Socioeconomic inequality in intermittent preventive treatment using Sulphadoxine pyrimethamine among pregnant women in Nigeria: A Decomposition analysis

Fatima Muhammad Mahmud
Tehran University of Medical Sciences https://orcid.org/0000-0002-7839-3508

Reza Majdzadeh
Tehran University of Medical Sciences

Saharnaz Nedjat
Tehran University of Medical Sciences

Haniye Sadat Sajadi
Tehran University of Medical Sciences

Mahboubeh Parsaeian (mahboubehparsaeian@yahoo.com)
Tehran University of Medical Sciences https://orcid.org/0000-0003-1928-5424

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Abstract

Background: Sulphadoxine pyrimethamine using intermittent preventive treatment (IPTp-SP) for malaria prevention is recommended for all pregnant women at malaria endemic areas. However, there is limited evidence on the level of socioeconomic inequality in IPTp-SP use to prevent malaria in pregnant women in Nigeria. Thus, this study aimed to determine the level of socioeconomic inequality in IPTp-SP use among pregnant women and to decompose it into its contributing factors.

Methods: A secondary data analysis of Nigerian demographic and health survey of 2018 was conducted. A sample of 2,162 pregnant women aged between 15-49 years and had live birth in the past 2 years before the survey were included to this analysis. Participants were recruited based on two-stage cluster sampling method. Socioeconomic inequality was decomposed into its contributing factors by concentration index.

Result: The pregnant women who took at least one or more IPTp was 63.4%, while those who took two or more doses were 40.0 % and those who took three or more doses were 17%. Based on concentration index of 0.180 (p-value= <0.001, 95% CI: 0.176 to 0.183) and the Erreyger's normalization concentration index 0.280 (p-value=<0.001, 95% CI: 0.251 to 0.309 IPTp utilization was pro-rich. The largest contributors to the inequality in IPTp uptake were wealth index (47.81%) and educational status (28.66%).

Conclusion: Our findings showed that IPTp use was pro-rich in Nigeria. Wealth index and educational status were the factors that significantly contributed to the inequality. The disparities could be reduced through IPTp service expansion by targeting pregnant women from low socioeconomic status.

Introduction

Malaria is one of the most public health problems in low and middle income countries. It mainly affects children and pregnant women in Sub-Saharan Africa (1). Pregnant women in malaria endemic areas are at greater risk of various pregnancy related adverse consequences such as maternal anemia, placental accumulation of parasite, low birth weight (LBW) and intrauterine growth retardation (IUGR), congenital infection and infant mortality (IM) (2, 3).

An estimation indicated that 11 million pregnant women living in 38 countries with moderate-to-high transmission rate in sub-Saharan Africa are infected with malaria in 2018 (4). This makes malaria infection in pregnant women 29% of all pregnancies (4). Nigeria is one of the countries bearing high burden of malaria. High prevalence of malaria has reported from different parts of Nigeria in pregnant women (5, 6). The prevalence of malaria in pregnant women in Nigeria ranges from 19.7–72.0% (6, 7).

World Health Organization (WHO) recommends Intermittent Preventive Treatment in pregnancy (IPTp) in moderate to high malaria transmission areas in Africa for each antenatal care visit after the first trimester in the interval of at least 1 month between doses (3). However, considerable proportion of pregnant

women are not using IPTp in Nigeria. For example the Malaria indicator survey of 2018 revealed that 64% of women took IPTp only once during the current pregnancy(7).

Previous study reported from Nigeria has linked malaria with poverty (8). Furthermore, women living in poorest household are less likely report two doses use of IPT compared to women from the richest household (9, 10). Inequity in health service is unacceptable and unfair (11). It should be avoided through service expansion to the most underserved population in the country. Inequality is frequently assessed based on socioeconomic status that is measured in asset-based wealth quintiles, residence, sex, age and ethnicity (12).

Recent studies have reported inequalities related to malaria prevention especially in the use and ownership of mosquito nets, (13, 14), however there are little evidence on the inequality related to IPTp use in pregnant women. Determining socioeconomic factors that contributed to an inequality on the use of IPTp among pregnant women is important to create awareness among the people and to inform policy makers .In this study, the factors that contributed to the inequality on the use of IPTp were assessed by decomposition analysis. Decomposition analysis helps to break inequality into its contributive factors to show the independent contribution of each socioeconomic factors for the available inequality (15). This study aimed to determine the level of socioeconomic inequality in IPTp-SP use among pregnant women in Nigeria and to decompose the inequality into its determinant factors. The study provides evidence about the key drivers of socioeconomic inequality to the Malaria prevention stakeholders, and improves the IPTp distribution among pregnant women to reduce the socioeconomic inequality.

Methods

Study design and data source

A cross-sectional study was conducted to determine inequality on the use of IPTp among pregnant women. Nigerian demographic and health survey (NDHS) of 2018 data was used (16). The sampling frame used for the survey was Population and Housing Census of Nigeria, which was conducted in 2006. Multistage sampling strategy was conducted by census enumeration areas serve as the primary sampling units during the first stage of sample selection. A total of 1400 clusters were selected randomly. In the second stage fixed number of 30 households were randomly selected in every cluster through systematic sampling.

Variable definition and Measurement

All women aged 15-49 in the households who were pregnant, and either residents of the selected household or visitor who stayed in the household the night before the survey were eligible to be interviewed. Data for the survey were collected from 14 August to 29 December 2018. A total of 41,821 women were interviewed and yielded a response rate of 99%. Of 41, 821 women, 21,621 responded to question on IPTp use during pregnancy 2 years preceding the survey. Thus, 21,621 women were used for the analysis of this study. Wealth index was constructed using principal component analysis (PCA) as a

proxy for socioeconomic status. The variables included in the PCA were ownership of household assets, housing conditions, water source and sanitation. The outcome variable of this study was use of IPTp at least one dosage among pregnant women. Whereas, the independent variables were place of residence, age, educational status, wealth index, region, marital status, number of antenatal care visits and parity.

Statistical Analysis

The main measures of inequality are concentration curve and concentration index (17). The concentration curve shows the cumulative percentage of the health outcome (IPTp use) on the y-axis against cumulative percentage of the population in the x-axis, ranked by the wealth index from the poorest to the richest. If all women irrespective of their wealth status have exactly the same value of the IPTp use, the curve will be a straight line. When it lies below the diagonal line it is pro-rich and above it indicates the pro poor inequality. The concentration index is defined as twice the area between the concentration curve and the line of equality (the 45-degree line).

However, the outcome variable was binary in this case we used the Erreyger's normalized concentration index which is preferred over the conventional concentration index as recommended by Erreygers and Van ourti (18) as shown below:

$$E(h) = 4 = \frac{\mu}{b_h - a_h} \mathrm{C(h)}$$

Where b_h and a_h are the maximum and minimum of the health variable.

Decomposition analysis

Decomposition analysis method was proposed by Wagstaff et al (15) to decompose socioeconomic inequality into its determinants. It also estimates how determinants proportionally contribute to inequality (e.g. the gap between poor and rich) in a health variable. We applied a linear regression model linking IPTp intake (y) to the set of k determinants (X_k).In this analysis we used the Generalized linear model for binomial distribution with identity link function (19) which is the best choice because it consider the structure of the outcome variable and the estimates does not vary with the choice of reference group.

In this study decomposition analysis was used to decompose the use of IPTp-SP. All analyses where weighted which was provided by the NDHS data and adjusted for the design effect due to the cluster sampling. Statistical analysis was conducted using STATA version 14 and significance level was set at $p \leq 0.05$.

Result

Table 1 shows respondents' socio-demographic characteristics. The mean age of the respondents was 29 years (SD = 9.70). The majority of the respondents (64.7%) were rural dwellers and 9498 (43.9%) with no education. Eighty-nine percent of the respondents received IPTp from antenatal care. The overall use of IPTp-SP among the women was 63.4%. The pregnant women who took at least one or more doses of IPTp was 63.4%, while those who took two or more doses were 40% and those who took three or more doses were 17%.

Table 1
Socio-demographic characteristics among women aged 15–49 years who had a live birth 2 years preceding the survey, by intake of one dose of 1PTp

	Variables	N (%)	IPT n (%)	
		21621 (100)	Yes	No
Place of residence	Rural	13987 (64.69)	8146 (58.24)	5841 (41.76)
	Urban	7634 (35.30)	5559 (72.82)	2075 (27.18)
Age group (years)	15–24	5362 (24.79)	3222 (60.09)	2140 (39.91)
	25–34	10197 (47.16)	6607 (64.79)	3590 (35.21)
	35–44	5357 (24.77)	3453 (64.46)	1904 (35.54)
	≥ 45	705 (3.26)	423 (60.00)	282 (40.00)
Educational status	No education	9498 (43.92)	4862 (51.18)	4636 (48.81)
	Primary	3373 (15.60)	2232 (66.17)	5162 (33.83)
	Secondary	6973 (32.25)	5162 (74.03)	1811 (25.97)
	Higher	1777 (8.21)	1449 (81.54)	328 (18.46)
Marital Status	Never Married	600 (2.77)	378 (63.00)	222 (37.00)
	Married	20259 (93.70)	12821 (63.29)	7438 (36.71)
	Separated/divorced/widowed	762 (3.52)	506 (66.40)	256 (33.60)
Wealth index	Poorest	5007 (23.15)	2368 (47.29)	2639 (52.71)
	Poorer	4865 (22.50)	2686 (55.21)	2179 (44.79)
	Middle	4549 (21.03)	3072 (67.53)	1477 (32.47)
	Richer	3986 (18.43)	2990 (75.01)	996 (24.99)
	Richest	3214 (14.86)	2589 (80.55)	625 (19.45)
Region	North central	3844 (17.77)	2245 (58.40)	1599 (41.60)
	North east	4502 (20.82)	2827 (62.79)	1675 (37.21)
	North west	6297 (29.12)	3678 (58.41)	2619 (41.59)
	South east	2340 (10.82)	1827 (78.08)	513 (21.92)

	Variables	N (%)	IPT n (%)	
	South south	2108 (9.74)	1481 (70.26)	627 (29.74)
	South west	2530 (11.70)	1647 (65.010)	883 (34.90)
ANC	No visits	5630 (26.03)	1158 (20.57)	4472 (79.43)
	< 4times	3778 (17.47)	2745 (72.66)	1033 (27.34)
	≥ 4times	12213 (56.48)	9802 (80.26)	2411 (19.74)
Parity	1 child	3678 (17.01)	2410 (65.52)	1268 (34.48)
	2 children	3750 (17.34)	2430 (64.80)	1320 (35.20)
	≥ 3 children	14193 (65.64)	8865 (62.46)	5328 (37.53)

The adjusted associations between IPTp use and its determinants are shown in (Table 2). Women with higher educational status [Adjusted OR (95% CI): 1.35 (1.14 to 1.60) p-value = < 0.001], being from the richest quintile [Adjusted OR (95% CI): 2.32(1.99 to 2.72) p-value = < 0.001], attending 4 or more antenatal visits [Adjusted OR (95% CI): 14.66 (13.42 to 16.02) increased the probability of IPTp use. Age group, area, parity and marital status shows no significant association

Table 2
Bivariate and Multivariable logistic regression of socio-demographic characteristics and risk factors among women aged 15–49 years who had a live birth 2 years preceding the survey, by the intake of IPT, NDHS 2018.

Variable		Crude OR(95% CI)	P value	Adjusted OR(95% CI)	P value
Age group	15–24	1		1	
	25–34	1.22 (1.14 to 1.31)	< 0.001	1.03 (0.93 to 1.13)	0.57
	35–44	1.20 (1.11 to 1.30)	< 0.001	1.09(0.97 to 1.23)	0.14
	≥ 45	0.99 (0.85 to 1.17)	0.960	1.07 (0.87 to 1.32)	
Educational status	No education	1		1	
	Primary	1.87 (1.72 to 2.02)	< 0.001	1.13(1.02 to 1.26)	0.023
	secondary	2.72 (2.54 to 2.91)	< 0.001	1.32(1.18 to 1.47)	< 0.001
	Higher	4.21 (3.71 to 4.78)	< 0.001	1.35(1.14 to 1.60)	< 0.001
Marital status	Never married	1		1	
	Married	1.01 (0.86 to 1.20)	0.890	1.12(0.91 to 1.37)	0.28
	separated	1.16 (0.93 to 1.45)	0.190	1.15(0.88 to 1.50)	0.32
Area	Urban	1		1	
	Rural	0.52 (0.49 to 0.55)	< 0.001	1.05(0.96 to 1.14)	0.28
Wealth index	Poorest	1			
	Poorer	1.37 (1.27 to 1.49)	< 0.001	1.01(0.91 to 1.14)	0.91
	Middle	2.32 (2.13 to 2.52)	< 0.001	1.36(1.22 to 1.52)	< 0.001
	Richer	3.35 (3.06 to 3.70)	< 0.001	1.79(1.58 to 2.04)	< 0.001
	Richest	4.62 (4.16 to 5.12)	< 0.001	2.32(1.99 to 2.72)	< 0.001
Region	North central	1		1	

Variable		Crude OR(95% CI)	P value	Adjusted OR(95% CI)	P value
	north east	1.20 (1.10 to 1.31)	< 0.001	1.83(1.64 to 2.05)	< 0.001
	north west	1.00 (0.92 to 1.09)	< 0.001	1.87(1.68 to 2.07)	< 0.001
	south east	2.54 (2.26 to 2.85)	< 0.001	1.18(1.03 to 1.35)	
	south south	1.68 (1.50 to 1.88)	< 0.001	1.64 (1.42 to 1.90)	< 0.001
	south west	1.33 (1.20 to 1.47)	< 0.001	0.61 (0.54 to 0.69)	< 0.001
ANC visits	no visit	1		1	
	< 4visits	10.26 (9.31 to 11.30)	< 0.001	9.66 (8.75 to 10.68)	< 0.001
	>=4visits	15.70 (14.51 to 16.98)	< 0.001	14.66 (13.42 to 16.02)	< 0.001
Parity	1 Child	1		1	
	2 children	0.97 (0.88 to 1.07)	0.510	1.01 (0.90 to 1.13)	0.89
	≥ 3children	0.88 (0.81 to 0.94)	< 0.001	1.08 (0.96 t0 1.21)	0.19

Inequality In Iptp Use

IPTp use was pro-rich (Fig. 1) and the concentration index was 0.180 (p-value < 0.001) (95% CI:0.176 to 0.183). The Erreyger's normalized concentration index was 0.280 (p-value < 0.001) (95% CI: 0.251 to 0.309) which was significantly different from zero. Wealth index was the main contributor of IPTp use related inequality (47.81) followed by educational status (28.66) (Table 3). Positive and negative signs of the percentage contributed shows the inequality concentrated either in the poorest or richest women (Table 3)

Table 3
Decomposing socioeconomic inequality in the use of IPTp among pregnant women Nigeria 2018

Variable	Coefficients	Mean	Elasticity	Concentration index	Absolute contribution	Percentage contribution
Wealth Index						**47.81**
Poorest	1					
Poorer	0.067	0.192	0.020	-0.399	-0.008	-4.50
Middle	0.165	0.196	0.051	0.081	0.004	2.31
Richer	0.221	0.215	0.074	0.407	0.030	17.0
Richest	0.259	0.223	0.092	0.638	0.058	33.0
Region						**-9.67**
North central	1					
North east	0.148	0.159	0.040	-0.372	-0.015	-8.30
North west	0.119	0.292	0.055	-0.271	0.015	-8.30
South east	0.092	0.119	0.016	0.295	0.004	2.67
South South	0.022	0.116	0.003	0.330	0.001	0.62
South west	-0.049	0.173	-0.014	0.460	0.007	3.64
Area						**1.13**
Urban	1					
Rural	-0.002	1.541	-0.019	-0.105	0.002	1.13
Educational status						**28.66**
No education	1					
Primary	0.131	0.144	0.030	0.006	0.000	0.10
Secondary	0.177	0.397	0.112	0.282	0.032	17.76
Higher	0.202	0.110	.03	0.540	0.019	10.80
Age group						**0.69**
15-24yrs	1					
25-34yrs	0.018	0.321	0.009	0.083	0.001	0.46
35-44yrs	0.029	0.225	0.010	0.05	0.001	0.30
≥ 45yrs	0.022	0.089	0.003	-0.043	0.000	-0.07

Variable	Coefficients	Mean	Elasticity	Concentration index	Absolute contribution	Percentage contribution
Marital status						**-0.18**
Never married	1					
Married	0.054	0.696	0.059	-0.008	-0.000	-0.27
Separated	0.051	0.052	0.004	0.032	0.000	0.09
Parity						**0.03**
1 child	1					
2children	-0.013	0.165	-0.003	0.120	-0.000	-0.26
≥ 3children	-0.008	0.678	-0.009	0.521	0.000	0.29

Discussion

To the best of our knowledge, this study is the first to provide evidence on the decomposing of socioeconomic inequality in the use of IPTp-SP among women in Nigeria. The results of the current study indicated disproportionate concentration of IPTp-SP intake was pro-rich. Four or more antenatal visit and education status were significantly associated with IPTp utilization in the adjusted odds ratio. This study shows that the pregnant women who took at least one or more doses of IPTp were 63.4%, while those who took two or more doses 40% and those who took three or more doses 17%. Considering the recommendation from WHO that women should receive at least 3 doses of Sulphadoxine pyrimethamine, which was revised to a monthly administration during pregnancy(20), more efforts should be made to increase its access in malaria endemic countries. Recent studies in Ghana and Malawi reported three or more doses to be 64.5% and 70.2%, respectively(21, 22). Although the overall use of IPTp-SP increased from 27% in 2013 to 64% in 2018(23), still the Nigerian national strategic plan for malaria reports variation in the uptake of at least a dose among women (24).

The value of the concentration index of IPTp intake was 0.180 indicating that the rich reported the use of IPTp more often. Further decomposition of IPTp showed that the variables wealth index and the level of education are the main contributors, while region, age, marital status, parity had negligible contribution to the observed socioeconomic inequality. Another study reported from earlier work in Nigeria, using only the concentration index to asses inequality, also showed the IPTp utilization is pro-rich (14). This finding was comparable with the study reported from Kenya (25) which shows that poor individuals were less likely to use any kind antimalarial drugs for pregnant women. Other studies in some developing countries indicated that IPTp use during pregnancy was concentrated among women in the richest households (26–28).

In contrast to the current study finding, the study reported by Mathanga et al (13) indicated there was no inequality between pregnant women on IPTp utilization. The difference between our finding and previous study results is probably due to the difference in IPTp coverage malaria prevention program strength and awareness level difference among the women in the study areas.

The adjusted odds ratio shown that covariates such as higher educational status and adequate antenatal visits significantly contributed to the IPTp utilization during pregnancy in Nigeria. Women with secondary and higher education had higher odds of taking IPTp-SP compared to those with no education. This reveals that educated women are aware of the effect of malaria in pregnancy which is consistent with other studies that showed educated women are more likely to take IPTp –SP (29, 30). The number of ANC visits was significantly associated with at least one dose of IPTp –SP. This is not surprising because pregnant women are recommended to be given the drug during the ANC visits (3). Although findings from a systematic review shows inconsistent association between the ANC attendance and the IPTp uptake (31), the possible reason of the variation is that some women attend ANC but were not given SP due to stock out (32, 33). Due to the high correlation observed between ANC visits and IPTp in this study, the ANC variable was excluded during the decomposition analysis.

The odds of taking a dose of SP among women with high parity (three or more children) was lower in the bivariate analysis, however, the association was no longer significant after adjusting for education status, age, marital status, region, antenatal visits and wealth index. Ideally women with more children should have known the importance due to previous pregnancies. This is in consonance with a study by Bouyou-Akotet et al which shows that having more than four children lowers the intake (34), this result contradicts a study in Uganda which reported that women with more children used IPTp due to the possible exposure to the message of its significance (35). Marital status and age did not show significant association in the logistic regression.

The present study has some limitations. The main limitation is cross sectional nature of the study design which could not show the causal relationship between the available inequality on IPTp utilization and the factors that contributed to the inequality. In addition, all potential determinant factors of inequality were not included in the analysis. This might limit the comprehensiveness of our findings on the factors contributed to the observed inequality.

Implications For Policy And Research

- To maximize the intake of IPTp across the country by targeting women from the low socioeconomic status
- Policy makers should ensure community based delivery approach for IPTp
- Further research is needed to explore the barriers of IPTp intake in Nigeria

Conclusion

The current study showed the presence of considerable inequality between pregnant women in IPTp utilization in Nigeria. IPTp use is concentrated among women from the richest households which are more likely to take one or more dose compared to their counterparts. IPTp service expansion through targeting pregnant women from low socioeconomic status and rural area are important to reduce the available inequality.

List Of Abbreviations

ANC-Antenatal care; IPTp- Intermittent preventive treatment in pregnancy; NDHS-Nigerian demographic health survey; SP-Sulphadoxine Pyrimethamine; WHO-World health organization.

Declarations

The authors declare that they have no competing interests

Ethics approval and consent to participate

This study was approved by the ethics review boards of Tehran University of Medical Sciences (IR.TUMS.SPH.REC.1398.070),

Consent for publication

Not applicable

Availability of data and materials

The data for this work can be accessed on the DHS website. Available at: https://dhsprogram.com/data/dataset/Nigeria_Standard-DHS_2018.cfm?flag=1

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Authors contribution

FM, MP, SN, HS, RM performed data extraction, data cleaning, data analysis, drafted and critically review the manuscript

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Figures

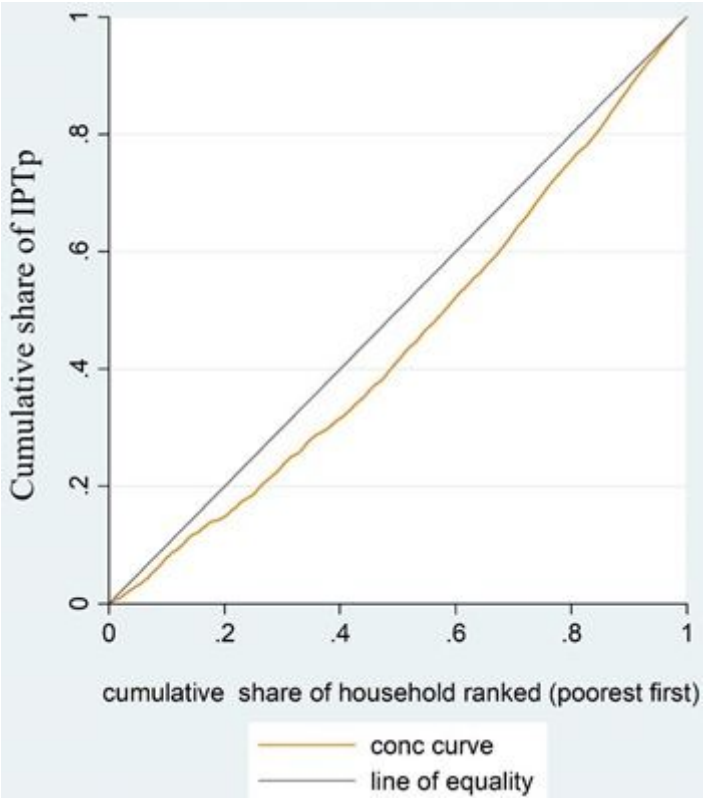

Figure 1

Concentration curve for IPTp (antimalarial drug) among pregnant women.

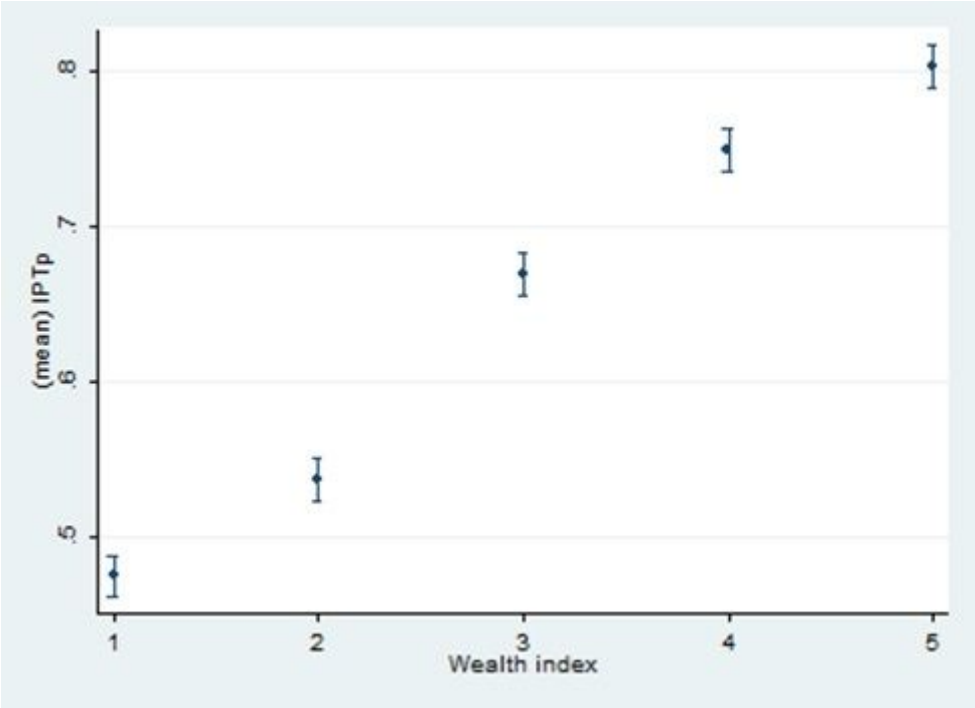

Figure 2

Mean intake of Intermittent preventive treatment using Sulphadoxine Pyrimethamine (IPTp-SP) among pregnant women in Nigeria, by household wealth index 2018.