1, p. 285-301, July 2012.
12. M. Haugen, A.L. Brantsæter, A. Winkvist, et al. Associations of pre-pregnancy body mass index and gestational weight gain with pregnancy outcome and postpartum weight retention: a prospective observational cohort study. BMC Pregnancy Childbirth. vol. 14, p. 201, June 2014
13. C. Li, Y. Liu, W. Zhang. Joint and independent associations of gestational weight gain and pre-pregnancy body mass index with outcomes of pregnancy in Chinese women: A retrospective cohort study. PLoS One. vol. 10, no. 8, e0136850, Aug. 2015.
14. S. Dzakpasu, J. Fahey, R. S. Kirby, et al. Contribution of prepregnancy body mass index and gestational weight gain to adverse neonatal outcomes: population attributable fractions for Canada. BMC Pregnancy Childbirth. vol. 15, no. 21, Feb. 2015.
15. O.A. Esimai, E. Ojofeitimi. Pattern and determinants of gestational weight gain an important predictor of infant birth weight in a developing country. Glob J Health Sci. vol.6, no. 4, p.148-54, July 2014.
16. A. Abubakari, G. Kynast-wolf, A. Jahn. Maternal determinants of birth weight in Northern Ghana. PLoS One. vol. 10, no. 8, e0135641, Aug. 2015.
17. F. Asefa, D. Nemomsa. Gestational weight gain and its associated factors in Harari Regional State: Institution based cross-sectional study, Eastern Ethiopia. Reprod Health. vol. 13, no. 1, p. 101, Aug. 2016.
18. F.Y. Fouelifack, J.H. Fouedjio, J.T. Fouogue, et al. Associations of body mass index and gestational weight gain with term pregnancy outcomes in urban Cameroon: a retrospective cohort study in a tertiary hospital. BMC Res Notes. vol. 8, no. 1, p. 806, Dec. 2015.
19. S. Munim, H. Maheen. Association of gestational weight gain and pre-pregnancy body mass index with adverse pregnancy outcome. J Coll Physicians Surg Pak. vol. 22, no. 11, p. 694-8, Nov. 2012.
20. N. Li, E. Liu, J. Guo, et al. Maternal Prepregnancy Body Mass Index and Gestational Weight Gain on Pregnancy Outcomes. PloS One. vol. 8, no. 12, e82310. Dec. 2013.
21. G.R. Alexander, J.H. Himes, R.B. Kaufman, et al. A United States national reference for fetal growth. Obstet Gynecol. vol. 87, no.2, p. 163–8, Feb. 1996.
22. WHO. Global Nutrition Monitoring Framework. 2016. Available from: http://apps.who.int/nutrition/landscape/report.aspx?iso=rwa. Accessed January 19, 2019.
23. R. Wanyama, G. Obai, P. Odongo, et al. Are women in Uganda gaining adequate gestational weight? A prospective study in low income urban Kampala. Reprod Health. vol. 24, no. 15, p. 160. Sept. 2018.
24. E. R. Black, G.C. Victora, P. S. Walker, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet; vol. 382, no. 9890, p. 427–51, Aug. 2013.
25. M. S. Harrison, R. L. Goldenberg. Cesarean section in sub-Saharan Africa. Matern Health Neonatol Perinatol; vol. 2, no. 6. July 2016.
26. J.P. Souza, A. M. Gülmezoglu, J. Vogel, et al. Moving beyond essential interventions for reduction of maternal mortality (the WHO Multicountry Survey on Maternal and Newborn Health): a cross-sectional study. Lancet. vol. 381, no. 9879, p. 1747-55, May 2013.
27. A. R. Amorim, S. Rossner, M. Neovius, et al. Does excess pregnancy weight gain constitute a major risk for increasing long-term BMI? Obesity. vol. 15, no. 5, p. 1278-86, May 2007.