Estimating the Spatially Varying Relationship Between Intimate Partner Violence & Socio-Demographic Variables in Nigeria

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ABSTRACT

Violence done against women carried out by an intimate spouse in particular had become a social and public menace through the world, Abuse occurring within intimate relationships represent a substantial proportion of interpersonal violence recorded in particular against womenfolks which comprises physical, sexual, emotional abuse and manipulative behaviours by a close companion. However, there are limited evidences on estimating spatially varying relationships that might exist between this violence and socio-demographic variables to determine the pattern of abuse. Therefore, this study estimated the spatially varying relationships that exist amongst intimate partner violence IPV and selected socio-demographic variables in Nigeria. The Nigerian Demographic and Health Surveys (DHS) conducted during the years 2008, 2013 and 2018 survey were used. Semi-Parametric Geoadditive Regression Model was adopted. Results revealed that spatial distribution trend of IPV in the studied population were clustered. The probability of undergoing IPV amongst women in Nigeria was high among those whose husbands drank alcohol and women whose wealth index were poorer compared to women whose wealth index were high or very rich. It was concluded that, there exist spatial difference in the spreading pattern of intimate partner assault in Nigeria. Also as women advanced in age, her exposure to any form of IPV decreases. Therefore, women in the poorest wealth index, not gainfully employed; and with low or without education should be the main focus in formation and execution of programes against close partner assault in Nigeria.

Keywords: Violence, Physical abuse, Sexual abuse, Emotional abuse, spatial pattern

Introduction

Close partner abuse as touching womenfolk is a social and public threat throughout the world. Several research works had shown that the spread of IPV spatially differs throughout different countries, Adjah and Agbemafle (2016). The spatial difference in the distributions of home violence was ascribed to locality of socio-demographic characteristic as predictor variables, Kiss *et al.* (2012). Not minding the advantages of spatial procedures, discoveries are scarce, especially in the area of statistical estimation. The main reason is that observational records gathered from socio-demographic data and topographical sites often disrupts the independent hypothesis of linear regression models. According to WHO in the 2017 annual report, it was reported that a third of womenfolk globally has been an object of home assault, WHO (2017). While the weight of the problem differs from

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nation to nation, zone-to-zone or residential area/ settlements. It is however reported that assault in any form is not defensible or admissible, Balogun and John-Akinola (2014). A relative investigation of the Demographic and Health Surveys (DHS) statistics by WHO from nine nations established that the proportion of ever-married womenfolk who reported ever undergoing any of physical or sexual assault by their present or new husband or cohabiting companion was estimated 18% in Cambodia to 48% in Zambia regarding physical abuse, and estimated 4% to 17% with respect to sexual assault. Also from another 10-nation analysis of DHS information, physical or sexual IPV reported by presently wedded females was estimated from 17% in the Dominican Republic to 75% in Bangladesh, while comparable ranges have been recounted in other multi-nation researches, WHO (2012). Accessible researches confirm that the load of the problem is on high in Africa countries, Adjah and Agbemafle (2016), Benebo *et al.* (2018), Finch *et al.* (2014), Kusanthan *et al.* (2016), Elias *et al.* (2021). Even though, most published situations of IPV are done by men against women, previous research had shown that two in every three casualties of close partner violence are done to females, meaning that men also suffers from IPV, Ezenwoko (2023). Nigeria assault against womenfolk lingers as a main challenge in various communities, Adjah and Agbemafle (2016). BMC Women's Health 2018, reported that one in every four women in Nigeria were stated to have ever experienced close or intimate partner violence, Benebo *et al.* (2018). Reports from Nigerian National Population Commission projected women's lifespan vulnerability to abuses from their present spouse or partner was estimated at 19% for emotional, 14% for physical, and 5% for sexual IPV. The incidence of IPV in Nigeria varies from 31% to 61% for psychological/emotional, 20% to 31% for sexual and 7% to 31% for physical assault, Benebo *et al.* (2018), WHO/LSHTM (2010).

Recently, some international assessments had produced proof of capable, or at least promising methods to checking and reacting to assault done against womenfolk which also includes IPV, Adjah

and Agbemafle (2016). The assessments advocate a need for all-inclusive, multi-sectoral, lasting collaborations amongst government administrations and civil society at every stage of the environmental agenda. While individual-level interventions are reasonably simple to appraise, assessment of all-inclusive, multi-level, multi-component programs and institution-wide restructurings are unfortunately more difficult, consequently, while these methods are undoubtedly the keys to lasting prevention, they are the greatest under-studied. Nevertheless, the assessments have recognized a set of precise policies that have demonstrated promises of efficiency, Ezenwoko (2023), WHO/LSHTM (2010), West (1985). While there is a rising body of information about the scope, forms and risk factors related with IPV, research gaps persist, which include patterns of women's reactions to assault and the impacts of IPV on children as carried out in Swiss, Cattagni (2025). Increasing the knowledge about IPV, circulating existing and new evidence will enhance improved programs and policies.

There are limited studies on the spatial spread and predictors of close companion assault, hence, this study researched the spatially varying relationship that exist between the various kinds of IPV (Physical, Emotional, Sexual or their combination) and predictors (socio-demographic) in Nigeria. It is therefore important to consider such challenge and make a reasonable statistical impact to such problems, where we can draw efficient and accurate inference regarding its unknown quantities, so as to give accurate answers to some of the important scientific questions regarding the underlying problems.

Methodology

Study Design & Source of Data

The data used is from the surveys by Nigeria Demographic and Health Surveys done in the following years: 2008, 2013 and 2018 respectively. These are nationwide representative of family surveys that make available information for a varied range of monitoring and impact assessment pointers in the

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fields of population, health, and nutrition. The study was restricted to women under the age of fertility between ages 15 and 49 years in the 36 states and Federal Capital Territory (FCT) of Nigeria. Women who lived in family unit either with or without spouse (single, married or cohabiting). Dataset is accessible on https://dhsprogram.com/data/available-datasets.cfm.

Variables of the Study

The dependent variable was lifespan experience of IPV created from the three key variables of assault (sexual, emotional and physical). The variables were gotten from some interrogations from the home assault section connected to the number of assault acts undergone by a woman. On physical assault, each participants was asked if her current or past companion ever pushed her; shook or flung things at her, hit her, beat her with his fist or something injurious, jolted or pulled her, choked or burnt her, endangered her with a knife, gun or other weaponries, twisted her arm or dragged her hair. Interrogations on emotional abuse concentrated on if a participant's current or past companion ever: disgraced her, threatened to injure her, disrespected or made her feel bad. On sexual assault, participants were questioned if their companion ever physically mandated them into undesirable sex, if the companion ever forced her into other undesirable sexual acts and if the participant has been physically enforced to perform other sexual acts she did not want to. From the cross-examinations on the experience of physical, emotional, and sexual assault, lifespan IPV was produced, with participants undergoing at least one of these acts regarded as ever had IPV or not.

Individual and structural-level (household and community) features were reflected as independent variables in the research. The individual based level features comprised the age of participants (15–49 years), educational level (No education, primary, secondary/higher), husband/partner's educational level (No education, primary, and secondary/higher), married status (currently married, cohabiting, and previously married), employment level (not working and working), Media exposure (yes and no) and husband alcohol consumption among others. The structural-level features were residence of dwelling (urban and rural), wealth index (poorest, poorer, middle, richer, and richest), region (urban or rural), and municipal socioeconomic status was the percentage of womenfolk in the richest family quintile (low and high). All the variables were carefully selected based on their theoretical, practical significance to IPV and their accessibility in 2008, 2013 & 2018 Nigeria DHS dataset.

The Model formulations

Data set on IPV was created with the goal of evaluating the influence of some covariates on domestic violence answer as presented in the health surveys.

The response variable of interest, IPV, is categorized as:

$$\text{Model} \quad y_{i1} = \begin{cases} 1, & \text{if the women ever experienced any intimate partners violence} \\ 0, & \text{otherwise} \end{cases}$$

Varying Coefficient Models

Varying coefficient models are common types of models that includes a large number of statistical models as exceptional cases: the generalized linear model, generalized additive models, dynamic generalized linear models or even the more current functional linear models. They are also seen as a precise case of structured additive regression (STAR) models, Fahrmeir (2004). We explored a class of regression and generalized regression models in which the coefficients are permitted to vary as smooth functions of other variables [WHO/LSHTM (2010), Nelder and Wedderburn (1972). General algorithms are used for estimating the models flexibly. This type of models ties together generalized additive models and dynamic generalized linear models into one standard framework. We considered seemingly diverse generalization-models that are linear in the covariates, but their coefficients are accepTable to transform smoothly with the value of other variables, which we might call 'effect modifiers'. By relaxing the restrictive linearity and normality assumptions of classical regression models, this study adopt a flexible Semi-parametric Geo-additive spatial model

that accommodates the usual fixed effect, nonlinear and geographical component in a unified model, Zhang (2004).

Assume that we have a random variable y whose distribution depends on a parameter η, and we also have predictors $x_1, x_2, \ldots, x_p$ and $z_1, z_2, \ldots, z_p$.
A varying-coefficients model has the form:

$$\eta = \beta_0 + \beta_1 x_1(z_1) + \beta_2 x_2(z_2) + \cdots + \beta_p x_p(z_p) \qquad (1)$$

where η is a logit link function, that is the response variable of women experience sexual, emotional, physical or the combination of the three violence, the $\beta_j(z_j)$ represents non-parametric function of the spatial covariate that measure the effect of spatially varying coefficient, j = 1, …, p and xj denotes independent variables of interest under study.

The Model states that $z_1, z_2, \ldots, z_p$ modify the coefficients of the $x_1, x_2, \ldots, x_p$ through the (unspecified) functions $\beta_1(.), \ldots, \beta_p(.)$. The dependence of β_j on zj indicates a special type of interface between each zj, and xj. In some cases, the variables zj, are not different from the variables xj, in other cases z, this might be a special variable such as 'time', 'region' or 'state'. A common setting for the application is the class of generalized linear models, Nelder and Wedderburn (1972). In that case η is called the linear predictor and is associated to the mean μ= E(y) through the link function.

η = g(μ). In the simplest case of the Gaussian model, g(μ) = μ, and y is normally distributed with mean η, and the Model has the form:

$$\eta = \beta_0 + \beta_1 x_1(z_1) + \beta_2 x_2(z_2) + \cdots + \beta_p x_p(z_p) + \epsilon \qquad (2)$$

Where $E(\epsilon) = 0$, variance of $\epsilon = \sigma^2$ implies that $\epsilon \sim N(0, \sigma^2)$.
Generalized additive models extend generalized linear models by substituting the linear predictor by an additive sum of smooth functions. The generalized additive model is a different case of the varying-coefficient model, as is the dynamic generalized linear model, West (1985).
Assume that the model is a normal linear model with only one term. Thus we have

$$Y = X\beta(Z) + \epsilon \qquad (3)$$

This research considered Bayesian method of parameter estimation to carry out above methods. For Bayesian inference, unidentified functions $f_1 \ldots f_k$ in predictor, the vector of the linear effects parameter $(\alpha = \beta_0, \beta_1, \ldots \beta_k)$, are measured as random variables and are complemented by prior assumptions. In the nonexistence of any prior knowledge, diffuse priors are the appropriate choice for fixed effects parameters, i.e.

$$p(\beta_j) \propto constant \qquad (4)$$

For continuous (smooth) functions $f_1 \ldots f_k$, a second order random walk prior is used for f as follows. Consider the case of a metrical covariate x with equal spaced observations $x_i, i = 1, \ldots, m, m \leq n$ (n is the number of observations). Suppose that $x_{(1)} < \ldots < x_{(t)} < \ldots < x_{(m)}$ is an ordered sequence of distinct values for a covariate and define $f_{(t)} = f(x_{(t)})$. The second order random walk is then defined by:

$$f_{(t)} = 2f_{(t-1)} - f_{(t-2)} + u_{(t)} \qquad (5)$$

with Gaussian errors $u_{(t)} \sim N(0, \tau^2)$ and diffuse priors $f_1 \propto C^{st}$ and $f_2 \propto C^{st}$, for initial values. A second order random walk penalizes deviations from the linear pattern $2f_{(t-1)} - f_{(t-2)}$.

For the spatially correlated effect f_{str}, Markov random field prior is selected. This prior specifies spatial neighborhood association. For geographic data, a common assumption is that two sites or regions r_1 and r_2 are neighbors if they have a shared boundary. Thus, a spatial extension of the random walk model leads to the following conditional spatially autoregressive

design:

$$f_{str}(p)/f_{str}(p'), p \neq p', \tau^2_{str}$$

$$\sim N\left(\frac{1}{N_s}\sum f_{str}(p'), \frac{\tau^2_{str}}{N_s}\right) \qquad (6)$$

here N_s is the quantity of adjacent provinces and $p' \in p$ represents that province p' is a neighbour of province p. The variance parameters τ^2_{str} control the trade-off amongst flexibility and smoothness.

Statistical Packages

All the computation was carried out by Stata and R Integrated Nested Laplace Approximation (INLA)

package. R-INLA is a technique for estimated Bayesian inference, Finch *et al.* (2014).

Results and Discussions

The outputs of the analysis are presented in the forms of Table, spatial maps and non-linear effects.

Table 1 shows the social demographic variables that are significant to the women undergoing any kind of IPV (emotional, sexual and physical) in Nigeria. The result shows that compared to those with no education, other levels of education, which is primary, secondary or high school are significantly less likely to undergo IPV. Likewise, likened to those in the poorest wealth

Table 1. Social Demographic variables of the Combined IPV

Socio-Demographic Variable	Posterior mean	Sd	95% Credible Interval	
			0.025quant	0.975quant
Urban	0.040	0.029	-0.018	0.097
Work	0.033	0.023	-0.013	0.078
Primary	0.120	0.037	0.048	0.194
Secondary	0.050	0.041	-0.030	0.131
High school	-0.342	0.065	-0.468	-0.215
Poorer	-0.106	0.037	-0.182	-0.036
Middle	-0.081	0.038	-0.156	-0.006
Richer	-0.192	0.045	-0.281	-0.104
Richest	-0.332	0.054	-0.438	-0.227
Christian	-0.606	0.060	-0.724	-0.488
Islam	-0.592	0.062	-0.713	-0.470
Newspaper	-0.066	0.041	-0.145	0.015
Radio	-0.126	0.027	-0.180	-0.072
Television	-0.204	0.026	-0.256	-0.153
Hausa Fulani	-0.301	0.042	-0.384	-0.218
Yoruba	0.012	0.059	-0.104	0.127
Igbo	-0.196	0.064	-0.323	-0.070
Alcohol	1.203	0.047	1.112	1.297

index, women in the poorer, middle, richer and the richest wealth index are significantly less likely to undergo IPV. Similarly, compared to those in other religions, Christians and women practicing Islam are significantly less likely to undergo IPV. Also, in relation to women without access to information, women who listened to radio or television at least twice in a week are significantly less likely to suffer IPV, while reading of Newspaper is not significant. Women from Hausa Fulani and Igbo are significantly less likely to undergo IPV compared to other ethnicity, Yoruba ethnic group is not significant. Only women whose companions consume alcohol are significantly more likely to suffer IPV [Posteriors mean = 1.203; 95% (CI = 1.112, 1.297)] likened to women whose companions do not consume alcohol.

Spatial Effects of Combined IPV

Below are the spatial effects of the varying coefficients relationships between the intimate violence and the socio-economic variables under study. The odds ratio of the 95% confidence intervals of the results were represented in the Figures below.

Figure 1: Map of Nigeria, Gayawan (2014).

Figure 1 revealed the map of Nigeria with the six geopolitical zones that exist in the country. Figures 2-7 shows a clustering outcome of IPV in Nigeria. The dark blue colours to the bright yellow of the odd ratio credible interval (CI) pattern which indicate
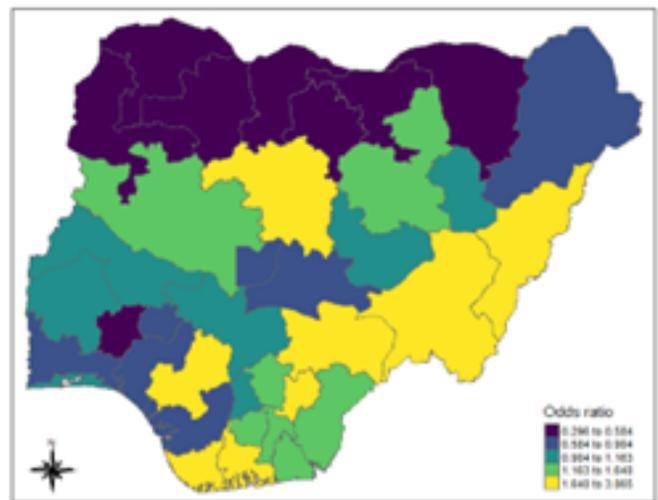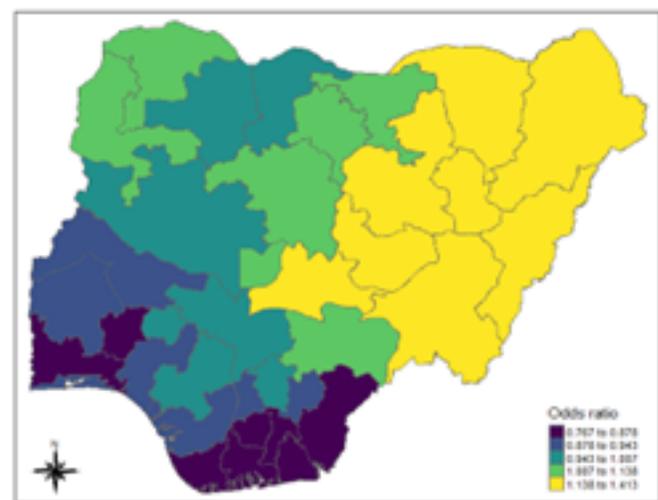

Figure 2. Shows General spatial effects

Figure 3. Shows working status spatial effects

prevalence experiencing of IPV from less to the increased significance level. Figure 2 shows the prevalence of the combined IPV in Nigeria generally. South South region has the highest with three states (Edo, Bayelsa and Rivers), this was followed by the North East region with two states (Taraba and Adamawa), South East, North West and North Central has one state each as follows: Ebonyi, Kaduna and Benue respectively. Figure 3 reveals a waning in the odds of experiencing IPV under working status. This shows that women who are working, receiving an income, supporting the family revenue and may add their voice to decision making in the household are less likely to undergo IPV. Exposure to IPV is however
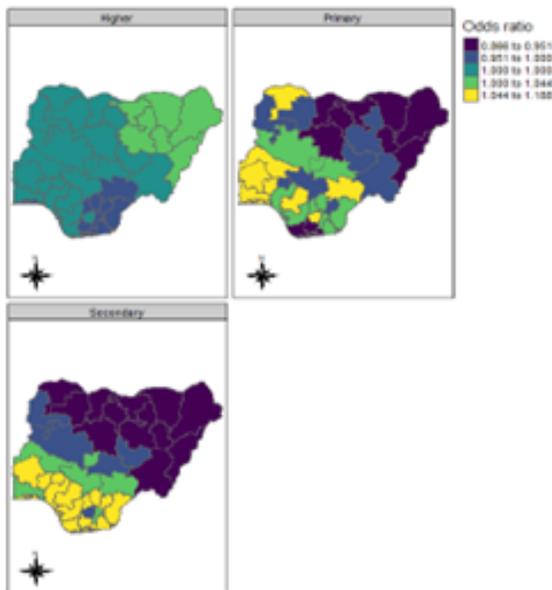
Figure 4. Shows women's level of education spatial effects
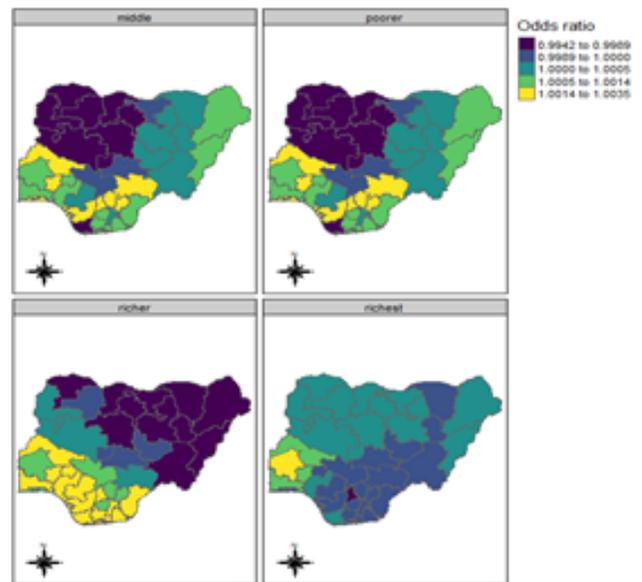

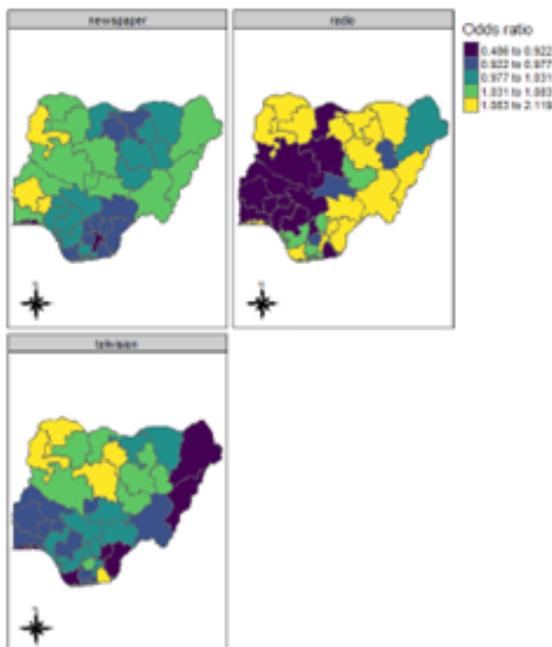
Figure 5. Shows wealth index spatial effects

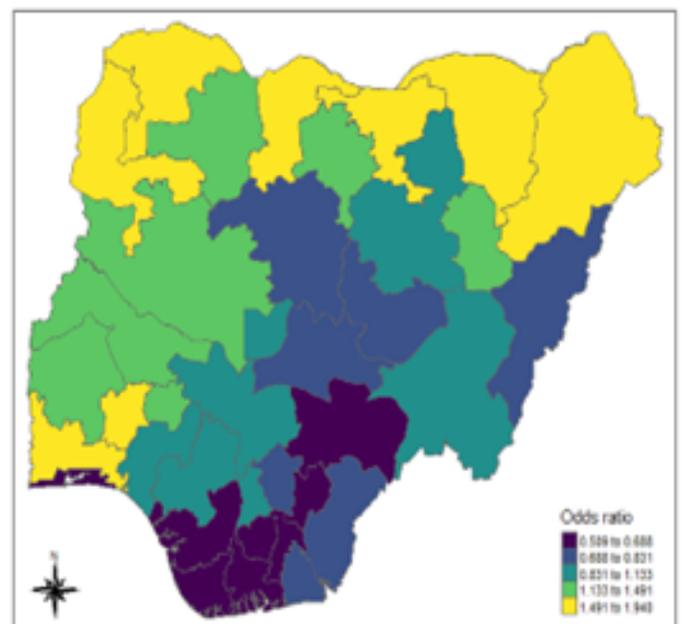Figure 6. Shows media exposure spatial effects

Figure 7. Shows husband alcoholic drink spatial effects

highest in all the six states in the North East and two states (Plateau and Nasarawa) in the North Central. Figure 4 shows that the likelihood of undergoing IPV among women who had at least primary education is high likened with those with higher education throughout the country. Figure 5 reveals that the odds of experiencing IPV amongst women from the richest households were significantly lower likened to those from the poorest households. Meaning that women from poor households tends to rely greatly on their companions for economic supports. This is in line with existing literature that women who are

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working or have good financial status are less likely to be exposed to IPV, Shitu *et al.* (2021), Gedefa *et al.* (2024). Figure 6 shows the spatial effect of access to information that women who only accessed radio experienced IPV more, compared to those who accessed newspaper and television. Figure 7 shows spatial effect of partner alcohol consumption, women whose partner exhibited habit of alcohol consumption were more likely to have all forms of IPV experience. This evidence is line with the work in Portuguese on attributes of male perpetrators of IPV, Cunha *et al.* (2024).

Non-linear effects for different forms of IPV: Emotional, Sexual and Physical

The non-linear effects revealed how age of woman which is a continuous variable is distributed across
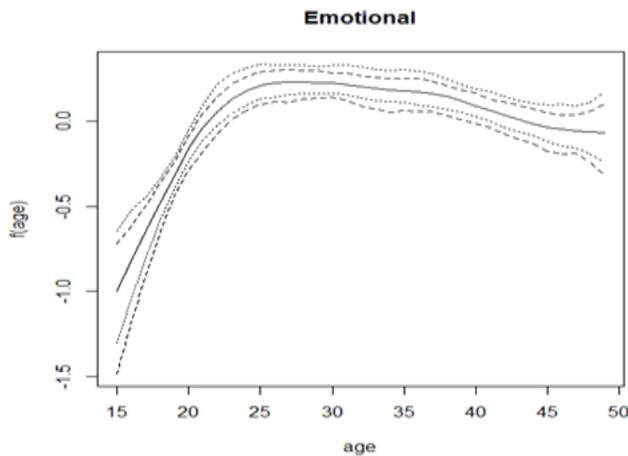

Figure 8 Non-linear effects of emotional type of IPV in Nigeria

the diverse forms of IPV in Nigeria.

Figure 8 shows that women at younger age experience emotional IPV compared to older women. That is women under 25 years experience high emotional IPV and as the women age increases, there is a gradual decrease in the experience of emotional IPV.

Figure 9 shows that women at younger age experience sexual IPV compared to older women. That is, as the women age increases, there is a gradual decrease in the experience of sexual IPV, once a woman is 35
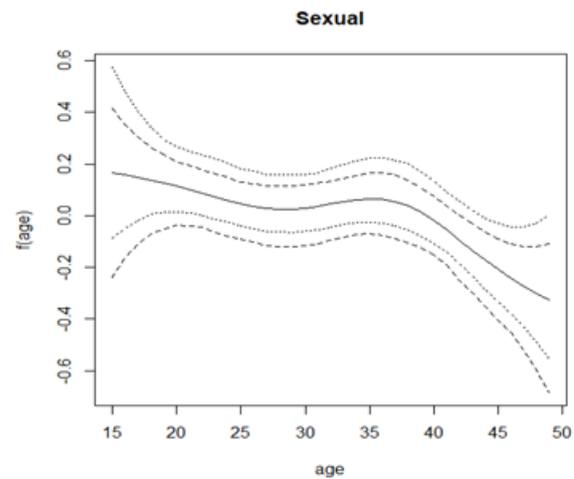

Figure 9: Non-linear effects of sexual type of IPV in Nigeria
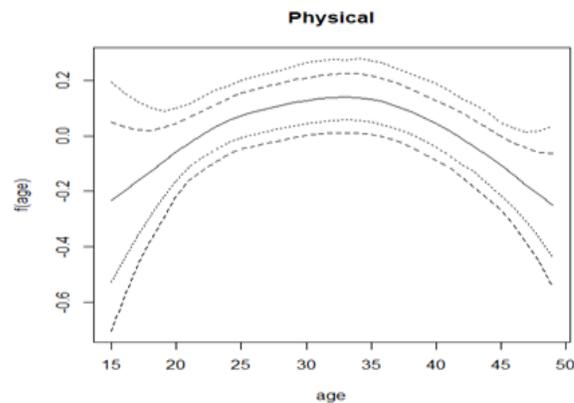

Figure 10: Non-linear effects of physical type of IPV in Nigeria

years, there is a decline in the experience.

Figure 10 shows that women at younger age suffer physical IPV compared to older women. That is womenfolk between 25 and 35 years are more likely to undergo physical IPV, as the women age increases, there is a gradual decrease in the experience.

Model Information

Deviance Information Criteria (DIC) measure was used to access model fitness. The DIC (53700.75) shows that the Model fit the data used for this study.

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Conclusion

It has been established that two in five women undergo one type of assault in their lifetime, WHO (2017), Shitu *et al.* (2021), therefore Nigeria is not an exception. This study however, considered close partner assault and some selected socio-demographic variables in Nigeria that had shown certain patterns which requires attention. Employment status appears to have a significant influence on IPV prevalence, women who are employed tend to report lower incidences on IPV. This may be attributed to the economic empowerment that comes with earning an income and contributing to household finances, which in turns enhances their participation in household decision-making processes. Education attainment also demonstrates a noTable association with IPV. Womenfolk with lower levels of education are more likely to experience IPV compared to persons with higher educational qualifications. This suggests that education may assist as a shielding factor against IPV. Wealth index reveals that women classified within the richest category are less likely to undergo IPV under the general IPV category compared to those in other economic strata. Media exposure, suggests that the type and nature of media exposure may play a role in shaping awareness, attitudes, or risk factors related to IPV. It was observed that IPV varied within the studied population and there is spatial inequality in the distribution of IPV within Nigeria. Results from the spatial effect of the Model showed that pattern of IPV spatially clustered among the six-geopolitical zone in Nigeria for the social-demographic variables. Generally, for the diverse forms of IPV which exist as: emotional, sexual and physical, there is a reduction in the exposure to IPV as a woman advances in age, particularly from 35 years. This is in agreement with findings from lecture that prevalence of IPV is higher among young women, Mazza (2021). Therefore, both government and non-governmental organizations in Nigeria can consider implementation of activities that can assist women with no education, women who are not gainfully employed and those whose partners consume alcohol with interventions against intimate partner violence. Legal laws that keep the rights of womenfolk and endorse gender equality should be strictly followed in order to achieve SDGs programme that seeks to attain zero sexual and close partner assault, including zero child marriage, zero early and forced marriage, and zero female genital mutilation like other African nations, Gedefa *et al.* (2024), Mukaddas (2024). It should also be encouraged that women who suffered violence by partners should make adequate use of the social media to report their experiences thereby exposing this menace and not given a hiding place to perpetrators.

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