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ORIGINAL ARTICLE

A Longitudinal Multilevel Analysis of the Effects of Contraceptive Failures on Unintended Pregnancies among Women in Urban Nigeria

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Abstract Unintended pregnancy is a global public health concern. However, the effect of contraceptive failure on unintended pregnancy remains unclear in Nigeria. We undertook a longitudinal analysis to examine the effect of contraceptive failure on unintended pregnancy among urban women in Nigeria. We used panel data from the Nigerian Urban Reproductive Health Initiative. The Measurement, Learning and Evaluation program conducted the surveys among a cohort of women aged 15–49 who were first interviewed at baseline in 2010/2011 and followed up at endline in 2014/2015. Analytic sample was 4140 women aged 15–49 who ever used contraceptives. We fitted three-level multilevel binary logistic regression models estimated with GLLAMM. The study established evidence that there is a significant effect of contraceptive failure on unintended pregnancy among urban women in Nigeria. The positive effect of between-person contraceptive failure indicates that respondents who experienced more contraceptive failure than the average in the sample had 5.26 times higher odds of unintended pregnancy (OR = 5.26; p-value < 0.001). Results also established a significant effect of within-person contraceptive failures among the respondents. Findings suggest there is evidence of a significant longitudinal effect of contraceptive failure on unintended pregnancy in urban Nigeria. Efforts to reduce unintended pregnancy must include interventions to address the problem of contraceptive failure among urban women in Nigeria.

Keywords Contraceptive failure · Unintended pregnancy · Longitudinal analysis · Urban Nigeria

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Introduction

Unintended pregnancy continues to be a public health concern of global importance. Scholars have defined unintended pregnancy as either unwanted (at that particular point in time) or mistimed (happening at the wrong time but wanted later) [1, 2]. More than 4 in 10 of all pregnancies worldwide are unintended [3]. Evidence also shows that about 1 in 4 of the estimated 210 million annual global pregnancies are resolved through induced abortion [2]. This often results in complications or death due to poor quality of abortion care services particularly in resource-poor settings.

Evidently, unsafe abortion is a significant driver of maternal mortality, causing around 13% of all global maternal deaths [4]. This has a significant implication for the attainment of targets 3.1 of the Sustainable Development Goals (SDG) which aims to reduce the global maternal mortality to less than 70 per 100,000 live births by 2030 [5].

Despite efforts to improve maternal health by successive governments and development partners in Nigeria, relevant reproductive health indicators remain poor. Nigeria has low modern contraceptive prevalence rate—currently standing at 12% among married women (18.2% in urban areas) [6], while the country also has one of the highest burdens of childhood mortality in the world [6, 7]. Over 9 million Nigerian women and girls become pregnant every year, with almost half of these pregnancies reported as unintended [6, 8, 9]. Studies have established a strong link between unintended pregnancy and unsafe abortion [2–4]. Unsafe abortion is a social and public health concern in Nigeria particularly because pregnancy terminations are often done clandestinely, in some cases, by unqualified health care providers due to the country's restrictive abortion legal framework. As a result, Nigeria is the largest contributor to maternal mortality statistics worldwide [9, 10]. Large proportion of maternal deaths arising from unsafe abortions would have been averted through effective contraception, albeit, contraceptive prevalence rate remains low in Nigeria. Unmet need for family planning is also high in Nigeria, currently standing at 48% and 19% among sexually active unmarried women and currently married women, respectively [11, 12].

Studies have identified the predictors of unmet need for family planning and low contraceptive use in Nigeria, including cultural and religious beliefs [11, 13], low education and lack of knowledge and awareness about contraceptives [14], household poverty [15, 16], fear of side effects [17, 18], early sexual initiation [19], desire for large family size [20], and poor access to good quality family planning services [21]. Also, a growing body of literature has identified factors that influence unintended pregnancy. Studies have implicated low socio-economic status [1], lack or improper use of contraceptives [22], poor awareness about effective use of contraception [23], being sexually active during adolescence, and lack of access to youth friendly services [24, 25] as determinants of unintended pregnancy. Unintended pregnancy may result from nonuse of contraceptives or contraceptive failure. Contraceptive failure rate has been defined as the percentage of women who will get pregnant within 12 months after starting using contraception [26]. Contraceptive failure is categorized as typical-use failure rates (effectiveness among all women, including those with inconsistent and incorrect method use) and perfect-use failure rate (effectiveness among only women with consistent and correct use). According to the latest Demographic and Health Survey, contraceptive failure rate is 41% in Nigeria, which is much higher compared to many other countries in sub-Saharan Africa, including Zimbabwe (22%) and Rwanda (30%) [27].

In terms of the characteristics of women in urban Nigeria, evidence suggests a much better situation compared to their rural counterparts. For instance, 16% of urban women were uneducated compared to 51% in rural areas, and total fertility rate is 4.5 among urban women compared to 5.9 in rural areas [28]. Further, contraceptive use is generally higher in urban areas than rural settings in almost all parts of the world, albeit, Nigeria's modern contraceptive prevalence rate in urban areas is much lower at 18% when compared to over 50% in urban areas of many other countries in sub-Saharan Africa such as Malawi, South Africa, and Rwanda [28, 29]. While contraceptive use is low in urban Nigeria, the urban poor generally face greater challenges and barriers to effective contraception, including limited access, poor social norms, partner disapproval, poor spousal communication, and poor negotiation power [11, 30, 31]. There are, however, gaps in evidence on the effects of contraceptive failures on unintended pregnancies among the urban women. The previous attempts at investigating this subject were largely an examination of association between contraceptive failure and unintended pregnancy. Thus, the present study aimed at examining the effects of contraceptive failure on unintended pregnancy by undertaking longitudinal analysis of panel data of women in urban Nigeria.

Materials and Methods

Study Designs and Participants

In 2010, an Urban Reproductive Health Initiative was launched in Nigeria as a program to support

increased use of modern methods of family planning in six targeted urban locations, including Abuja, Benin, Ibadan, Ilorin, Kaduna, and Zaria. As part of the Nigerian Urban Reproductive Health Initiative (NURHI) program, the Measurement, Learning and Evaluation (MLE) project was conducted, through sponsorship from Bill and Melinda Gates Foundation, to assess the effect of the initiative on attitudes toward family planning, as well as demands and supply of family planning services in urban Nigeria. The present study used longitudinal data that came from the MLE surveys among a cohort of women of childbearing age who were first interviewed at baseline in 2010 to 2011 and followed up over approximately 4-year interval before the last interviews at endline in 2014 to 2015. For additional details, the design and implementation procedures of the MLE project have been published [32].

Of the 10,672 women who participated in the baseline and endline MLE surveys, there were 4140 women who met the inclusion criteria for the present study. The inclusion criteria specified that women had to be in their reproductive age at both surveys, so women who were more than 49 years at the endline survey were excluded ($n=597$). Additionally, women must have ever used a contraceptive method, since the core of this research is to assess the effect of contraceptive failures on women's experience of unintended pregnancies. In other words, questions about contraceptive failure do not pertain to women who never used a contraceptive method. This led to the decision to exclude those who never used a contraceptive method in our analysis ($n=5796$). We also excluded cases with missing data on any of the study variables since there were few of them ($n=103$). Finally, we excluded women in primary sampling units (PSUs) that have less than five women ($n=36$) because multilevel models produce reliable results when groups have at least five observations [33]. Therefore, the analytic sample used in our study comprised 4140 women in 485 PSUs who have ever practiced contraception as depicted in Fig. 1.

Measures

Dependent Variable

We assessed unintended pregnancy at baseline and endline periods. Questions about unintended pregnancy in the MLE surveys pertain to three subgroups of the eligible participants in our study. The first category included women who had ever given birth, had abortions, had miscarriage, or had stillbirth: "at the time you became pregnant the first time, did you want to become pregnant then, did you want to wait until later, or did you not want to have any children at all?" The second category comprised women who had one or more births since 2008 (for baseline survey) or since January 2012 (for endline survey): "at the time you became pregnant with youngest child born, did you want to become pregnant then, did you want to wait until later, or did you not want to have any more children at all?" The last category included women who were currently pregnant: "At the time you became pregnant, did you want to become pregnant then, did you want to wait until later, or did you not want to have any more children at all?" At each survey, we combined the responses from the three sub-groups of women to create variable on unintended pregnancy. Women were coded as having "0 = no unintended pregnancy" if they wanted to become pregnant then, whereas those who wanted to wait until later or did not want to have any more children were coded as having "1 = unintended pregnancy." It is important to note that few respondents were found to belong to more than one sub-group, reporting unintended pregnancy each time. In any case, we categorized women as having unintended pregnancy in any of the three sub-groups. Additionally, our aim is to examine unintended pregnancy between the baseline and endline even though the unintended pregnancy is not associated with the same pregnancy/birth at each wave. This does not necessarily impose a limitation on our study since pregnancy desire is not static, i.e., pregnancy desire may change over time depending on women's circumstances.

Independent Variable

We evaluated contraceptive failure also at baseline and endline periods. We created this variable by combining responses from two groups of women at the baseline survey. The first group was women who themselves (or their partners) were currently doing something or using any method to delay or avoid getting pregnant. These women were asked a couple of follow-up questions: "before you started using current method did you (or your partner) use a different

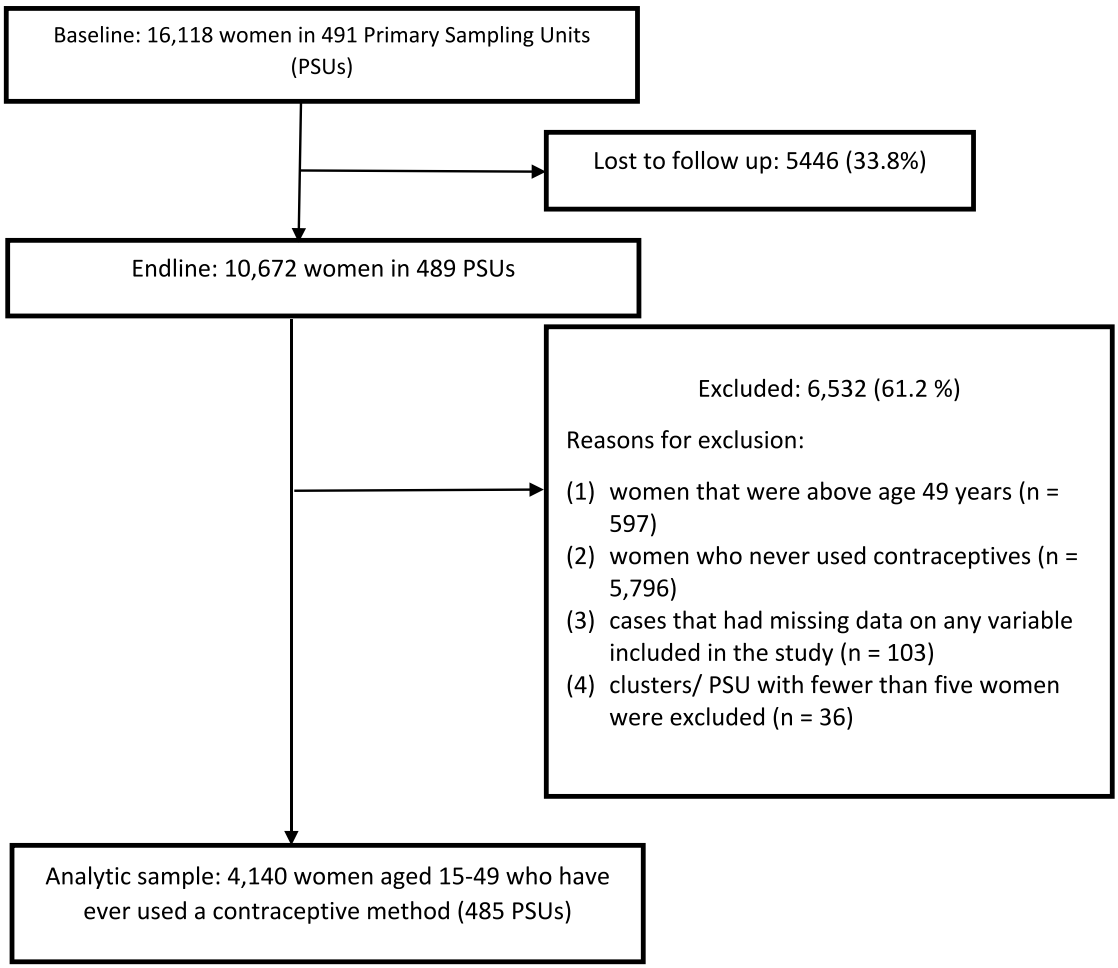

Fig. 1 Sample selection flowchart

method? (If yes,) why did you switch from previous method to current method?" The second group was women who themselves (or their partners) were not currently doing something or using any method to delay or avoid getting pregnant: "why did you stop using the method?" At the endline survey, women who themselves (or their partners) were currently using any contraceptive method were asked some follow-up questions: "before you started using current method did you (or your partner) use a different method? (If yes,) why did you stop using the previous method?" At both surveys, women were coded as having "0 = no contraceptive failure" if their reason for changing a contraceptive method or stopping to use a method was not attributable to method failure or becoming pregnant, whereas they were coded as having "1 = contraceptive failure" provided their reason for changing a contraceptive method or stopping to use a method was due to method failure or becoming pregnant.

Covariates

We assessed covariates only at baseline. These include individual woman characteristics: age groups in years (15–24, 25–34, and 35–49), educational attainment (none/Quranic, primary, secondary, and higher education), marital status (currently in union and not currently in union), religion (Muslim, and Christian, traditional or none), parity (0 children, 1–4 children, and 5 or more children), wealth status (poor and non-poor), and current contraceptive use (using

no method, using traditional method, and using modern method). To elaborate on wealth status, the MLE surveys employed principal component analyses to categorize women into household wealth quintiles—poorest, poorer, middle, richer, and richest—based on several indicators of women's household wealth such as source of drinking water, electricity, possession of land or livestock, type of toilet facility, and household building materials. In the current study, we grouped "poorest and poorer" women as having "poor" wealth status and "middle, richer, and richest" women as having "non-poor" wealth status.

Current contraceptive use was measured based on whether women (or their partners) were currently adopting a contraceptive method and questions about specific methods that they were adopting. We categorized women as "using no method" provided they were not currently adopting any method; "using traditional method" provided they were doing standard days method/cycle beads, rhythm method, and withdrawal; and "using modern method" if they selected the following methods: daily pill, injectables, implant, intrauterine device, male/female sterilization, diaphragm, emergency pill, spermicide (gels or foams), male/female condom, and lactational amenorrhea.

In addition, community-level characteristics include city of residence (Abuja, Benin, Ibadan, Ilorin, Kaduna, and Zaria); community-level education, i.e., proportion of women with higher education in the PSUs (low, medium, and high); and community-level poverty, i.e., proportion of women who belonged to poor households in the PSUs (low, medium, and high).

Analysis

We used Stata 16.1 for the data analysis [34]. Our first step involved computation of summary statistics such as percentages, means, and standard deviations for the distributions of respondent's characteristics at baseline. We used chi-square test (analysis not shown) to test relationship at the bivariate level to ensure that significant variables are included in our multivariable models. As a result, we excluded religion and city of residence due to non-significant bivariate association of these factors with unintended pregnancy.

We treated the variables used in this study as comprising three hierarchical levels: repeated measures (level 1) were clustered within individuals (level 2), and individuals were clustered within the PSUs (level 3). Thus, we estimated a set of multilevel models to assess temporal relationship between contraceptive failures and unintended pregnancy over the study period. We used the generalized linear latent and mixed models (GLLAMM) framework for the multilevel modeling because of its flexibility in estimating fixed and random effects of different outcome variables, e.g., continuous, count, dichotomous, and polychotomous categorical variables [35, 36]. For the purpose of this study, three-level multilevel binary logistic regression models were estimated with GLLAMM.

In addition to using multilevel modeling for the analysis of the clustered data, we accounted for longitudinal relationship between contraceptive failures and unintended pregnancy by measuring within-person (WP) change and between-person (BP) differences in contraceptive failure, allowing us to distinguish effects of cross-sectional differences and longitudinal changes in contraceptive failures [37]. We derived WP change in contraceptive failure by obtaining the difference of a respondent's observation at each wave from the respondent's mean across the two waves, i.e., WP = [person's observation at specific wave − person's mean]. We computed BP differences in contraceptive failure as respondent's mean value across their repeated observations, centered on the average value of all respondents' means, i.e., BP = [person mean – grand mean]. This approach allowed us to separate the two sources of variability, thereby testing the temporal relationship between contraceptive failure and unintended pregnancy.

We employed a three-step modeling approach. Model 1 described the effects of the WP change and BP differences in contraceptive failures on unintended pregnancy. Model 2 examined the effects of the covariates on unintended pregnancy. Finally, Model 3 examined the effect of WP and BP contraceptive failures on unintended pregnancy, controlling for the covariates. Our analysis of the NURHI data was weighted due to its complex sampling design, ensuring that estimates were representative of the urban women population.

Results

At baseline, the average age of the participants was 31.6 years (SD = 0.11) as shown in Table 1.

Greatest proportions of the participants attained secondary education (45.8%) and higher education (32.5%), were currently married or living with a partner (84.2%), and gave birth to one to four children (60.7%) and five or more children (21.0%). In terms of religious affiliation, a large proportion of the women were Muslims (40.9%), while the rest of the women (59.1%) was comprised of Christians, traditionalists, and others without a religious affiliation. Per wealth status, about three out of ten women were categorized as poor, implying that most of the participants belonged to non-poor households. Although about 61% of the women were currently using either traditional or modern contraceptive methods, a considerable proportion (39.4%) was currently not using a contraceptive method. The respondents were distributed across six cities in Nigeria, ranging from 7.8% of women in Zaria to 22.6% of women in Ibadan. About one third (35.4%) of the respondents lived in communities with a low proportion of women with higher education. Three out of ten respondents lived in communities with a low proportion of poor households. Only 4.4% of the respondents reported having contraceptive failure. Women who had unintended pregnancy accounted for 14.4% of the respondents.

Table 2 presents results from the multilevel models assessing the effect of contraceptive failure on unintended pregnancy. Model 1 shows the odds ratios of unintended pregnancy for the main effects of WP change and BP differences in contraceptive failure. The positive effect of WP contraceptive failure indicates that respondents who experienced more contraceptive failure than their own average during the baseline and endline surveys had 3.85 times higher odds of having unintended pregnancy (OR = 3.85; p-value < 0.001). This result shows there is a temporal association of contraceptive failure with unintended pregnancy among urban women in Nigeria. The positive effect of BP contraceptive failure indicates that respondents who experienced more contraceptive failure than the average in the sample had 5.26 times higher odds of unintended pregnancy (OR = 5.26; p-value < 0.001).

In Model 2, we examined the main effects of the covariates on unintended pregnancy. The odds of unintended pregnancy were 28% lower for respondents aged 25–34 (OR = 0.72; p-value < 0.01) and 62% lower for respondents aged 35–49 as compared to younger age 15–24 (OR = 0.38; p-value < 0.001).

Table 1 Characteristics of urban women aged 15–49 years in Nigeria at baseline

Characteristics	% or mean (SD)
Age group	
15–24	16.8
25–34	48.2
35–49	35.1
M (SD)	31.58 (7.09)
Education	
None/Quranic	6.4
Primary	15.4
Secondary	45.8
Higher	32.5
Marital status	
Currently in-union	84.2
Not currently in-union	15.8
Religion	
Muslim	40.9
Non-Muslim (Christian, traditional, none)	59.1
Parity	
0 children	18.3
1–4 children	60.7
5 or more children	21.0
M (SD)	2.85 (2.20)
Wealth status	
Poor	32.0
Non-poor	68.0
Current contraceptive use	
Using no method	39.4
Using traditional method	14.9
Using modern method	45.7
City of residence	
Abuja	18.3
Benin	16.2
Ibadan	22.6
Ilorin	19.5
Kaduna	15.5
Zaria	7.8
Community-level education	
Low	35.4
Medium	32.4
High	32.3
Community-level poverty	
Low	30.7
Medium	37.5
High	31.8

Table 1 (continued)

Characteristics	% or mean (SD)
Contraceptive failure	
No failure	95.6
Failure	4.4
Unintended pregnancy	
No unintended	85.6
Unintended	14.4
Number of women	4140

Wealth status was associated with unintended pregnancy, with women from non-poor households having 21% less odds of unintended pregnancy than those from poor households (OR = 0.79; p-value < 0.05). Among the respondents, those who had 1–4 children were 2.99 times more likely, and those who had 5 or more children were 3.57 times more likely to have unintended pregnancy relative to those who had no children. Respondents who belonged to non-poor households had lower odds of unintended pregnancy (OR = 0.77; p-value < 0.01). Respondents who lived in communities with high proportions of women in poor households were 1.35 times more likely to experience unintended pregnancy, compared to those who lived in communities with low proportions of women in poor households (OR = 1.35; p-value < 0.05).

Model 3 shows the results of the temporal association between contraceptive failure and unintended pregnancy, controlling for the covariates. Significant effects of WP and BP contraceptive failures persist. Similarly, the lower values for the model fit statistics (i.e., AIC, BIC, and -2loglikelihood) indicate that the effect of contraceptive failure on unintended pregnancy was robust to adjustment for covariates.

Discussion

The objective of this study was to examine the effect of contraceptive failure on unintended pregnancy in urban Nigeria. We undertook longitudinal multilevel analysis using panel data from the MLE surveys.

Our findings established the evidence demonstrating the effects of contraceptive failure on unintended pregnancy among women in urban Nigeria. The results show that respondents who experienced more contraceptive failure than their own average during the baseline and endline surveys had significantly higher odds of having unintended pregnancy. These results were further re-echoed after controlling for women's characteristics. Compared to women who reported no contraceptive failure, our analysis established that respondents who experienced contraceptive failures were more likely to experience unintended pregnancy, thus confirming our hypothesis. The results established a temporal association of contraceptive failure with unintended pregnancy among the respondents. In all the models fitted, we found that significant effects of WP and BP contraceptive failures persist. The positive effect of BP contraceptive failure indicates that respondents who experienced more contraceptive failure than the average in the sample had significantly higher odds of unintended pregnancy. Similarly, we found a positive effect of WP contraceptive failure as respondents who experienced more contraceptive failure than their own average during the baseline and endline surveys had significantly higher odds of having unintended pregnancy, though this had a lower odd compared to the BP differences.

These results have important policy implications. The study established a longitudinal relationship between contraceptive failures and unintended pregnancy, thus demonstrating significant risks of having unintended pregnancy from contraceptive failure. In urban Nigeria, fertility level will remain high, particularly from unintended pregnancy, if contraceptive failure persists. This accords well with a recent study on sub-national analysis of contraceptive discontinuation among women in Nigeria which established contraceptive failure (i.e., getting pregnant while using contraceptives) as one of the significant reasons for discontinuing contraceptive use within 12 months of initiating a method [27]. This reason stood out as a major factor for discontinuing contraceptive use across the six regions of Nigeria. Other similar studies have established that contraceptive nonuse or contraceptive failure is a dominant cause of unintended births in developing countries [38–40], and thus, addressing contraceptive failures should be a public health priority and a crucial component of the family planning programming in high-fertility countries such as Nigeria.

Specifically, urban population is rapidly growing in Nigeria, and the natural increase (excess of births over deaths) is the more dominant driver of the

Table 2 Results from multilevel models of contraceptive failure predicting unintended pregnancy

Unintended pregnancy	Model 1 OR (S.E)	Model 2 OR (S.E)	Model 3 OR (S.E)
Mixed Effects Intercept	0.15 (0.01)***	0.11 (0.03)***	0.12 (0.03)***
Contraceptive failure (WP)	3.85 (0.95)***		3.81 (0.93)***
Contraceptive failure (BP)	5.26 (1.37)***		4.21 (1.03)***
Age group (Ref. = 15–24)			
25–34		0.72 (0.08)**	0.73 (0.09)*
35–49		0.38 (0.05)***	0.38 (0.05)***
Level of education (Ref = none)			
Primary		1.28 (0.19)	1.26 (0.19)
Secondary		1.21 (0.17)	1.17 (0.17)
Higher		0.83 (0.14)	0.80 (0.14)
Current marital status (Ref = currently married)			
Not currently married		0.95 (0.16)	0.98 (0.17)
Parity (Ref. = 0 children)			
1–4 children		2.99 (0.51)***	2.87 (0.49)***
5 or more children		3.57 (0.74)***	3.24 (0.66)***
Wealth status (Ref = poor)			
Non-poor		0.77 (0.08)**	0.76 (0.07)**
Current contraceptive use (Ref. = using no method)			
Traditional method		0.81 (0.11)	0.81 (0.10)
Modern method		0.86 (0.08)	0.85 (0.08)
Community-level education (Ref = low)			
Medium		0.88 (0.09)	0.89 (0.09)
High		0.84 (0.11)	0.83 (0.11)
Community-level poverty (Ref = low)			
Medium		1.13 (0.14)	1.14 (0.14)
High		1.35 (0.20)*	1.34 (0.19)*
Random effects (variances and covariances)			
Person level	0.71 (0.18)	0.43 (0.15)	0.44 (0.16)
Primary sampling unit level	0.37 (0.07)	0.29 (0.06)	0.29 (0.06)
Model fit statistics			
AIC	7494.94	7357.09	7266.45
BIC	7530.05	7483.47	7406.88
-2Loglikelihood	7484.94	7321.09	7226.45

8280 observations were clustered within 4140 women of reproductive age 15–49 who lived in 485 primary sampling units

*p-value < .05, **p-value < .01, ***p-value < .001

OR Odds ratio, *SE* standard error

increasing unsustainable urbanization in the country than migration [41]. Thus, studies have established quality family planning program as an important strategy to achieve sustainable urbanization in Nigeria and other high-fertility countries [6, 41–44].

While earlier studies have established unintended pregnancy as a critical reproductive consequence of contraceptive failure in developing countries [38, 39], our study contributes to the reproductive health literature by establishing a causal relationship between the two phenomena (contraceptive failure and unintended pregnancy).

The study demonstrates convincing evidence of the longitudinal effects of contraceptive failure on

unintended pregnancy in urban Nigeria. Nigeria has aspiration to improve maternal health through her commitments to several pertinent international targets and agenda such as the Programme of Action of the International Conference on Population and Development (ICPD), Campaign on Accelerated Reduction of Maternal Mortality in Africa, 2030 Family Planning commitment, and Sustainable Development Goals. Despite these commitments and efforts, Nigeria ranks as the largest contributor to global maternal mortality statistics, with 15% of the global maternal deaths [10]. Evidently, unsafe abortion is a major driver and leading cause of maternal mortality in Nigeria, and high proportions of unintended pregnancies are resolved through induced abortion [45, 46]. With the findings of our study demonstrating a significant effect of contraceptive failure on unintended pregnancy, the need to address the challenge of contraceptive failures in urban Nigeria is therefore now more pertinent and urgent than ever.

Further, other characteristics included in our analysis show interesting findings. An in-depth examination of the results reveals that young women aged 15–24 were at higher risk of experiencing unintended pregnancy. In their study on who is most at the risk of contraceptive failure, Bradley and colleagues [47] found that younger women reported higher risk of experiencing unintended pregnancy due to contraceptive failure than their older counterparts.

Generally, data shows that a lower risk of unintended pregnancy is associated with higher socioeconomic status (SES) across different settings. Our analysis contributes to the extant literature to demonstrate a significant longitudinal effect of higher SES on lower risk of unintended pregnancy. The analysis also revealed a significant longitudinal association between some community-level variables and unintended pregnancy, thus demonstrating that context matters and significantly influences unintended pregnancy. Different authors have adduced that the contexts where individuals live in and cultural values and practices around them, to a very large extent, serve as contextual characteristics that play critical roles and influences on people's behaviors and their health outcomes [48–50].

Limitations and Strengths of the Study

This study has some limitations. First, the study analyzed self-reported data that could not be independently validated. Second, the use of secondary data constrains our analysis to the use of the available variables in the datasets, thus precluding us from considering pertinent contextual characteristics such as cultural practices and issues of gender norms. Future similar studies may consider complementing quantitative data with qualitative data. Third, in our operationalization of contraceptive failure at the endline, only women who were currently using contraceptive methods were included, while women who were not using a method were excluded since the MLE surveys did not include questions to assess contraceptive failure for the second group of women at the endline period. Fourth, even though the survey tools and data documentation of the MLE surveys provided very useful details, there were no specific codebooks created for the surveys, limiting our ability to provide additional information about some of our measures. For instance, additional details may be warranted about women who stopped using contraception due to method failure, but we were unable to give any supplemental information other than what we could find through the MLE project website. Notwithstanding these limitations, the study has some strengths, including the use of a representative data on urban women and a robust longitudinal multilevel analysis that allowed for inference of causality between contraceptive failure and unintended pregnancy. This is a key strength and contribution to reproductive health literature in low- and middle-income countries.

Conclusion

This study established evidence that there is significant effect of contraceptive failure on unintended pregnancy among urban women in Nigeria. While earlier studies have established unintended pregnancy as a critical reproductive consequence of contraceptive failure in developing countries, the current study contributes to the reproductive health literature by establishing a causal relationship between contraceptive failure and unintended pregnancy in Nigeria. Efforts to reduce unintended pregnancy must include interventions to address the challenge of contraceptive failure among urban women in Nigeria.

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Data Availability Since we signed a data-use agreement with Carolina Population Center (CPC), we are not allowed to share these data with other researchers who might want to replicate or expand our studies. To access these data, users must submit a request for access to the CPC for review and approval. Information on how to secure access to this data is available at the CPC data portal (data.cpc.unc.edu).

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