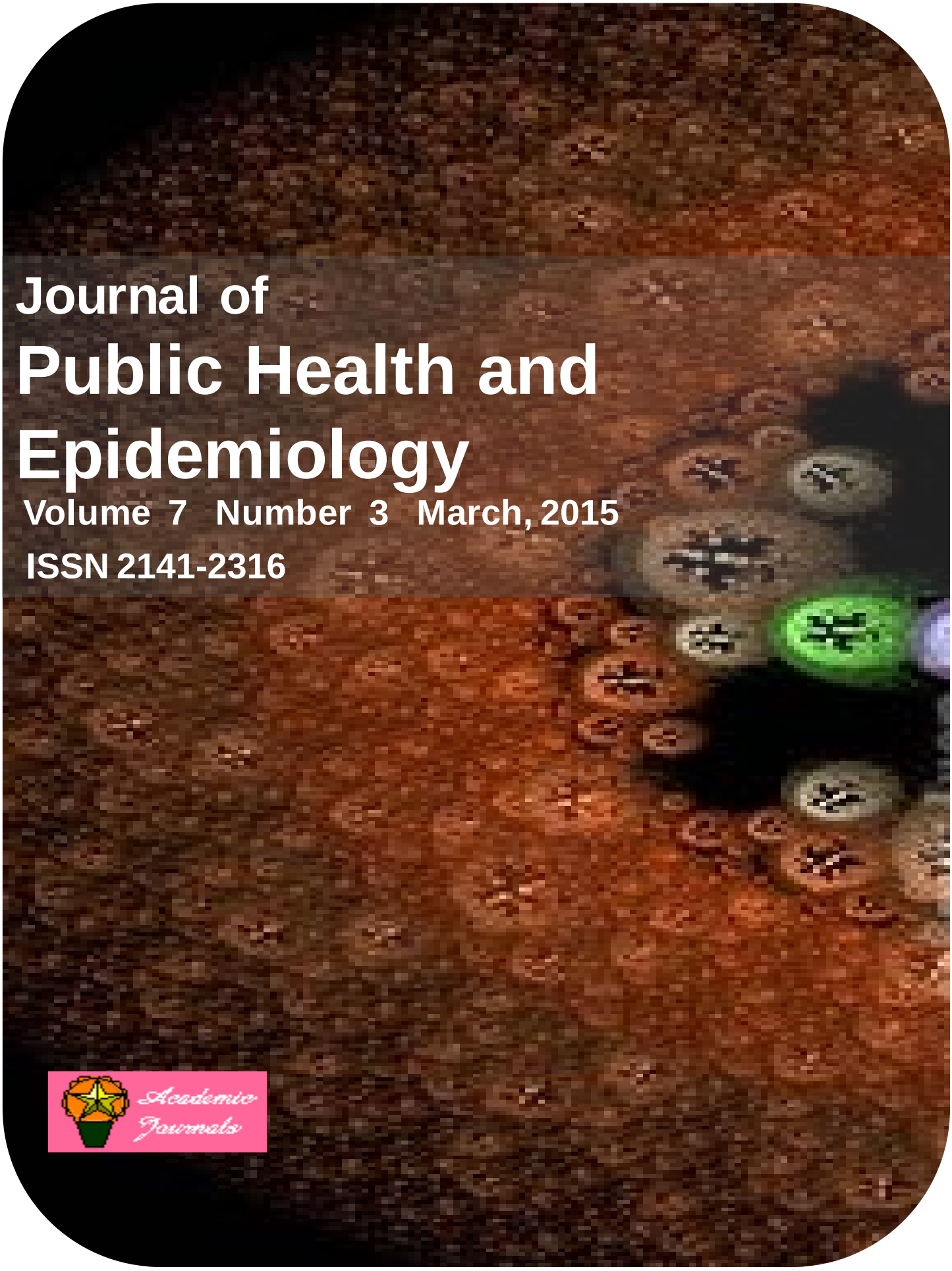

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Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing Escherichia coli in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: 1281-1286.

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Full Length Research Paper

Empirical analysis of factors associated with neonatal length of stay in Sunyani, Ghana

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Postpartum length of stay (LOS) in hospital continues to be a subject of intense discourse and research, especially for mothers of neonates born with low birth weight (LBW). This study investigates the association of total LOS (pre and postpartum) with a range of factors related to geo-demographics, maternal health and pregnancy history. It also provides simple estimates of likely duration of neonatal hospital length of stay based on data from two public hospitals at Sunyani, Brong Ahafo Region, Ghana. The LOS is affected by maternal age, parity (number of children ever born), neonate birth weight, maternal employment and income status. Smoking and consumption of locally brewed alcoholic drinks were also found to significantly prolong the total LOS. The Log-normal model was the best parametric model for total LOS.

Key words: Postpartum, neonates, Length of stay, log-normal, 2000 AMS subject classification, 62J12, 62P10.

INTRODUCTION

Hospital length of stay (LOS) is considered a reliable and valid proxy for measuring the consumption of hospital resources. Prolonged postpartum LOS results in an overstretching of hospital resources and bed blocking to new admissions. While the average length of stay is easy to quantify, it does not reflect the nature of the underlying distributions. The clinical care of neonates posses a huge challenge when the birth weight is less than 2.5 kg because it can be cost (direct and indirect) intensive and often associated with prolonged stay in hospital (Vasilakis and Marchall, 2005).

There has been a steady decrease in postpartum LOS and a review of literature on effect of this decrease on mothers and neonates shows no detrimental effects on maternal morbidity (for normal deliveries) but an increase in neonatal mortality and morbidity (Sareer et al., 2008; Shah et al., 2012). Disadvantages also include delayed breastfeeding, manifestation of new conditions affecting new-borns after early discharge and improper discharge planning. The proponents of early postpartum discharge often argue that it aids prevention of possible iatrogenic infection, promotes family bonding and attachment,

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Table 1. Univariate analysis of maternal age and LOS.

Age	Mean	Median	IQR
<20	7.61 ± 1.147	5.0	14
20-24	6.27 ± 1.225	3.5	24
25-29	3.96 ± 0.442	3.0	20
30-34	4.88 ± 0.542	4.0	21
35-39	7.37 ± 1.29	4.0	20

reduces hospitalization care and patient costs (Farhat and Rajab, 2011). Early discharge is referred to as a postpartum hospital stay of ≤ 48 h, as per the guidelines of American Academy of Pediatrics (AAP). Mothers discharged at less than 48 h postpartum are less likely to be readmitted to hospital than those discharged at more than 48 h. They are also less likely to suffer from depression and anxiety than those who stay longer. The neonate who is discharged at less than 48 h is however at greater risk of readmission especially when the neonate is born with a birth weight below 2.5 kg (Shah et al., 2012).

Discharge at any time < 72 h significantly increases the risk for readmission to hospital and the risk for readmission with hyperbilirubinemia when compared with discharge after 72 h (Maisels and Kring, 1998; Mishra et al., 2005). Shah et al. (2012) in an Eretria based study found hypothermia, pneumonia, younger gestational age, 1 min Apgar score and small size for gestational age as significantly associated with mortality and longer length of stay in the Eritrean specialized neonatal intensive care unit (Shah et al., 2012).

In developing countries, hospital resources are often stretched thin in caring for mothers and new-borns; especially for those born with birth weights less than 2.5 kg or gestational age < 36 weeks and requiring specialized care. Knowing how long the required postpartum stay will be allows for proper planning and parsimonious allocation of resources.

The aim of this study is to propose an empirical model of postpartum length of stay in Sunyani, Ghana. Sunyani municipality, Brong Ahafo Region of Ghana has a population of 79,165 (Ghana Statistical Service, 2011) and the Regional Hospital (a not-for-profit Ghana Health Facility) provides 24 h service and has a monthly average of 15,950 outpatients and 1,120 inpatients. The region recorded high incidence of low birth weight (LBW) in 2007 and thus experiencing a high demand for bed spaces in the neonatal units. The Regional Hospital is the referral hospital that serves Brong-Ahafo Region while the Municipal Hospitals serves the residents of the municipality and its immediate environs and thus the data captured is not limited to Sunyani.

Brong-Ahafo region is the second largest of the ten regions of Ghana and lies within longitude 0°15'E to 3°W and 8°45 'N to 7°30 'S. It shares latitude boundary with Cote d'Ivoire and has an area of 39,557sq km with highest elevation point of 712.6 m above sea level. Figure 1 presents the map of Ghana showing Brong-Ahafo region within.

MATERIALS AND METHODS

This is a retrospective study of singleton life births carried out at the Sunyani Regional and Municipal Hospitals. The data comprise questionnaire responses collected from 180 single birth mothers from the total of mothers delivered during the study period irrespective of birth-status and gestational age. The questionnaires were administered between February and March, 2010 after obtaining their consent to participate in the study. Sixty seven of the neonates had birth weight below 2.5 kg.

The questionnaire elicited information on maternal, child and health care factors. The maternal variables included socio-economic, environmental, anthropometric, lifestyle and medical history. The child variables were weighed at birth, Apgar score, sex of baby and gestation age. The health care factors were number of antenatal visits and place of delivery. This study has been conducted in public hospitals and there is no proper system that can record the maternal history at home and due to the non availability of databases this study had to recruit patients prospectively from the two main public hospitals in Sunyani. This necessarily excludes births in private hospital, clinics and at home. Due to limited voluntary participation of clinicians and budgetary constraints, it was not possible to collect information from all mothers admitted for delivery in the two hospitals from February to March. It should be noted that pregnancy registration was used as a proxy for prenatal care. We were also unable to collect data on nutritional values of the meals taken by the mothers. This might be one of the important factors as reported by others in developing countries (Kramer, 2003) but the number of meals per day was used as a proxy. This study sought to provide baseline information which could help with possible intervention regarding maternal and new-born health Ghana.

The exploratory statistical analyses carried out include descriptive statistics, graphical plots, correlation analysis and cross tabulation. The empirical data on total length of stay (TOS) was modelled using log-normal distribution. The lognormal distribution provides a good description for skewed data originating from time dependent phenomenon.

RESULTS AND DISCUSSION

Teenage mothers are well known to suffer from adverse pregnancy outcomes (SOGC Policy Statement, 2007). In this study, teenage mothers were associated with longer LOS compared to middle age mothers as reported in Table 1 and depicted by the boxplots in Figure 2. An outlier with LOS (17 days) was observed in the 35 to 39 age group. Furthermore, teenage mothers were associated with low body mass index (BMI) and had lower family income compared to the middle aged mothers. Mothers with parity > 4 were found to be at a higher risk of prolonged hospital stay (Table 2). The average LOS was

Table 2. Average LOS for different values of parity.

Parity	Mean	Median	IQR
0	5.80 ± 0.628	4.0	6
1	5.00 ± 0.893	3.0	3
2	4.73 ± 0.779	3.0	3
3	3.81 ± 0.366	3.0	3
4	4.44 ± 1.156	3.0	4
5	10.86 ± 2.241	8.0	11
6	12.83 ± 3.390	12.5	17
7	17.00 ± 2.00	17.0	-

Table 3. LOS by birth weights.

Birth weight (kg)	Mean	Median	IQR
<2.5	9.25 ± 0.799	3.0	2
≥2.5	3.42 ± 0.146	8.0	12

Table 4. Moments of TOS.

Parameter	180	Variance	25.2937
Mean	5.589 ± 0.374	Kurtosis	3.715
Standard deviation	5.029	Median	3.00
Skewness	2.045	Mode	2.00
Coeffivient of variation	89.987	Range	24.00

from 5.80 ± 0.628 to 17.00 ± 2.00 for parity of 0 and 7, respectively. The scatter plot of TOS and parity is presented as in Figure 3.

Low birth weight (LBW) is considered as a major multifaceted public health concern and serves as a reliable indicator in monitoring and evaluating the success of maternal and child health programs. It is estimated that worldwide 15.5% of all live births per year are LBW and more than 95% of LBW infants are born in developing countries. Several studies have associated LBW neonates with longer LOS (Mishra et al., 2005). The univariate analysis of TOS and birth weight shows that mothers of LBW neonates stayed an average of 5.5 longer than those of normal birth weight neonates. The summary statistics are presented in Table 3.

There was no significant difference between LOS when marital status was considered. The type of residence was also used as an indicator if wealth and the poorer women required longer hospital stay. This is further corroborated by the average LOS when employment status is considered. Employed women recorded the shortest average LOS while housewives recorded the longest TOS. The median length of days and IQR was 3.0 (3), 6.5 (9), 8.0 (10), 3.0 (3) for employed, unemployed, housewives and self-employed, respectively. Type of fuel was also found to affect the TOS with women using biofuel (firewood) requiring longest TOS. Mishra et al. (2005) studied the effect of cooking smoke and tobacco smoke on the likelihood resulting in a still birth in India and found that both were contributory factors.

Also, women who smoked during pregnancy stayed an average of 11 ± 4.0 days in hospital while the non-smoking mothers stayed an average of 5.50 ± 0.375 days with 3.0 ±4 and 15.0 ± 12 as the respective medians (IQR). Consumption of alcohol/fermented drinks was found to be associated with longer postpartum stay in hospital. The correlation between some maternal and child covariates were explored to determine the existence (or nonexistence) of correlation among these covariates and LOS, as well as an investigation of linear model fits. Birth weight is positively correlated with gestation age with $r = 0.77$ ($p < 0.001$) but a line plot did not indicate the presence of a linear relationship. The LogLOS and birth weight were negatively correlated with $r = -0.512$ ($P < 0.001$), logLOS and gestation age also have a negative correlation of $r = - 0.55$ ($P < 0.001$).

Fitting the lognormal model to LOS

The focus of this study is to evaluate the factors affecting neonatal length of stay in hospital and also to postulate a model that adequately describes the distribution of total LOS. The results for the model fit of TOS considering the exponential, lognormal and Weibull distributions shows the lognormal as providing the best parametric fit of the three distributions considered. The lognormal distribution is used in a wide range of applications, when the multiplicative scale is appropriate and the log-transformation removes the skew and brings about symmetry of the data distribution. Normality is the preferred distributional assumption in many contexts, and logarithm is often the first transformation that an analyst considers to promote it. Linear models are convenient to specify and all the relevant moments are easy to calculate and operate with on the log-scale. One of the most useful concepts in probability distribution theory is that of expectation (moments) of a random variable. The expected value may be viewed as the balance point of distribution of probability on the real line, or in common language, the average. The moments generate the mean, variance, skewness and kurtosis which together, gives a complete picture of the distribution. The moments for TOS are presented in Table 4 and the results of the model adequacy are presented in Table 5.

DISCUSSION

In this study, the modelling of pre and postpartum LOS,

Table 5. Tests of model effects.

Source	Type I			Type III		
	Likelihood Ratio Chi-Square	df	Significance	Likelihood ratio Chi-Square	df	Significance
Intercept	1810.210	1	0.000	135.801	1	0.000
Matage	0.167	1	0.683	3.010	1	0.083
Gesage	249.931	1	0.000	105.759	1	0.000
Nvisits	19.849	1	0.000	19.706	1	0.000
Nchld	5.479	1	0.019	5.479	1	0.019

Figure 1. Map of Ghana.

the lognormal model gave the best fit for describing and predicting total LOS. The significance of some maternal and socio economic determinants was also observed. The maternal factors are parity, poverty level and type of cooking fuel. Cooking smoke from biofuel are been identified as a risk factor for pregnancy resulting in stillbirth. In Farhat and Rajab (2011), it was observed that hospital discharge at any time ≤ 48 h significantly increased the risk for readmission as well as the risk for readmission due to hyperbilirubinemia. Planning and implementing a structured program for follow up of infants who are discharged ≤ 48 h was determined as vital to decreasing the risk for readmission, morbidity and neonatal mortality. This is similar to the findings of Maisels and Kring (1998) that discharge at any time < 72 h significantly increases the risk for readmission to hospital and the risk for readmission with hyper-bilirubinemia when compared with discharge after 72 h.

Shah et al. (2012), with the conclusions that younger gestational age, 1 min Apgar score and small size for gestational age are significantly associated with mortality and longer length of stay. The American Academy of Pediatrics recommends that infants discharged < 48 h should be seen by a health care professional within 2 to 3 days of discharge. Our observations, as well as those of others, suggest that this recommendation should also be extended to those discharged at < 72 h after birth. Effective breastfeeding should also be established before discharge as a means of reducing the risk of readmission and neonatal morbidity and mortality.

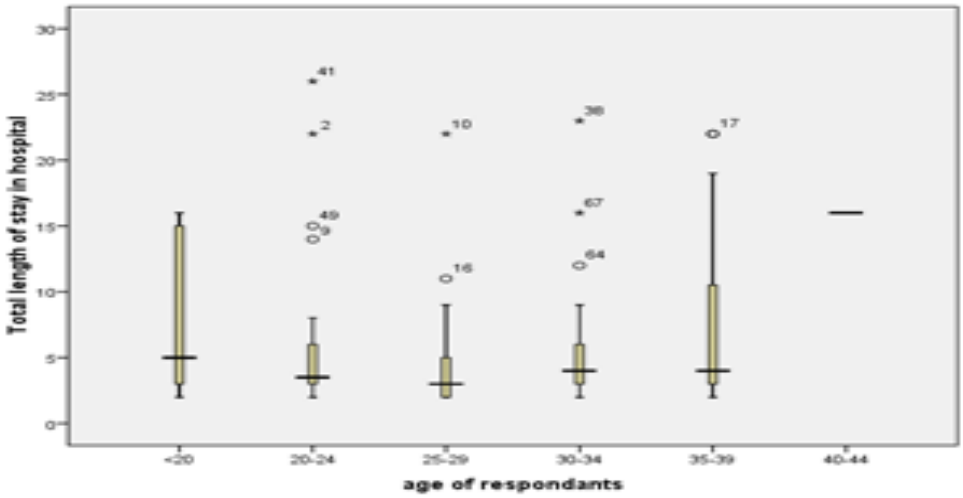

Figure 2. Total length of stay (TOS) and maternal age.

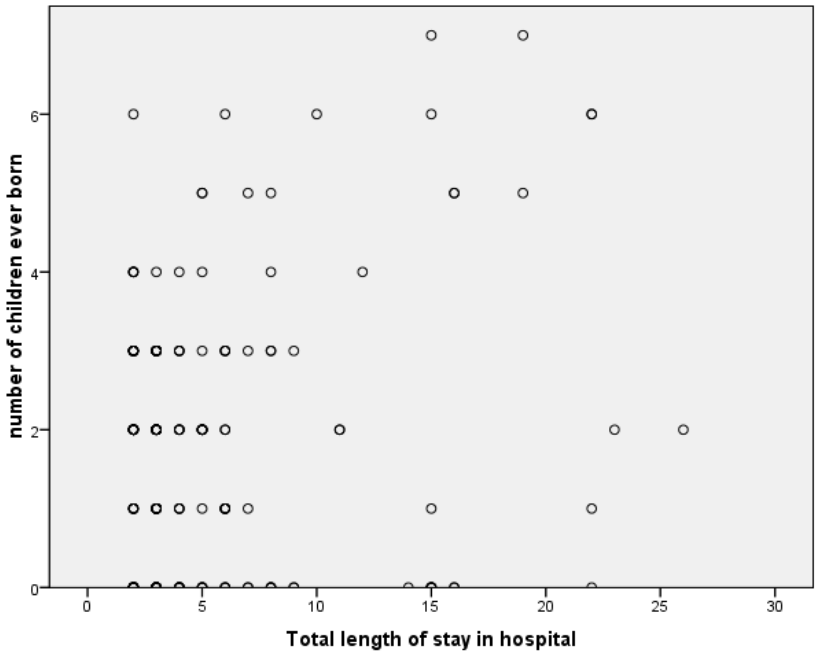

Figure 3. A scatter plot of TOS and parity.

Conclusion

In addition to gestational age and birth weight, specific factors related to geo-demographics (maternal age, parity, employment status and income level) were significantly associated with the TOS at the two hospitals surveyed in Sunyani. The results also show that pregnancies exposed to cigarette smoke and alcohol also resulted in longer TOS.

Conflict of interest

The authors have no conflict of interest

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Full Length Research Paper

Physicochemical and microbial analysis of portable water sources in Enugu metropolis

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Water borne diseases and heavy metal poisoning as a result of poor quality of portable water has been of a major public health concern in Nigeria. The quality of portable water in Enugu, a fast growing and population expanding city calls for a general concern. Hence, this study was aimed to ascertain the quality of portable water sources in Enugu metropolis. A total of twelve water samples were randomly collected and analysed for the physicochemical parameters, heavy metals and faecal contaminants. The samples were odourless without colour but a few showed high levels of calcium and magnesium hardness. The total hardness was within the WHO and Nigerian Industrial Standard (NIS) permissible level. The pH was low (2.0 to 6.3) and not within the WHO permissible level (6.5 to 8.5) but the acidity which ranged from 0.1 to 0.6 mg/L was within the acceptable range. Copper, lead and cadmium were present in a few samples but the level was beyond the tolerated limits of NIS and WHO for one sample contaminated with lead (0.29 mg/L) and two samples with cadmium (0.351 and 0.004 mg/L). Lactose fermenter was present in one sample and was confirmed to be a coliform (Gram negative bacilli). In all, portable water in Enugu is relatively safe and fit for consumption as the level of heavy metal and microbial contamination was low. However, there is need for regular quality control monitoring of portable water to minimize the risk of related health consequences due to heavy metal and microbial contamination. This will partly contribute towards the attainment of the Millennium Development Goal objective of making available quality portable water to the society.

Key words: Portable water, physiochemical, heavy metal, Enugu, coliform, contamination.

INTRODUCTION

Water serves as a major constituent of the human body for physiological and chemical processes and thus essential for health and life. Its availability and consumption is very vital for mans survival and sustainability (Sobsey, 2002). This is guaranteed if the quality of the water is good and safe for consumption. Good quality water or otherwise known as portable water is that which is odourless, colourless, practically tasteless and free from physical, chemical and biological contaminants and safe for consumption (Meybeck et al., 1996). Water also serve humans for various industrial processes in the production of beverages and are important for domestic activities such as cleaning, washing, bathing cooking, etc.

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Table 1. Samples collected and code.

Sample	Code
Overhead reservoir water tank from GOU	OR1
Sachet water 1 (Name Withheld)	SW1
St. Stephen reservoir water tank collected GOU	OR2
Sachet water 2 (Name Withheld)	SW2
Empty water tank from Ninth mile	EW
Bore-hole 1 from Ninth mile	BH1
Bore-hole 2 from Ninth mile	BH2
Bore-hole 3 from Ninth mile	BH3
Bore-hole 4 from Ninth mille	BH4
Loaded Water tank from Ninth mile	LW
Bore-hole 5 from Ninth mile	BH5
Bore-hole 6 from Ninth mile	BH6

The non-availability of potable water constitutes a major public health dilemma as the world is constantly challenged with waterborne diseases (Hunter, 1997). According to the World Health Organisation (WHO), more than one billion people worldwide do not have access to safe drinking water (WHO, 2000). It has also been estimated by WHO that more than two million deaths due to waterborne diseases occur annually and there are more than four billion cases of diarrhea recorded annually. In African, it is estimated that every child has five episodes of diarrhea per year and that 800,000 children die each year from diarrhoea and dehydration (WHO, 2000). These waterborne diseases such as typhoid fever, cholera, infectious hepatitis, dysenteries, diarrhoea and many varieties of gastro-intestinal diseases are mostly due to microbial contaminations in water particularly bacteria (Adeyinka et al., 2014; Raji and Ibrahim, 2011). Several studies in Nigeria have shown the presence of microbial contaminant in water (Aminu and Amadi, 2014; Anake et al., 2013; Bisi-Johnson et al., 2013; Ndamitso et al., 2013; Eze and Madumere, 2012; Odeyemi and Agunbiade, 2012; Adekoyeni and Salako, 2012; Odeyemi et al., 2011, Nyanganji et al., 2011).

Apart from waterborne diseases, heavy metal contamination in water has also been responsible for mortality and morbidity in human due to intoxication and constitutes a major public health problem (Ibrahim et al., 2006; Cabrera et al., 2005). The most important heavy metals of public health concern due to intoxication include lead, mercury, cadmium, chromium, arsenic, etc (Galadima and Garba, 2012; Ibrahim et al., 2006; Godt et al., 2006; Duffus, 2002). Although some of the heavy metals such as zinc, manganese, nickel, aluminium and copper act as micro-nutrients at lower concentrations, they can become toxic at higher concentrations (Singh et al., 2010). Health risk due to heavy metal contamination of water through soil has been reported (Eriyanremu et al., 2005).

As a result, the WHO, Food and Agricultural Organisation (FAO), United States Environmental Protection Agency (USEPA), as well as the Nigerian Industrial Standard for drinking water have set up standard for heavy metal contamination to ensure the quality and safety of potable water (USEPA, 2011; WHO, 2011; Nigerian Industrial Standard [NIS], 2007; FAO, 1997). These standards are based on the physical, chemical and microbiological constituents in water and defined with tolerable limits.

Enugu is a fast growing and population expanding city in Nigeria whose demands for portable water is becoming critical for water purification industries to meet up with supply. This high demand for portable water may warrant rapid supply and hence, jeopardize the quality. One of the major sources of portable water in this city is the use of bore-holes whereby the water is usually carried by commercial tankers and supplied into individual owned overhead tanks within the metropolis. Also, portable water is available in sachets locally called “pure water” from various industries; majority of which are located at Ninth mille, a locality within the Enugu metropolis where most natural sources of water are found. Enugu, especially Ninth mille is noted as a good source of portable water but little or no study has been carried out to ascertain this belief.

As part of the program to ensure the quality and availability of portable water, the United Nation in its Millennium Development Goal (MDG) has as target to reduce by half the proportion of people without sustainable access to safe drinking water by 2015 (MDG, 2011). Hence, this study, with the aim to assess the physical, chemical and microbiological content of water in Enugu metropolis is targeted towards the attainment of the MDG objective to ensure the quality and safety of portable water for human consumption.

MATERIALS AND METHODS

Sample collection

A total of 12 samples of water were randomly collected within and around Enugu metropolis. Among these samples, 6 were obtained from bore-holes, 2 from water loaded tanker vehicles, 2 from overhead reservoir tanks and 2 sachet water from different producers (Table 1). These water samples were collected in sterile containers under aseptic conditions and transported to the Chemistry Laboratory of Godfrey Okoye University (GOU) for analysis.

Physicochemical analysis

Water samples were analyzed in accordance to the standard methods of the American Society for Testing and Materials (ASTM), American Public Health Association (APHA) and FAO procedures (APHA, 1998; FAO, 1997; ASTM, 1982). Physical parameters were analyzed according to the methods of APHA (1998). The odour of the water was assessed by nasal inhalation (sensory evaluation) method and the colour was determined by spectrophotometric method using distilled water as blank. The chemical parameters, acidity, water hardness were evaluated in accordance to the ASTM and AOAC method (AOAC, 2005; ASTM, 1982). The pH of the water was determined using a microprocessor pH meter while the

Table 2. Physicochemical parameters.

Sample ID	Colour (HU)	Odor	pH	Acidity (mg/L)	Total hardness (mg/L)	Calcium hardness (mg/L)	Magnesium hardness (mg/L)
OR1	0.005	-	5.8	0.6	176	34	142
SW1	0.003	-	2.2	0.4	72	80	-8
OR2	0.014	-	2.3	0.2	56	44	12
SW2	0.005	-	6.3	0.4	152	32	120
EW	0.002	-	4.5	0.2	60	10	50
BH1	0.001	-	2.1	0.6	72	30	42
BH2	0.001	-	4.3	0.4	60	38	22
BH3	0.003	-	2.0	0.6	58	10	46
BH4	0.003	-	4.2	0.1	72	50	22
LW	0.003	-	3.5	0.2	50	24	26
BH5	0.001	-	4.8	0.2	52	22	30
BH6	0.002	-	5.0	0.4	46	4	42
WHO/NIS STD	5-15	-	6.5-8.5	4.5-8.2	500	75.0	50

acidity was by titration with NAOH using phenolphthalein as indicator. Analyses of total hardness and calcium hardness in water made use of NH_4Cl and NAOH as buffers, respectively and were titrated with EDTA using Erichrome Black T-indicator. Magnesium hardness was determined by subtracting calcium hardness from total hardness.

Heavy metals analysis

Heavy metal analysis was conducted using varian AA240 atomic absorption spectrophotometer (AAS) according to the method of APHA (1998). In this method, 100 ml of the sample was thoroughly mixed by shaking in a beaker and 5 ml of concentrated nitric acid was added. The mixture was heated to evaporation until the volume was reduced to about 20 ml and concentrated nitric acid was further added till the point of complete dissolution of all the residues. This mixture was cooled and completed to a volume of 100 ml with metal free distilled water. The sample was aspired into the oxidizing air-acetylene flame of the AAS and the sensitivity for 1% absorption was observed. The wavelength (nm) for absorption was 372.0, 324.8, 228.8, 309.3, 283.3, and 193.7 for iron, cupper, cadmium, aluminium, lead, and arsenic, respectively.

Microbial analysis

The determination of coliform in water was done via two stages: firstly, the presumptive test followed by the confirmative test according to the method of APHA (1998).

In the presumptive test, 1 ml of sample and lactose was added in a culture bottle containing 10 ml of MacConkey agar broth. A Durham tube for gas collection was inverted in the culture bottle and incubated at 37°C for 48 h (Test 1). This procedure was repeated twice using 10 ml of the sample for 10 ml of the sterile broth (Test 2) and 50 ml of the sample for 50 ml of the sterile broth (Test 3). Gas formed in the inverted Durham tube was evidenced of the presence of fecal contaminants. Also, in the presence of a lactose fermenter, the colour of the media changes from violet to yellow.

In the confirmatory test, a positive sample for the presumptive test was further inoculated unto an agar medium containing Eosin blue in a Petridish and incubated at 37°C for 48 h. After incubation, the culture was examined for any metallic green coloration formed in the colonies which were gram stained and viewed under the microscope. If microorganism retained the colour of the secondary dye, coli formed bacteria (Gram negative bacilli) were confirmed to be present.

RESULTS AND DISCUSSION

Physicochemical properties of water such as odour, taste, colour and hardness are usually evaluated in water not because of their health related consequences but for the organoleptic and aesthetic qualities. Other properties such as pH and acidity are indicators of how acidic or basic water is. The results of physicochemical properties of the samples are as shown in Table 2. The samples were odourless and the colour was below the acceptable limit of the WHO, hence characteristic of good quality water.

Extreme pH in water is not usually healthy for consumption especially when the acidity is high. Low pH in water tends to be corrosive to some certain metals, asbestos, pipelines, etc., even more corrosive, while that of a high pH form scale (UNICEF, 2008). According to WHO, health effects are most pronounced in pH extremes. Drinking water with an elevated pH above 11 can cause skin, eye and mucous membrane irritation. On the opposite end of the scale, pH values below 4 also cause irritation due to the corrosive effects of low pH levels. WHO warns that extreme pH levels can worsen existing skin conditions (WHO, 2009). WHO standard pH for portable water lies between 6.5 and 7.5 as well as NIS and USEPA. Results from the study showed the pH of the samples to be low (acidic) ranging from 2.0 to 6.3 and are not within the NIS and WHO acceptable limit (Table 2). However, the acidity (acid concentration) was low ranging from 0.1 to 0.6 mg/L and was below the tolerated limits of WHO (Table 2). This suggests that though portable

Table 3. Heavy metals concentration.

Sample ID	Arsenic (mg/L)	Lead (mg/L)	Cadmium (mg/L)	Iron (mg/L)	Copper (mg/L)	Aluminum (mg/L)
OR1	ND	0.29	ND	ND	0.006	ND
SW1	ND	ND	ND	ND	ND	ND
OR2	ND	0.01	ND	ND	ND	ND
SW2	ND	ND	ND	ND	ND	ND
EW	ND	ND	0.351	ND	ND	ND
BH1	ND	ND	ND	ND	ND	ND
BH2	ND	ND	0.004	ND	ND	ND
BH3	ND	ND	ND	ND	ND	ND
BH4	ND	ND	ND	ND	ND	ND
LW	ND	0.03	ND	ND	ND	ND
BH5	ND	ND	ND	ND	ND	ND
BH6	ND	ND	ND	ND	ND	ND
WHO/NIS STD	0.01	0.05	0.003	0.3	1.0	0.2

water in Enugu metropolis is acidic in nature, it is not of a major health concern because the acid concentration (acidity) is low. However, minimum level of treatment is required to increase the pH to a fairly neutral and acceptable range.

Water hardness is a property that is defined by the quantity of calcium and magnesium found in water. Though calcium and magnesium are important minerals of the body, evaluating water hardness is usually not considered for health benefits because these minerals can be obtained from other dietary sources. Rather, hardness of water is usually a property evaluated to qualify water for domestic use. Hard water does not usually lather enough which makes it unsuitable for domestic purposes. From the result of the study as shown in Table 2, calcium hardness was low and within the tolerated limits of WHO (75 mg/L) except sample SW1 (80 mg/L). Magnesium hardness was also low in most of the sample and within the WHO and NIS limit of 50 mg/L, but except for samples SW2 and OR1 with values of 120 and 142 mg/L, respectively. However, the total hardness (the sum of calcium and magnesium hardness) of the samples were less than 500 mg/L and within the permissible limit of WHO suggesting that portable water in Enugu is fit for domestic use.

Heavy metal refers to any metallic chemical element that has a relatively high density and is toxic or poisonous at low concentrations (Danyal et al., 2006). Heavy metals are dangerous because they tend to bio-accumulate in living organism over time without been eliminated (Life Extension, 2003; Wallace, 2001). Heavy metal toxicity can result to damaged or reduced mental and central nervous function, lower energy levels, blood composition and damage of the lungs, kidneys, liver, and other vital organs (Godt et al., 2006; Sharma and Agrawal, 2005; Shaw et al., 2004; Lidsky and Schneider, 2003; Lockitch, 1993). Long-term exposure may result in slowly progressing physical, muscular, and neurological degenerative processes that mimic Alzheimer's disease, Parkinson's disease, muscular dystrophy, and multiple sclerosis (Ibrahim et al., 2006; Sharma and Agrawal, 2005). Allergies are not uncommon and repeated long-term contact with some metals or their compounds may even cause cancer (Rubio et al., 2006). In this study, arsenic, iron and aluminium were not detectable in all the samples but lead, cadmium and copper were detectable in a few. Previous studies in Nigeria have shown some of these heavy metals to be present in water (Aminu and Amadi, 2014; Eze and Madumere, 2012; Odeyemi et al., 2011; Adekoyeni and Salako, 2012). Lead was detectable in 3 samples but only sample OR1 (0.29 mg/L) was found to be above the WHO tolerated limit of 0.05 mg/L. Also, cadmium was detected in two samples and was far above the WHO limit in sample EW (0.36 mg/L). Though, copper was present in one sample (OR1), the concentration (0.006 mg/L) was far less than the WHO tolerated limit (1 mg/L). These results suggest possibilities of heavy metal contamination in water but at a very low risk of causing intoxication in humans (Table 3).

Coliforms are the most frequent bacteria in water responsible for waterborne diseases such as diarrhoea, typhoid, dysentery, etc., and have also been responsible for mortality across the world especially in Africa (Adeyinka et al., 2014; Raji and Ibrahim, 2011; WHO, 2000). Microbial analysis showed the presence of lactose fermenter in sample BH2 in test 1 and 2 for the presumptive test (Table 4). Also lactose fermenter was shown to be highly populated when the sample concentration was increased 10 fold to 10 ml in test 2 (Table 4). The confirmatory test confirmed the presence of coliform as Gram negative bacilli when observed under the microscope. This result is a confirmation of other studies in Nigeria which also showed the presence of coliforms particularly *Escherichia coli* in most portable water sources

Table 4. Presumptive test for microbial analysis.

Sample ID	Gas formed		
	Test 1	Test 2	Test 3
OR1	-	-	-
SW1	-	-	-
OR2	-	-	-
SW2	-	-	-
EW	-	-	-
BH1	-	-	-
BH2	++	+	-
BH3	-	-	-
BH4	-	-	-
LW	-	-	-
BH5	-	-	-
BH6	-	-	-

(Aminu and Amadi, 2014; Anake et al., 2013; Ndamitso et al., 2013; Odeyemi and Agunbiade, 2012).

Conclusion

Contamination of water due to heavy metals and microorganism is becoming a major public health challenge in Nigeria. This study reveals that portable water in Enugu is relatively safe and fit for consumption as the level of heavy metal and microbial contamination is relatively low as compared to WHO and NIS standards. However, there is need for regular monitoring to control the quality of water in Enugu and Nigeria as a whole to minimize possible contamination and the risk of water borne diseases. This measure will partly help towards the attainment of the MDG objective by ensuring the quality and safety of portable water to the masses.

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Conflict of interest statement

There is no conflict of interest to declare.

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Review

Review: Health literacy intervention and their consequences

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Health literacy is one of the most critical issues threating the public health today and there are significant gaps behind the discipline of health literacy. Low health literacy was found to threaten the health and welfare of people. The past decades witnessed a revolutionary alteration in the health patterns and disease spread among the community from infectious diseases to chronic diseases such as, heart disease, stroke, cancer, diabetes and accidents. Furthermore, to enhance health status among the population with effective intervention methods, through health teaching, increasing access to health information and communication technologies will eliminate the health literacy consequences among different community levels, including children and adults. The aim of the present review was to find out the current status about research progress towards health literacy. Furthermore, to examine health literacy status, intervention, possible consequences and future prospective, and to find out the options for improving health literacy status and fill in the future research. A systematic review based on literature research related to health literacy covered the recent publication from 2000 to 2014 years. The results indicated that the wide range opportunities for improving health literacy are coming through health literacy intervention among target community. Future research concerning health literacy is still needed to give much more efforts in the field of community and community health works.

Key words: Health literacy, intervention, knowledge and community health.

INTRODUCTION

Health literacy is “the degree to which individuals can obtain, process, and understand the basic health information and services, to make appropriate health decisions”. It needs interpersonal skills for effective health care systems. These skills include information, ability to interpret documents, read and write prose (print literacy), use the quantitative information (numeracy), and speak and listen effectively (oral literacy). In the resent years the importance of health literacy issue were increased to support and promote

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health well-being among children and adults. It is concerned to meet the complex demands of health in a modern society (Kindig et al., 2004; Sorensen et al., 2012). Health literacy has been simply described "as the ability to read, understand and act on health information, which means promote good health, reduce health risks through the strength of primary health care providers, in order to develop health literacy of patients, and change patient lifestyle. Moreover, health literacy was a "key outcome from health education", which aim to reduce the consequence of health among the population (Nutbeam, 2000; Nutbeam and Kickbusch, 2000; Dennis et al., 2012).

Previous research indicates that low health literacy lead to poorer health status, negatively influence health outcomes, especially among the low-income groups (Al Sayah, 2013). Previous studies also suggest that people with "inadequate or marginal health literacy skills have a higher mortality rate over a five year age than those with adequate health skills". Although routine screening for inadequate health literacy in clinical settings is still contentious with poor outcome in prevalence rate among the US population (Paasche-Orlow et al., 2005; Berkman et al., 2011), with such situation leading to increasing the interest in the health literacy project. Health literacy is a practically new concept, with its first paper published in 1974 entitled "Health Education and Social Policy" and it was simply described as the ability to read and comprehend written medical information and instruction (Coulter and Ellins, 2006).The modern idea of health literacy literature appeared in the mid 1990s and it has rapidly preset the attention of policy makers, researchers, and clinicians due to its general impact on health and human welfare, whereas, the term of health literacy remains a confusing concept (Peerson and Saunders, 2009).

Previous research showed that over 90 million adults in the US had less adequate health literacy skills, and 20% of adult that had reading skills their age was around 10 to 11 years. While recently, the poor health literacy was found linked with patient age, ethnicity, and level of education (Paasche-Orlow et al., 2005).Low health literacy was becoming a substantial problem in the United States. In 2003, more than 36 million adults in the United States were found to have limited health literacy, while the poor health literacy were increasing the risk of cardiovascular and higher rates of mortality and hospitalization among the patient (Paasche-Orlow et al., 2005; Baker et al., 2007).

As a result, the demands of health literacy and health information would lead to reduced risk of disease through improved people's habits, for adolescents and young adults in order to reduce the death among people of ages 15 to 24 years by at least 20% (People, 2011). Chinese people used health education program as social marketing to increase health literacy and to realize significant health literacy among the Chinese population, as the intervention to improve people's health (Wang, 2000). Numerous research in health literacy interventions are in its early years, although there was evidence for improvement of health literacy in the long term, so far many intervention studies have been performed in the area of HIV/AIDS, asthma, health services use, psychological and physical wellbeing, adherence to medication, chronic disease, diabetes, hospital admission, hypertension, cardiovascular disease, reproductive health, and sexually transmitted infections (Morris et al., 2006).

Further works on cardiovascular disease treatments indicate that despite improvements in the diagnosis and treatment of cardiovascular disease, it remains serious consequences of personal and health care, financial level, while it leads to destruction due to the patient awareness (Health and Human Services, 2000). Furthermore, proper methods, model to understanding the relationship between health literacy, health knowledge and health behaviors among school student, community committee level, and promote a good health status and fill the gap in literacy within across specific populations are needed. According to these understandings, an urgent solution is needed for the presence of an effective central administration of health education and health literacy intervention among different population groups.

METHODOLOGY

Strategy for selection criteria is depending on an online data sources for recent review. It is based on various wide literature in health literacy, much more it is focused on tracking recent papers among the previous research article related to understanding the health literacy, definition, intervention and their consequence, to find out the progress of current research, and to improve the health status of children and adults. Data were carried out from related databases, including primary online data based, such as Web of Science; Cochrane Database of Systematic Reviews, National Library of Medicine databases Pub (MED). Secondary online data covered the Google scholar, world Health Organization (WHO) publication, Centers for Disease Control and Prevention (CDC) web site. Among the 3.050 articles founded in Google scholar indicated the low heath literacy and 21.300 article cited highlighted the risk factors of health literacy programme, while only one article indicated the poor health literacy status. Article keywords raised by previous researchers was divided among screening articles as: Health literacy outcome, health literacy programme among children and adults, and health literacy skills, such as use of health care services cost and services. Health literacy interventions in male and female with low health literacy skills showed improve use of health care services, health outcomes, and cost effectiveness of health care, and improve health care service among different racial, ethnic, cultural, or age groups. Furthermore, the quantitative skills components of some measures have been extracted and used independently as measures of numeracy, to simplify this systematic review and find out the

progress towards health literacy consequences and intervention for healthy community.

Definitions and features of health literacy

Health literacy is defined in the Institute of Medicine report, as "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services (Kindig et al., 2004). More recent definitions focus on specific skills needed to navigate the health care system and the importance of clear communication between health care providers and their patients. Both health care providers and patients play important roles in health literacy. Health literacy is defined as the degree to which persons have the capacity to obtain, process and understand the basic health information and services needed to make appropriate health-related decisions (Health and Human Services, 2000). While many definitions for health literacy exist, the definition that has been adopted in this paper is, “the degree to which people are able to access, understand, appraise and communicate information to engage with the demands of different health contexts in order to promote and maintain good health across the life-course (Kwan et al., 2006). Evidence accumulated over the past two decades suggests that health literacy, defined as an individual’s ability to obtain, process, and understand basic health information and services is needed to make appropriate health decisions (Clement et al., 2009). Based on this definition, three levels of health literacy have been described: they need health literacy research for improving the health of people to able, to access, understand, health information related to the different health contexts in order to promote and maintain good health across the life-course.

Association with health knowledge, behavior and outcome

Evidence from health literacy research indicated that the association between health literacy and health behaviors has been proving nothing. Low-literacy at the individuals level is faced with problems of less health knowledge, lower self-management skills, higher rates of chronic illnesses, and do not effectively participate in preventive health care. On the other hand, limited health literacy person has also been shown to be associated with higher health care costs, greater use of health care services, and higher rates of hospitalization. Poor health outcomes were found linked with low literacy for patient around the world, while the inadequate health literacy lead to poor understanding of disease processes, poor recall and comprehension of advice and instructions, health beliefs that interfere with care, and poor problem-solving skills (Zarcadoolas et al., 2005).

Relationship between health literacy, knowledge and behaviors

A number of researchers have investigated the relationship between health literacy, knowledge and behaviors. They found that the relationships varied by age groups. While other several studies reported that adequate health literacy improved the likelihood of good eating habits, regular exercise and cancer screening through thriving health awareness and share information among stake community holders. However, Wolf and Baker (2007) found individuals with low levels of health literacy which have less health knowledge and worse self-management of chronic disease, while health literacy framework were useful to explicate the relationships between health literacy and understand the relation between health information and health literacy (Zarcadoolas et al., 2005; Ishikawa and Yano, 2008).

Important of health literacy

Importance of health literacy comes from the contribution of the inadequate health literacy which has been found to directly contribute to the health gap in vulnerable populations. Women's health-related behaviors in Taiwan present health literacy research is unclear about the contribution of health literacy to health behaviors and is limited regarding women’s health issues. It was found that the association between health literacy and five health behaviors, interestingly women with higher health literacy were more likely to be a current smoker. Research over the past few decades has received increasing attention in the health field and established powerful links between educational attainment and health outcomes, especially for patients with chronic disease, while further studies indicated that patients with limited health literacy have less interest in participating in health decision-making (Paasche-Orlow et al., 2005; Baker et al., 2007).

The current estimation of health literacy research which comes from the research literature on health literacy has expanded exponentially, with nearly 6,477 Pub MED-listed publications from (2000 August, 2014). In the past years, health literacy has received the attention of researchers in the health field. It is also a fundamental element of self care system. Evidence-based medicine can increase our understanding of the critical health literacy construct and help us understand its usefulness as a social asset which helps individuals towards a critical engagement with health information (Rudd, 2007).

Health literacy skills and intervention

Evidence has shown that health literacy intervention can have positive effect on health, particularly when combined with each other; further research indicated that health literacy skills declined with age. This is a fact that health literacy intervention is directed at relatively advanced students and requires a considerable investment of formal educational resources (Chinn, 2011). Researcher summarized that doctor, nurse, dentist, pharmacist, or public health workers also need health literacy skills in order to help people to better understand health information and services (King, 2010).

Health literacy consequences

The consequences of low health literacy include poorer health outcomes and furthermore associated with several diverse health effects, patients with limited literacy are at higher risk for poor health outcomes (DeWalt et al., 2007). Other researchers added that low health literacy levels might provide an additional barrier towards achievement of health care goals. These are negative consequences that limited health literacy has on access to care, service use, and health outcomes, not just for adults, but also for their children (Rootman and Ronson, 2005; Tokuda et al., 2009). Researchers began to consider health literacy in adolescents; however, no research was done directly with children, which is a critical oversight because health-related knowledge, attitudes, and behaviors developed during childhood are increasingly being recognized as foundational, deeply rooted, and resistant to change later, when children become adults (Hironaka and Paasche-Orlow, 2008). Further research indicated that increased risk in emergency situations, lack of social empowerment and self-efficacy, and increased financial costs, increased burden on health care providers. Low health literacy also results in misuse of the health care system, such as increasing of chronic disease due to the results of low health literacy, adverse events resulting from medication errors.

While patients' literacy and their ability to understand medication prescription are increasingly seen as a safety issue for being at healthy condition, so far health literacy skills were conserved as opportunity methods to improve patients' knowledge of their chronic diseases such as (Heart disease and stroke), cancer, cardiovascular, diabetes, and accidents (King, 2011). Inference indicated that China mortality due to chronic diseases and cancer has become the leading cause of death in overall population (Gazmararian et al., 2003; Davis et al., 2006).

DISCUSSION

Based on the literature review, we found significant evidence of limited health literacy skills in children and community level, in response to situation of a million adults world-wide still struggling from low health literacy and difficult in understanding even the basic health information. Despite clear standards for developing and developed countries, low-literacy and health awareness knowledge is still under growth, while the improvement of health literacy status is still needed more, as mechanism to understanding the situation among different peer groups of the population.

Community at family levels were limited by health literacy, the complexity of health information may present significant barriers threats to child health status, such situation need unique health care attention and efforts to overcome the consequence of health literacy among them. However, this shows that policy implications at community, national, and international levels are the way to improve and understand the pathways of health literacy and their interventions of health at patients and family, relatives, or friends in particular situation. The efforts for transferring knowledge need more efforts by health workers to develop methods and ways for handling health information and multi strategies such as effect of policy and practice. Effective health literacy programs is needed among the community, while research indicated that improving health literacy has been one of objective for a healthy people in 2010. Several researches indicated that the health literacy consequences was one of main issues and responsibility towards health professionals and public health medical practitioners' and community health workers responsibility for improving health literacy health systems (Driessnack et al., 2014). Finally, opportunities for improving health status are coming through health literacy intervention among community. Therefore future research concerning health literacy is still needed.

Conflict of interest

The authors have no conflicts of interest to declare.

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Perpetration and perceived spatial patterns of violent behaviours among university undergraduates in South-East Nigeria

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The study investigated perceived spatial patterns and formulated preventive strategies against violent behaviours among undergraduates of South-East Universities, Nigeria. Descriptive survey research design was adopted for the study while multi-stage sampling procedure was employed to draw the sample for the study. Well-completed 1,707 copies of researcher-designed undergraduates violent behaviours perpetration patterns questionnaire (UVBPPQ) that comprised five sections A, B, C, D, and E were returned by undergraduates of eighteen randomly selected departments from seventeen faculties in four federal and five state universities situated in South-East Nigeria and were analyzed. Split-half was used to determine reliability of instrument (UVBPPQ) while Spearman-Brown Prophecy (correction) Formula was used to establish reliability co-efficient of the sub-scales. Cronbach's alpha statistic was also utilized to establish inter-item correlation co-efficient of items in Sections B and C of the instrument. Mean statistic and percentages were utilized for answering the research questions while Chi-square (χ^2) was utilized to test the four postulated null hypotheses. Undergraduates violent behaviour in-depth interview guide (UVBIIG) was adopted to generate qualitative data to complement the quantitative data. Results revealed that low prevalence of violent behaviours was found among undergraduates of South-East Nigerian universities.

Key words: Pattern, spatial pattern, violence, behaviours, surveillance.

INTRODUCTION

Attainment of a very sound and qualitative education that fosters development of individuals with the capacity to function effectively depends largely on a conducive environment of learning devoid of violent behaviours. A university environment plagued with violent behaviours cannot accomplish the goals of Nigerian higher development of the individuals. World Health Organization (WHO) (1996) defined violence as the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, which either results in or has a high likelihood of resulting in injury, death, psychological harm,

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mal-development or deprivation. National Center for Injury Prevention and Control (2004) defined violence as threatened or actual physical force or power initiated by an individual that results in, or has a high likelihood of resulting in physical or psychological injury or death. The definition used by WHO associates intentionality with the committing of the act itself, irrespective of the outcome it produces. This study in essence adopted WHO's (1996) definition of violence.

Few typologies existed already and none is very comprehensive (Foege et al., 1995). The typology proposed by WHO (1996) divides violence into three broad categories according to characteristics of those committing the violent act: self-directed violence; interpersonal violence; and collective violence. This initial categorization differentiates between violence a person inflicts upon himself or herself, violence inflicted by another individual or by a small group of individuals, and violence inflicted by larger groups such as states, organized political groups, militia groups and terrorist organizations. However, this study was restricted to interpersonal and community violent behaviours, which are most prevalent among undergraduates of federal and state universities in Nigeria (Aluede and Aluede, 1999; Aluede, 2001; Aluede et al., 2005; Smith, 2006). In addition, the restriction of the study to interpersonal and community violent behaviours was justified by the university's existence as an institutional setting, which functions as a community where youths from diverse backgrounds perpetrate random acts of violence, rape or sexual assault, bullying, arson, and so on with the intention of maiming other youths or inflicting injuries on university staff.

Studies have shown that violence and violent behaviours perpetration breed devastating consequences (Dahlberg and Krug et al., 2002). Perpetration of violence and violent behaviours when allowed to flourish poses serious immediate and future long-term implications for health, psychological and social development of individuals, families, communities, institutions and countries (United Nations, 2007). Similarly, any educational institutional that allows violence to permeate its structures and fabrics cannot actualize the goals for its establishment and existence. Nigerian higher educational institution is established with the aim of giving any student who enrolls, a very sound and qualitative education, to be able to function effectively in any environment in which he/she may find him/herself; so as to become more productive, self-fulfilling and attain self - actualization (Federal Government of Nigeria, 1981). With the monumental manifestations of violence (especially cult-related violence) and violent behaviours in Nigerian universities in recent time, this worthwhile goal is gradually becoming elusive (Aluede et al., 2005; Oruwari and Owei, 2006).

Interest in behaviours that have important impacts on human health and well-being is based upon two assumptions: that a significant proportion of the mortality from the leading causes of death is caused by the behaviour of individuals, and that such behaviour is modifiable (Conner and Norman, 1996). Behaviour is held to exert its influence on health in three basic ways: by producing direct biological changes, by conveying health risks or protecting against them, or by leading to the early detection or treatment of disease (Baum and Posluszny, 1999). Starr and Taggart (1992) defined behaviour as a response to external and internal stimuli, following integration of sensory, neural, endocrine and effector components. Behaviour has a genetic basis, hence is subject to natural selection, and it commonly can be modified through experience. Olweus (1999) defined violent behaviour as aggressive behaviour where the actor or perpetrator uses his or her own body as an object (including a weapon) to inflict (relatively serious) injury or discomfort upon an individual. With such a definition there is an overlap between violence and bullying, where bullying is carried out by physical aggression. The behaviour of people and other organisms falls within a range with some behaviours being common, some unusual, some acceptable, and some outside acceptable limits. Thus, violent behaviours belong to unacceptable limits.

Tabrizi and Madanipour (2006) stated that environmental criminologists have correlated crime patterns with the environmental and physical layout of places where crimes occur. Incidents of crime tend to concentrate in specific locations at particular time periods. It is also important to note that fear of crime has spatial and temporal dimensions as well. People tend to fear specific locations and times, especially during the night. Dangerous places are linked to perceptions of blocked prospects which reduce visibility and create opportunities for potential criminals to hide. Nelson et al. (2001) indicated that potential threat of violence and violent behaviours shapes people's perceptions of risk and subsequent behaviour. These perceptions are strongly attached to specific localities.

Lindsay and Norman (1977) defined perception as the process by which organisms interpret and organize sensation to produce a meaningful experience of the world. Sensation usually refers to the immediate, relatively unprocessed result of stimulation of sensory receptors in the eyes, ears, nose, tongue, or skin. Perception, on the other hand, better describes one's ultimate experience of the world and typically involves further processing of sensory input. In practice, sensation and perception are virtually impossible to separate, because they are part of one continuous process. Thus, perception in humans describes the process whereby sensory stimulation is translated into organized experience. That experience, or percept, is the joint product of the stimulation and of the process itself. Relations found between various types of stimulation (for example, light waves and sound waves) and their associated percepts

suggest inferences that can be made about the properties of the perceptual process; theories of perceiving then can be developed on the basis of these inferences.

Pomerantz (2003) viewed perception as the process of attaining awareness or understanding of the environment by organizing and interpreting sensory information. He further expounded that perception involves signals in the nervous system, which in turn result from physical stimulation of the sense organs. For example, vision involves light striking the retinas of the eyes, smell is mediated by odour molecules and hearing involves pressure waves. Perception is not the passive receipt of these signals, but can be shaped by learning, memory and expectation. Perception involves these "top-down" effects as well as the "bottom-up" process of processing sensory input (Bernstein, 2010). Perception depends on complex functions of the nervous system, but subjectively seems mostly effortless because this processing happens outside conscious awareness. In this study, perception refers to the opinion; awareness or understanding an undergraduate possesses based on violent behaviour perpetration and its spatial patterns within the university environment.

Violent behaviours and violence-related crimes have emerged as two of the most prominent challenges facing Nigerian educational system including university system where the spate of violence seems to impinge profound effects on university administration, lecturers' and students' welfare and property (Aluede et al., 2005; Smith, 2006; Egbochukwu, 2007). Perpetration of violent behaviours, its perceptions, patterns and safety have been at the centre stage of several debates and discussions. Institute for Security Studies-ISS (2001) stated that addressing perceptions of crime (violent behaviours inclusive) is as important as reducing crime levels. Additionally, ISS (2001) asserted that fear of crime or violent behaviour perpetration affects quality of life and has negative economic and political consequences irrespective of cultural, social and geographical contexts.

The study investigated how, within the context of heightened safety and security concerns in Nigeria and universities environments in particular; undergraduate populations perceive violent behaviours perpetration patterns in public spaces such as drinking establishments, lecture halls/amphitheaters, sports centres, shopping districts, cyber café, restaurants, entertainment venues and hostels. The analysis was undertaken as part of a broader attempt to examine perceptions of violent behaviours perpetration, especially in relation to spatial patterns of human behaviours.

Forms of violent behaviours most prevalent among undergraduates of Nigerian universities (federal and state universities) as highlighted by Nwokwule (1992) and Aluede et al., (2005), which include sexual assault/abuse, verbal aggression, bullying, stabbing, shooting, arson, weapon carrying, robbery, arson, gang fight and violent acts/crimes against property or materials (such as burglary, theft) were investigated. Violent behaviours are also perpetrated in patterns. Cowie (1990) referred to pattern as the various forms that something may take. Pridemore et al. (2003) classified patterns into three forms. These are spatial, temporal and demographic. However, the scope of this study was restricted to spatial pattern of violent behaviours among university undergraduates in South-East Nigeria. A spatial pattern is a perceptual structure, placement, or arrangement of objects on earth. It also includes the space in between those objects. Patterns may be recognized because of their arrangement; maybe in a line or by a clustering of points. Three classifications are often used when discussing spatial patterns, aggregated (or clustered), random and regular. In reference of spatial behaviours, Canter and Hammond (2006b) stated that offenders do not typically travel far from their homes to offend because of the increase in time, money and effort to travel further a far, as well as the fact that individuals prefer to remain within the area around their homes, with which they feel most comfortable and most familiar.

Several studies (Canter and Larkin, 1993; Canter and Gregory, 1994; Snook, 2004; Cusimano et al., 2010) conducted on spatial behaviour of criminals have also indicated that individual characteristics of offenders are influencing the distances travelled by them to commit offences.

In a study of serial burglars, Snook (2004) provided some evidences that differences in age, experience, monetary reward and methods of transportation can determine offenders' travel choice. Snook (2004) asserted that young offenders select targets that are located nearer to their homes than older ones. However, age differences in criminal mobility may exist because "age summarizes a wide range of aspects related to differences in criminal spatial development such as the size of their cognitive maps, levels of restriction on mobility (for example, the amount of parental control) and access to resources (for example, vehicle)". Considering this study, age difference among undergraduates of South-East Nigerian universities may have significant impact on perception of spatial pattern of violent behaviours perpetration.

In this study, spatial pattern of violent behaviour can be exemplified as the manner by which an individual undergraduate or group of undergraduates perpetrate violent behaviours in relation to the immediate environment, which encompasses students, staff (animate objects) and university infrastructure (inanimate objects). Perception of spatial pattern of violent behaviour on the other hand refers to opinion, awareness or understanding undergraduates have based on violent behaviours in relation to the immediate environment, which encompasses students, staff (animate objects), university infrastructure (inanimate objects) and places. The baseline data generated in the study established that

undergraduates perceived violent behaviours to significantly occurred in the hostels, restaurant and drinking establishments (RDE), entertainment and shopping districts (ESD). The data on perceived spatial pattern of violent behaviours perpetration among university undergraduates in South-east Nigeria were collected during the 2010/2011 academic session.

The spatial aspects of human interactions are key issues to understand human activities and behaviours including violent behaviours. Theories such as Routine Activity Theory-RAT (Cohen and Felson, 1979), Spatial Syntax Theory-SST (Nubani and Wineman, 2005; Baran et al., 2006), Social Ecological Model-SEM (Bronfenbrenner, 1977, 1979) and Social Perception Theory-SPT (Smith and Mackie, 2000), which have been developed to investigate and understand spatio-temporal characteristics and perception of human activities and interactions were also adopted as theories of anchor.

Spatial syntax theory emphasizes spatial factors (street networks, building placement, and building size) as correlates of crime (Nubani and Wineman, 2005; Baran et al., 2006) or of other social phenomena. As such it addresses one aspect of the "suitable targets" dimension of routine activity analysis. For instance, network locations which make for easy escape are more suitable targets than network locations which are not. Spatial syntax theory provides a methodology for mapping a space into a connected set of discrete units through a process terms spatial configuration. This map results in identification of 'syntactic steps,' which are line segments in a network, with a new step starting when there is a change in direction. The 'depth' between any two spaces in the network is the least number of syntactic steps connecting them. One may measure the degree of 'integration' between spaces in terms of depth. A given space has greater 'global choice' when there are many potential paths connected to it. All these measures of spatial syntax may be used as potential correlates of crime or any other social phenomenon.

Social perception theory (SPT) is, in psychology and other cognitive sciences, that part of perception that allows people to understand the individuals and groups of their social world, and thus an element of social cognition (Smith and Mackie, 2000). It allows people to determine how others affect their personal lives. While social perceptions can be flawed, they help people to form impressions of others by making the necessary information available to assess what people are like. Missing information is filled in by using an implicit personality theory: if a person is observed to have one particular trait, observers tend to assume that he or she has other traits related to this observed one. These assumptions help to "categorize" people and then infer additional facts and predict behaviour (Delamate et al., 2003). Social perceptions are also interlinked with self-perceptions. Both are influenced by self-motives. Society has the desire to achieve beneficial outcomes for the self and to maintain a positive self-image, both for personal psychic benefits and because we know that others perceive us as well. It is human nature to want to create a good impression on others, almost as if self-perceptions are others' social perceptions (Dunning, 2001).

The study was also anchored on routine activity theory since studies on violence, violent crime, violent behaviour and victimization involve utilization of demographic variables (age, race, education, gender, etc.) which are often applied as proxies for unmeasured risk variables (living in high-crime neighbourhoods, frequenting high-crime establishments, work in areas low in police protection, low personal capacity to resist and so on) and parameters for determining occurrence of social phenomena (Mustaine and Tewksbury, 1998).

Also, this study was also anchored on ecological model. The model comprehensively addresses public health problems such as injury, violent behaviours, health risk behaviours, and violence against women at multiple levels (University of Florida, 1999). These levels highlight the interaction and integration of biological, behavioural, environmental and social determinants (these determinants can be broadly divided into 'upstream' determinants-education, employment, income, living and working conditions; 'midstream'-health behaviours and psychosocial factors and 'downstream'-physiological and biological factors), as well as the influence of organizations (for examples, workplace and schools), other persons (for instance, family, friends, and peers), and public policies all of which together help individuals make healthy choices in their daily lives (Glanz and Rimmer, 1995). A key feature is that it highlights how health and wellbeing are affected by changes and interactions between all these factors over the course of one's life (McClure et al., 2004). The model provides a complex web of causation and creates a rich context for intervention. To buttress this fact, it recognizes that: young people (university undergraduates) come to university campuses with social, family and behavioural histories that influence their university behaviours; and once on campus, peers, residence, and lifestyle factors further influence what they believe, endorse, and do with regard to violence. Consequently, SEM can be used to exemplify pattern of violent behaviours among university undergraduates of south-east Nigeria and design appropriate intervention strategies for their eradication.

Violent incidents and fear of violence have permeated higher educational institutions including university campuses in Nigeria. These have profound damaging effects on the educational process. Schools with high rates of crime and violence are less effective in educating learners. These universities have lower levels of learner achievement, higher rates of absenteeism, and more dropouts. Violent behaviours perpetration in universities' environments not only has immediate devastating effects on students, but often persists into adulthood and supports an intergenerational culture of coercion and

violence. The study of spatial pattern of violent behaviours perpetration provides a much more significant picture of violence in the university environments that overlays previously computed fatality data. Furthermore, examining perceived spatial patterns of violent behaviours perpetration among undergraduates based on certain demographics can be utilized to theorize on the impact of violent behaviours on undergraduates and formulate preventive strategies.

There exists a dearth of studies and reliable data on perpetration, perceived spatial pattern of violent behaviours among undergraduates of South-East Nigerian universities. Therefore, there subsists the pertinent question of what perceived spatial patterns of violent behaviours exist among university undergraduates of South-East Nigeria? Addressing the perpetration and perceived spatial patterns of violent behaviours among undergraduates of South-East Nigerian universities is as important as reducing its magnitude and damaging effects. Effective eradication of violent behaviours perpetration requires primary intervention, that is, formulation of appropriate preventive strategies. Thus, this situation poses a question of which appropriate preventive strategies can be formulated against perpetration and perceived spatial pattern of violent behaviours among undergraduates of South-East Nigerian universities?

The purpose of the current study was to investigate perpetration, perceived spatial pattern of violent behaviours among university undergraduates in South-East, Nigeria and recommend preventive strategies against such behaviours.

MATERIALS AND METHODS

The study adopted cross-sectional survey research design. The study was carried from 2010 to 2012. The population of the study was 176,531 university undergraduates that enrolled during 2010/2011 academic session in the public universities in South-East, Nigeria. A sample of 1,800 representing 1.02 per cent of the population participated in the study. Multi-stage sampling procedure was employed to draw the sample for the study. Three forms of instruments were utilized for data collection. These include: Undergraduates violent behaviours perpetration and patterns questionnaire (UVBPPQ), undergraduates violent behaviours interview guide (UVBIG) and appropriate violent behaviours preventive strategies questionnaire (APVBPSQ). The face validity of the instruments was established through the judgments of five experts from Sociology and Anthropology Department, Health and Physical Education Department, Psychology and Measurement and Evaluation Department, University of Nigeria, Nsukka. Split-half method of reliability testing and Cronbach Alpha statistic were used to determine reliability indices of UVBPPQ, APVBPSQ and its subscales while reliability co-efficient values of 0.79, 0.82 and 0.77, respectively were obtained. Research questions were answered using means and standard deviations, as well as percentages while Chi-square was used to test the null hypotheses at 0.05 level of significance.

Research instruments

The procedures involved in the design of the instrument include: Extensive literature review and interview with specialists in the field and related fields were conducted, extraction of topics required for the formulation of questionnaire items, determination of items for each sub-topic, preparation of the draft of the questionnaire and determination of the appropriate scales for each of the sub-topics. Subsequently, the face and content validity of the instrument were established. To establish the reliability of the instrument, 30 copies of the instrument (UVBPPQ) were administered on 30 undergraduates of Kogi State University, Anyigba. The instrument items were divided into two equal sets of even and odd numbers. The responses of the two sets were analyzed to ascertain the reliability co-efficient of the entire instrument using Spearman-Brown prophecy (correction) formula statistics. The reliability co-efficient of the entire instrument was 0.79. Furthermore, using inter-item analysis, the reliability co-efficient of items in Section B of the (UVBPPQ) was established using Cronbach's alpha coefficient. However, Section E (perception of spatial pattern of VBs) had reliability co-efficient of 0.82 and 0.77, respectively. Since reliability co-efficient of the instrument was above 0.79 (the cut-off point was considered to be 0.7) for all subscales of UVBPPQ. Thus, the instrument was considered reliable for use in the study.

Procedures adopted in formulating appropriate preventive strategies against perpetration and perceived spatial pattern of violent behaviours

The formulation underwent three distinct phases namely: outlining the baseline findings; outlining the objectives and components of the preventive strategies, and subjecting the objectives and proposed preventive strategies to experts for both face and content validity. This procedure though slightly differed from the method adopted by Ezedum (1999) and Ekenedo (2007); the two procedures have similar modus operandi and guiding modalities. The APSAVBQ comprising the objectives of the study and suggested preventive strategies was presented together with the summary of major findings from the baseline data to 15 experts selected from the fields of Geography, Health and Physical Education, Psychology, Sociology and Anthropology. The experts were required to adjudge the degree of appropriateness of the suggested preventive strategies in the questionnaire by ticking (√) against the items with response options of 'Very Appropriate', 'Appropriate' and 'Not Appropriate'. They were also requested to make their inputs. The data were analysed using mean statistic. Responses to the questionnaire items were weighted as follows:

'Very Appropriate' (3 points), 'Appropriate' (2 points) and 'Not Appropriate' (1 point). A criterion mean of 2.00 was utilized in taking decision in reference to the appropriateness of the items. The criterion was calculated as follows:

$$\frac{3+2+1}{3} = \frac{6}{3} = 2.00$$

Hence, an item with a mean that is equal to or greater than the criterion mean of 2.00 was adjudged as 'Appropriate'. In addition, an item with a mean less than 2.00 was considered to be 'Not Appropriate' as a component of the preventive strategies.

Inclusion criteria

The inclusion criteria included being a bona fide student of any of the selected universities during 2010/2011 academic session in the south-east Nigeria and willingness to participate in the study after given informed consent.

Exclusion criteria

These include not responding to all the items in the copies of the questionnaires, or inappropriate or inconsistent response to the questionnaire items based on the investigators' discretion.

Ethical consideration

Undergraduates were given informed consent letters seeking their permission to participate in the study. Undergraduates were not coerced to participate in the study.

RESULTS

After retrieval of the administered copies of the UVBPPQ, the researchers gathered and sorted out the improperly completed copies. Copies of the questionnaire returned were crosschecked for completeness of responses while those that were incorrectly completed were discarded. A total of 93 copies of the questionnaire were excluded from data analysis considering the exclusion criteria. Hence, 1,707 properly completed copies of the instrument were used for data analysis. The quantitative data were analyzed using the statistical package for the social sciences (SPSS batch system version 16). The data were analyzed on an item-by-item basis to indicate the response frequencies and percentages of various categories of respondents such as age, academic level, gender, and university type. Out of the 1,800 copies each of the questionnaires distributed, 1707 [age = (15 to 19 years = 334, 20 to 24 years^{+} = 1373]; [academic level = (200 level = 629, 300 level = 290, 400 level = 788)]; [gender = (male = 842, female = 865)]; [university type = (federal = 774, state = 933)]; representing 94.8% return rate, were used for data analysis.

Table 7 shows that χ^2-cal value of test of hypothesis of no significant difference in the perceived spatial pattern of violent behaviours perpetration based on age (χ^2 = 0.88 < 43.77, df = 30, p < .05) is less than the critical χ^2-value. Thus, the hypothesis is, therefore, accepted. Table 8 indicates that χ^2 -cal value of test of hypothesis of no significant difference in the perceived spatial pattern of violent behaviours perpetration based on gender (χ^2 = 72.98 > 43.77, df = 33, p < .05) is greater than the critical χ^2-cal value. Thus, the hypothesis is, therefore, rejected. Table 9 reveals that χ^2-cal value of test of hypothesis of no significant difference in the perceived spatial pattern of violent behaviours perpetration according to academic level (χ^2 = 36.82 < 79.08, df = 33, p < .05) is less than the critical χ^2-value. The hypothesis is, therefore, accepted. Table 10 reveals that χ^2-cal value of test of hypothesis of no significant difference in the perceived spatial pattern of violent behaviours perpetration according to university type (χ^2 = 17.06 < 43.77, df = 30, p < .05) is less than the critical χ^2-value. The hypothesis that there is no significant difference in the perceived spatial pattern of violent behaviours perpetration according to university type university type is, therefore, accepted.

Undergraduates in universities reported low perpetration of indicated violent behaviours: bullying (1.55 ± 0.49), stabbing (1.35 ± 0.47), rape (1.10 ± 0.30), gang fights (1.05 ± 0.28), and weapon carrying (1.20 ± 0.50). In reference to perceived spatial pattern of violent behaviours, undergraduates of different ages reported that violent behaviours were mostly perpetrated in the hostels (15 to 19 years = 36.4%; 20 to 24 years^{+} = 31.4%), restaurants and drinking establishments (15 to 19 years = 23.7%; 20 to 24 years^{+} = 27.4%). Undergraduates based on gender reported that violent behaviours were mostly perpetrated in the hostels (male = 34.7%; female = 30.2%), restaurants and drinking establishments (male = 23.8%; female = 29.5%). Undergraduates of different academic levels indicated violent behaviours were mostly perpetrated in the hostels (200 level = 29.9%; 300 level = 32.45%; 400 level = 34.5%), restaurants and drinking establishments (200 level = 27.2%; 300 level = 21.7%; 400 level = 28.0%). Based on university type, respondents' perception of spatial pattern of VBs was as follows: HST (federal = 26.2%; state = 35.5%), moderately at RDE (federal = 26.0%; state = 25.6%), and infinitesimally at ESD (federal = 18.1%; state = 17.9%). There was a significant difference (χ^2 = 72.98 > 43.77, df = 30, p < .05) in the undergraduates' perceived spatial pattern of violent behaviours based on gender. Intervention strategies such as development of youth violence surveillance system (2.40 ±.91) and implementation of hostel violence surveillance system in the university environment (2.40 ±.82) were recommended.

DISCUSSION

Data in Table 1 show low prevalence of violent behaviours (grand $\bar{X}$ = 1.98 < 2.00; ± 0.73) among undergraduates. This finding was not expected and thus surprising. This is because surveys conducted by Aluede et al. (2005), Smith (2006), Egbochukwu (2007) and Egwunyenga, (2009) revealed high prevalence of violent behaviours among undergraduates of Nigerian universities and youths of other cultural or ethnic backgrounds who were in higher institutions of learning (Olweus, 1993). Although, when data on prevalence of some VBs were isolated and analyzed, results indicated that arson ($\bar{X}$ = 2.01 > 2.00), robbery cases ($\bar{X}$ = 2. 13 > 2.00), theft and burglary ($\bar{X}$ = 2.07 > 2.00) were violent behaviours prevalent in the university environments. This finding contradicts those of Nwokule (1992), Aluede et al. (2005), Smith (2006) who reported high prevalence of

Table 1. Prevalence of violent behaviours in the university environment (n = 1,707).

Parameter	$\bar{X}$	SD	Decision
Occurrence of bullying in the university environment in the past 12 months	1.84	0.71	*LPVB
Occurrence of stabbing in the university premise in the past 12 months	1.91	0.76	*LPVB
Occurrence of rape in the university environment in the past 12 months	1.98	0.74	*LPVB
Manifestation of gang fights in the university environment in the past 12 months	1.97	0.69	*LPVB
Occurrence of weapon (knife, cutlass, gun) carrying in the past 12 months	1.96	0.73	*LPVB
Occurrence of arson on the campus in the past 12 months	2.01	0.68	*PVB
Manifestation of robbery cases on campus in the past 12 months	2.13	0.73	*PVB
Occurrence of violent acts against property in the past 12 months	2.07	0.79	*PVB
Occurrence of gun shooting in university environment in the past 12 months	1.97	0.75	*LPVB
Grand mean	1.98	0.73	*LPVB

*LPVB = Low prevalence of violent behavior. *PVB = Prevalence of violent behaviour

Table 2. Percentage of perceived spatial patterns of violent behaviours among undergraduates (n = 1,707).

Variable	Spatial pattern													
	*LRA		*RDE		*HST		*ESD		*SPC		*DAB		*OTR	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Where does bullying occur in the university premise?	179	10.5	483	28.3	469	27.5	160	9.40	207	12.1	114	6.7	46	2.7
Where does stabbing often occur in the campus?	52	3.00	600	35.1	406	23.8	444	26.4	74	4.3	69	4.0	62	3.6
Where do undergraduates often commit act of rape?	49	2.90	162	9.50	1010	59.2	129	7.60	44	2.6	131	7.7	182	10.7
Where does shooting usually occur in the campus?	156	9.10	558	32.7	222	13.0	517	30.3	98	5.7	88	5.2	68	4.0
Where do students usually engage in gang fight?	156	9.10	711	41.7	188	11.0	406	23.8	140	8.2	59	3.5	47	2.8
Where does weapon carrying mostly perpetrated?	196	11.5	623	36.5	212	12.4	432	25.3	96	5.6	117	6.9	31	1.8
Where do undergraduates mostly engage in arson?	79	4.60	539	31.6	421	24.7	263	15.4	83	4.9	297	17.4	25	1.5
Where does robbery usually occur in the campus?	51	3.00	217	12.7	1011	59.2	267	15.6	23	1.3	116	6.8	22	1.3
Where do students mostly commit theft and burglary?	66	3.90	203	11.9	1042	61.0	102	6.00	13	0.8	249	14.6	32	1.9
Average		6.40		26.7		32.4		17.7		5.1		8.1		3.6

*LRA = Lecture rooms and amphitheatres, *RDE = Restaurants and other drinking establishments, *HST = Hostels, *ESD = Entertainment venues and shopping districts, *SPC = Sports centres, *DAB=Departmental and administrative buildings, *OTR=Others

investigated violent acts among undergraduates of Nigerian universities. In contrast, results on specific violent behaviours (arson, robbery incidents, theft and burglary) are consistent with those of Gudlaugsdottir et al. (2004) and Sibai et al. (2009) who investigated violent behaviours

among adolescents in Iceland and post-war Lebanon, respectively. These contrasts could be attributed to homogeneity of subjects of this study and previous studies even though their geographical and cultural settings varied.

Data in Table 2 indicated that undergraduates perceived violent behaviours (VBs) to be considerably perpetrated in HST (32.4 %), RDE (26.7%), and infinitesimally at ESD (17.7%) in their university campuses. Sampson et al. (1997) and Tabrizi and Madanipour (2006) asserted that environmental criminologists have correlated crime patterns with the environmental and physical layout of places where crimes occur. Incidents of crime tend to concentrate in specific locations at particular time periods. This finding is in agreement with those of Cusimano et al. (2010), whose reports corroborated the above assertion by reiterating that violent acts are significantly perpetrated where there is a convergence of different populations or same population that moves with time. Also, such population is characterized by several indicators of social deprivation. Therefore, perpetration of violent behaviours in hostels was plausible but astonishing. The hostels are perceived as safe places that should provide comfort and safety for students but are also sites associated with undergraduates' routine activities, their mobility and provide opportunities for potential criminals to hide and unleash violent behaviours on other students. In other words the hostels are potential crime sites. This finding is in agreement with those of Graham et al. (2006) who studied large drinking establishments and found that the immediate bar-room environment had an important impact on the frequency of aggression but less on the severity of aggression.

According to Graham et al. (2006), the strongest predictors of both the frequency and severity of patron aggression in large drinking establishments were social factors such as rowdiness/permissiveness and sexual activity, contact and competition, and closing time variables such as over-serving at closing time and the number of people hanging around after closing. Nelson et al. (2001) who conducted a survey in Cardiff and Worcester in the UK, also reported major clusters of violent crime at night in the pub/leisure zones of the city centre and secondary clusters during the day in major retail streets/entertainment districts. Dangerous places are linked to perceptions of blocked prospects which reduce visibility and create opportunities for potential criminals to hide (Tabrizi and Madanipour, 2006). Thus, this agreement was acknowledged and may be due to subjects' composition and similarities between physical properties of the environments where the earlier studies were conducted and the present study.

Data in Table 3 showed that regardless of age, undergraduates perceived VBs to mostly occurred in HST (15 to 19 years = 36.4%; 20 to 24 years^{+} =31.4%), RDE (15 to 19 years = 23.7%; 20 to 24 years^{+} = 27.4%), and ESD (15 to 19 years = 13.9%; 20 to 24 years^{+} = 18.6%), respectively. This finding is in consonance with those of Graham et al. (2006) who studied large drinking establishments and found that the immediate bar-room environment had an important impact on the frequency of aggression but less on the severity of aggression. According to Graham et al. (2006), the strongest predictors of both the frequency and severity of patron aggression in large drinking establishments were social factors such as rowdiness/permissiveness and sexual activity, contact and competition, and closing time variables such as over-serving at closing time and the number of people hanging around after closing.

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Data in Table 4 indicated that undergraduates' perceived spatial pattern of VBs based on gender were as follows: male (HST = 34.7%; RDE = 23.8%; ESD = 19.6%), female (HST = 30.2%; RDE = 29.5%; ESD = 15.9%), respectively. The finding was interesting but expected. The finding is inconsistent with those of Krakowski and Czobor (2004) who reported gender differences in the frequency and course of physical and verbal assaults over the 4-week period among their subjects. The finding also contradicted that of Egbochukwu (2007) whose reports indicated that secondary school students perceived that boys more than girls were both bullies and victims of bullying. Boys reported being kicked or hit more often than girls. The results further showed that it was more common for bullying to take place in the classroom in government schools than in private schools. The contradiction may be because of subjects' composition and disparities in dispositions of secondary school students and university undergraduates.

Data in Table 5 showed that undergraduates across academic level perceived VBs to be typically perpetrated in the HST (200 level = 29.9%; 300 level = 32.45%; 400 level = 34.5%), RDE (200 level = 27.2%; 300 level = 21.7%; 400 level = 28.0%), and ESD (200 level = 15.1%; 300 level = 18.5%; 400 level = 19.5%). The finding was expected, thus, not a surprise because any environmental condition irrespective academic class that generates significant discomfort or displeasure, such as poverty, overcrowded hostels, and dilapidated buildings,

Table 3. Percentage of perceived spatial pattern of violent behaviours perpetration based on Age (n = 1,707).

Variable	15-19 years (n = 334)													
	*LRA		*RDE		*HST		*ESD		*SPC		*DAB		*OTR	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Where does bullying occur in the university premise?	40	12.0	96	28.7	117	35.0	28	8.4	24	7.2	24	7.2	5	1.5
Where does stabbing often occur in the campus?	4	1.2	155	46.4	98	29.3	45	13.5	0	0.0	24	7.2	8	2.4
Where do undergraduates often commit act of rape?	3	0.9	57	17.1	209	62.6	18	5.4	3	0.9	28	8.4	16	4.8
Where does shooting usually occur in the campus?	37	11.1	85	25.4	66	19.8	82	24.6	16	4.8	35	10.5	13	3.9
Where do students usually engage in gang fight?	44	13.2	99	29.6	32	9.6	76	22.8	58	17.4	16	4.8	9	2.7
Where does weapon carrying mostly perpetrated?	76	22.8	95	28.4	67	20.1	37	11.1	0	0.0	56	16.8	3	0.9
Where do undergraduates mostly engage in arson?	32	9.6	83	24.9	58	17.4	60	18.0	12	3.6	86	25.7	3	0.9
Where does robbery usually occur in the campus?	6	1.8	21	6.3	221	66.2	55	16.5	10	3.0	21	6.3	0	0.0
Where do students mostly commit theft and burglary?	7	2.1	21	6.3	226	67.7	17	5.10	10	3.0	53	15.9	0	0.0
Average		8.3		23.7		36.4		13.9		4.4		11.4		1.9

Variable	20-24 years + (n = 1,373)													
	*LRA		*RDE		*HST		*ESD		*SPC		*DAB		*OTR	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Where does bullying occur in the university premise?	139	10.5	387	28.2	352	25.6	132	9.6	90	6.6	232	16.9	41	3.0
Where does stabbing often occur in the campus?	48	3.5	445	32.4	308	22.4	399	29.1	74	5.4	45	3.3	54	3.9
Where do undergraduates often commit act of rape?	46	3.4	105	7.6	801	58.3	111	8.1	41	3.0	103	7.5	166	12.1
Where does shooting usually occur in the campus?	119	8.7	473	34.5	156	11.4	435	37.1	82	6.0	53	3.9	55	4.0
Where do students usually engage in gang fight?	112	8.2	612	44.6	156	11.4	330	24.0	82	6.0	43	3.1	38	2.8
Where does weapon carrying mostly perpetrated?	120	8.7	528	38.5	145	10.6	395	28.8	96	7.0	61	4.4	28	2.0
Where do undergraduates mostly engage in arson?	47	3.4	456	33.2	363	26.4	203	14.8	71	5.2	211	15.4	22	1.6
Where does robbery usually occur in the campus?	45	3.3	196	14.3	290	57.5	212	15.4	13	0.9	95	6.9	22	1.6
Where do students mostly commit theft and burglary?	59	4.3	182	13.3	816	59.4	85	6.2	3	0.2	196	14.3	32	2.3
Average	5.9		27.4		31.4		18.6		4.5		8.4		3.7	

can both produce violent inclinations and reduce disinhibitions against violent behaviours as part of the social disorganization and weak social controls that accompany these conditions. This finding is in agreement with those of Graham et al. (2006) who studied large drinking establishments and found that the immediate bar-room environment had an important impact on the frequency of aggression but less on the severity of aggression. According to Graham et al. (2006), the strongest predictors of both frequency and severity of patron aggression in large drinking establishments were social factors such as rowdiness/permissiveness and sexual activity, contact and competition, and closing time variables such as over-serving at closing time and the number of people hanging around after closing. Thus, this agreement was acknowledged and may be due to subjects' composition and similarities between physical properties of the environments where the earlier studies were conducted and the present study.

Results in Table 6 showed that based on university type, respondents' perceptions of

Table 4. Percentage of perceived spatial pattern of violent behaviours perpetration according to gender (n = 1,707).

Items	Male (n = 842)													
	*LRA		*RDE		*HST		*ESD		*SPC		*DAB		*OTR	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Where does bullying occur in the university premise?	83	9.9	174	20.7	206	24.5	95	11.3	36	4.3	212	25.2	36	4.3
Where does stabbing often occur in the campus?	23	2.7	204	24.2	217	25.8	304	36.1	34	4.0	22	2.6	38	4.5
Where do undergraduates often commit act of rape?	17	2.0	49	5.8	497	59.0	81	9.6	30	3.6	89	10.6	79	9.4
Where does shooting usually occur in the campus?	43	5.1	235	27.9	74	8.8	328	39.0	49	5.8	66	7.8	47	5.6
Where do students usually engage in gang fight?	44	5.2	425	50.5	94	11.2	166	19.7	62	7.4	16	1.9	35	4.2
Where does weapon carrying mostly perpetrated?	38	4.5	244	29.0	122	14.5	320	38.0	45	5.3	45	5.3	28	3.3
Where do undergraduates mostly engage in arson?	15	1.8	321	38.1	232	27.6	101	12.0	21	2.5	133	15.8	19	2.3
Where does robbery usually occur in the campus?	23	2.7	72	8.6	587	69.7	64	7.6	23	2.7	54	6.4	19	2.3
Where do students mostly commit theft and burglary?	10	1.2	79	9.4	599	71.1	24	2.9	10	1.2	53	12.4	16	1.9
Average	-	3.9	-	23.8	-	34.7	-	19.6	-	4.1	-	9.7	-	4.2
							Female (n = 865)							
Where does bullying occur in the university premise?	96	11.1	309	35.7	263	30.4	65	7.5	78	9.0	44	5.1	10	1.2
Where does stabbing often occur in the campus?	29	3.4	396	45.8	189	21.8	140	16.2	40	4.6	47	5.4	24	2.8
Where do undergraduates often commit act of rape?	32	3.7	113	13.1	513	59.3	48	5.5	14	1.6	42	4.9	103	11.9
Where does shooting usually occur in the campus?	113	13.1	323	37.3	148	17.1	189	21.8	49	5.7	22	2.5	21	2.4
Where do students usually engage in gang fight?	112	12.9	286	33.1	94	10.9	240	27.7	78	9.0	43	5.0	12	1.4
Where does weapon carrying mostly perpetrated?	158	18.3	379	43.8	90	10.4	112	12.9	51	5.9	72	8.3	3	0.3
Where do undergraduates mostly engage in arson?	64	7.4	218	25.2	189	21.8	162	18.7	62	7.2	164	19.0	6	0.7
Where does robbery usually occur in the campus?	28	3.2	145	16.8	424	49.0	203	23.5	0	0.0	62	7.2	3	0.3
Where do students mostly commit theft and burglary?	56	6.5	124	14.3	443	51.2	78	9.0	3	0.3	145	16.8	16	1.8
Average	-	8.8	-	29.5	-	30.2	-	15.9	-	4.8	-	8.2	-	2.6

spatial pattern of violent behaviours were as follows: HST (federal = 26.2%; state = 35.5%), moderately at RDE (federal = 26.0%; state = 25.6%), and infinitesimally at ESD (federal = 18.1%; state = 17.9%). The finding was interesting but anticipated because experience has shown that locations of violent injuries and residence locations of victims were both closely related to each other and clearly clustered in certain parts of neighbourhoods characterized by high numbers of drinking establishments/bars, social housing units, shopping districts, entertainment venues, homeless shelters, as well as lower household incomes (Cusimano, et al., 2010). In Nigerian context, many university environments either federal or state in recent times have been characterized by proliferation and concentration of restaurants and drinking establishments and shopping districts for economic gains without considering that such places are hotspots of violence and possess propensity to breed clusters of violent crimes with attendant health, social and economic consequences on university community. The finding contradicts those of Sampson et al. (1997), who used census and survey data to measure neighbourhood characteristics and violent crime rates for Chicago's 343 neighbourhoods. Survey questions in that study included perceived levels of crime and community response to crime and antisocial behaviour, while census data were used to measure social deprivation. Sampson et al. (1997) found that neighbourhood's stability, social deprivation, and

Table 5. Percentage of perceived spatial pattern of violent behaviours perpetration according to academic level (n = 1,707).

Items	*LRA		*RDE		*HST		*ESD		*SPC		*DAB		*OTR	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
200 Level (n = 629)														
Where does bullying occur in the university premise?	40	6.4	260	41.3	175	27.8	53	8.4	36	5.7	33	5.2	32	5.1
Where does stabbing often occur in the campus?	43	6.8	211	33.5	148	23.5	163	25.9	7	1.1	27	4.3	30	4.8
Where do undergraduates often commit act of rape?	14	2.2	104	16.5	262	41.7	40	6.4	6	1.0	96	15.3	107	17.0
Where does shooting usually occur in the campus?	69	11.0	220	35.0	61	9.7	164	26.1	19	3.0	48	7.6	48	7.6
Where do students usually engage in gang fight?	68	10.8	216	34.3	62	9.9	147	23.4	79	12.6	22	3.5	35	5.6
Where does weapon carrying mostly perpetrated?	93	14.8	232	36.9	101	16.1	57	9.1	52	8.3	69	11.0	25	4.0
Where do undergraduates mostly engage in arson?	29	4.6	146	23.2	168	26.7	107	17.0	34	5.4	129	20.5	16	2.5
Where does robbery usually occur in the campus?	20	3.2	70	11.1	343	54.5	100	15.9	10	1.6	70	11.1	16	2.5
Where do students mostly commit theft and burglary?	4	0.6	81	12.9	374	59.5	24	3.8	13	2.1	117	18.6	16	2.5
Average	-	6.7	-	27.2	-	29.9	-	15.1	-	4.5	-	10.8	-	5.8
300 Level (n = 290)														
Where does bullying occur in the university premise?	51	17.6	39	13.4	106	36.6	31	10.7	38	13.1	14	4.8	11	3.8
Where does stabbing often occur in the campus?	3	1.0	108	37.2	94	32.4	21	7.2	20	6.9	28	9.7	16	5.5
Where do undergraduates often commit act of rape?	6	2.1	12	4.1	205	70.7	13	4.5	16	5.5	9	3.1	29	10.0
Where does shooting usually occur in the campus?	40	13.8	84	29.0	46	15.9	83	28.6	20	6.9	9	3.1	8	2.8
Where do students usually engage in gang fight?	38	13.1	78	26.9	37	12.8	99	34.1	14	4.8	15	5.2	9	3.1
Where does weapon carrying mostly perpetrated?	60	20.7	105	36.2	23	7.9	60	20.7	19	6.6	23	7.9	0	0.0
Where do undergraduates mostly engage in arson?	10	3.4	78	26.9	51	17.6	65	22.4	17	5.9	63	21.7	6	2.1
Where does robbery usually occur in the campus?	9	3.1	42	14.5	138	47.6	76	26.2	3	1.0	22	7.6	0	0.0
Where do students mostly commit theft and burglary?	9	3.1	21	7.2	144	49.8	36	12.4	0	0.0	75	25.9	5	1.7
Average	-	8.7	-	21.7	-	32.4	-	18.5	-	5.6	-	9.9	-	3.2
400 Level (n = 788)														
Where does bullying occur in the university premise?	88	11.2	184	23.4	188	23.9	76	9.6	40	5.1	209	26.5	3	0.4
Where does stabbing often occur in the campus?	6	0.8	281	35.7	164	20.8	260	33.0	47	6.0	14	1.8	16	2.0
Where do undergraduates often commit act of rape?	29	3.7	46	5.8	543	68.9	76	9.6	22	2.8	26	3.3	46	5.8
Where does shooting usually occur in the campus?	47	6.0	254	32.2	115	14.6	270	34.3	59	7.5	31	3.9	12	1.5
Where do students usually engage in gang fight?	50	6.3	417	52.9	89	11.3	160	20.3	47	6.0	22	2.8	3	0.4
Where does weapon carrying mostly perpetrated?	43	5.5	286	36.3	88	11.2	315	40.0	25	3.2	25	3.2	6	0.8
Where do undergraduates mostly engage in arson?	40	5.1	315	40.0	202	25.6	91	11.5	32	4.1	105	13.3	3	0.4
Where does robbery usually occur in the campus?	22	2.8	105	13.3	530	67.3	91	11.5	10	1.3	24	3.0	6	0.8
Where do students mostly commit theft and burglary?	53	6.7	101	12.8	524	66.5	42	5.3	0	0.0	57	7.2	11	1.4
Average	-	5.3	-	28.0	-	34.5	-	19.5	-	4.0	-	7.2	-	1.5

Table 6. Percentage of perceived spatial pattern of violent behaviours perpetration according to university type (n = 1,707).

Items	Federal University (n = 774)													
	*LRA		*RDE		*HST		*ESD		*SPC		*DAB		*OTR	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Where does bullying occur in the university premise?	20	2.6	243	31.4	251	32.4	69	8.9	152	19.6	19	2.5	20	2.6
Where does stabbing often occur in the campus?	10	1.3	289	37.3	291	37.6	116	15.0	10	1.3	0	0.0	58	7.5
Where do undergraduates often commit act of rape?	19	2.5	49	6.3	446	57.6	70	9.0	0	0.0	10	1.3	180	23.3
Where does shooting usually occur in the campus?	50	6.5	291	37.6	40	5.2	195	25.2	32	4.1	78	10.1	88	11.3
Where do students usually engage in gang fight?	19	2.5	244	31.5	49	6.3	237	30.6	50	6.5	79	10.2	96	12.4
Where does weapon carrying mostly perpetrated?	172	22.2	271	35.0	49	6.3	145	18.7	39	5.0	79	10.2	19	2.5
Where do undergraduates mostly engage in arson?	60	7.8	270	34.9	157	20.3	134	17.2	49	6.3	85	11.0	19	2.5
Where does robbery usually occur in the campus?	10	1.3	128	16.5	253	32.7	220	28.4	9	1.2	92	11.9	62	8.0
Where do students mostly commit theft and burglary?	30	3.9	30	3.9	292	37.7	77	9.9	0	0.0	307	39.7	38	4.9
Average	-	5.6	-	26.0	-	26.2	-	18.1	-	4.9	-	10.8	-	8.3
	State university (n = 933)													
Where does bullying occur in the university premise?	207	22.2	219	23.5	262	28.1	93	10.0	55	5.9	87	9.3	10	1.0
Where does stabbing often occur in the campus?	20	2.1	380	40.7	244	26.2	234	25.1	28	3.0	9	1.0	18	3.0
Where do undergraduates often commit act of rape?	0	0.0	48	5.1	534	57.2	110	11.8	19	2.0	104	11.1	118	12.1
Where does shooting usually occur in the campus?	56	6.0	315	33.8	122	13.1	245	26.3	109	11.7	30	3.2	56	6.0
Where do students usually engage in gang fight?	18	1.9	440	47.2	113	12.1	177	19.0	129	13.8	19	2.0	37	4.0
Where does weapon carrying mostly perpetrated?	1	0.1	347	37.2	141	15.1	331	35.5	67	7.2	37	4.0	9	0.9
Where do undergraduates mostly engage in arson?	0	0.0	164	17.6	356	38.2	118	12.6	149	16.0	128	13.7	18	1.9
Where does robbery usually occur in the campus?	29	3.1	120	12.8	608	65.2	158	16.9	0	0.0	9	1.0	9	1.0
Where do students mostly commit theft and burglary?	139	14.9	113	12.1	597	64.0	36	3.8	9	1.0	30	3.2	9	1.0
Average	-	5.6	-	25.6	-	35.5	-	17.9	-	6.7	-	5.3	-	3.4

local immigrant concentration explained 70% of variations in the perception of crime, community response and violent crime rates. The contradiction may be because of variations in subjects' composition of the earlier study and present study.

Data in Table 7 showed that no significant difference ($\chi^2 = 0.88 < 43.77$, df = 30, $p < 0.05$) was found in the perceived spatial pattern of violent behaviours perpetration by age. The finding was interesting but anticipated. This finding is in line with those of Nelson etal. (2001) who conducted a survey in Cardiff and Worcester in the United Kingdom and reported major clusters of violent crime at night in the pub/leisure zones of the city centre and secondary clusters during the day in major retail streets/entertainment districts. Dangerous places are linked to perceptions of blocked prospects which reduce visibility and create opportunities for potential criminals to hide (Tabrizi and Madanipour, 2006; Freidrich et al., 2009). The finding is also consistent with that of Australian Bureau of Statistics' (2006) Crime and Safety Survey reports conducted in 2005, which revealed that age of respondents did not significantly influence their perception of problems relating to crime and/or public nuisance in their local neighbourhoods. Thus, this agreement was acknowledged.

Results in Table 8 showed that a significant difference ($\chi^2 = 72.98 > 43.77$, df = 30, $p < 0.05$)

Table 7. Summary of Chi-square (χ^2) analysis of no significant difference in the perceived spatial pattern of violent behaviours perpetration based on Age (n = 1,707).

Variable	N	χ^2 –cal. value	df	χ^2 –Crit. value
Age				
15-19 years	334	0.88	30	43.77
20-24 years$^+$	1373			

*Significant at p <0.05.

Table 8. Summary of Chi-square (χ^2) analysis of no significant difference in the perceived spatial pattern of violent behaviours based on gender (n = 1,707).

Variable	N	χ^2 –cal. value	df	χ^2 –Crit. value
Gender				
Male	842	72.98	30	43.77
Female	865			

*Significant at p <0.05.

Table 9. Summary of Chi-square (χ^2) analysis of significant difference in the perceived spatial pattern of violent behaviours perpetration based on academic level (n = 1707).

Variable	N	χ^2 –cal. value	df	χ^2 –Crit. value
Academic level				
200 level	629			
300 level	290	36.82	60	79.08
400 level	788			

*Significant at p <0.05.

Table 10. Summary of Chi-square (χ^2) Analysis of No Significant Difference in the Perceived Spatial Pattern of Violent Behaviours Perpetration Based on University Type (n = 1,707).

Variable	N	χ^2 –cal. value	df	χ^2 –Crit. value
University type				
Federal University	774	17.06	30	43.77
State University	933			

was found in the perceived spatial pattern of violent behaviours perpetration by gender. The finding was fascinating but anticipated because experience has indicated that a male preponderance in violent behaviour has been demonstrated both with respect to property offences and violent offences, therefore, the result that gender had significant influence on perception of spatial pattern of violent behaviours was a surprise and anticipated. The finding lent credence to those of Krakowski and Czobor (2004) who found that gender had significant effect on their subjects' violent behaviour perpetration. Though, Krakowski and Czobor (2004) utilized psychiatric patients whose violent incidents occurred during their first 2 months of hospitalization, the agreement in the findings could be attributed to male preponderance in violent behaviours perpetration. In addition, this finding contradicts that of Poipoi (2011) who found that there was no significant difference between male and female students in their perception of forms of violence among secondary school students. The dissimilarity in findings might have arisen because of variations in geographic features inherent in locations of both studies.

Results in Table 9 revealed that a significant difference ($\chi^2 = 36.82 < 79.08$, df = 60, $p < 0.05$) was found in the perceived spatial pattern of violent behaviours perpetration by academic level. The finding was expected, thus, not a surprise because any environmental condition irrespective academic class that generates significant discomfort or displeasure, such as poverty, overcrowded hostels, and dilapidated buildings, can both produce violent inclinations and reduce disinhibitions against violent behaviours as part of the social disorganization and weak social controls that accompany these conditions. This finding is in agreement with those of Graham et al. (2006) who studied large drinking establishments and found that the immediate bar-room environment had an important impact on the frequency of aggression but less on the severity of aggression. Thus, this agreement was acknowledged.

Results in Table 10 indicated that no significant difference ($\chi^2 = 17.06 < 43.77$, df = 30, $p < 0.05$) was found in the perceived spatial pattern of violent behaviours perpetration by university type. The finding was interesting but anticipated because experience has shown that locations of violent injuries and residence locations of victims were both closely related to each other and clearly clustered in certain parts of neighborhoods characterized by high numbers of drinking establishments/bars, social housing units, shopping districts, entertainment venues, homeless shelters, as well as lower household incomes (Cusimano et al., 2010). In Nigerian context, many university environments either federal or state in recent times have been characterized by proliferation and concentration of restaurants and drinking establishments and shopping districts for economic gains without considering that such places are hotspots of violence and possess propensity to breed clusters of violent crimes with attendant health, social and economic consequences on university community. The finding is consistent with that of Egwunyenga (2009), who

in her study of room-mates conflicts in Nigerian universities found that university type had no significant influence on perception and violent acts of room-mates in Nigerian universities. The agreement between both findings may be attributed to subjects' composition.

RECOMMENDATIONS

Recommendations such as installation of hostel violence surveillance system (HVSS) in the campuses, community-wide youth violence surveillance system and inclusion of youths in the campaign against violence were made based on the findings of the study.

Conflict of interest

The authors have no conflict of interest

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Assessment of community knowledge about Tuberculosis and its treatment in rural areas of Shashemane, Southern Ethiopia

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Tuberculosis (TB) is a chronic infectious disease caused by *Mycobacterium tuberculosis*. Poverty, malnutrition and crowded living conditions have been recognized for decades to increase the risk of developing TB. In addition, lack of knowledge about TB could affect the health-seeking behavior of patients and sustain the transmission of the disease within the community. A community based cross-sectional study was conducted in 4 randomly selected rural kebeles around Shashemene area to assess the community's knowledge about TB between March and May, 2011. A total of 422 voluntary residents were included. The study participants were interviewed about the cause, symptoms, mode of transmissions, treatment and preventive methods of tuberculosis. Despite the fact that higher proportion of the study participants 243 (58.8%, 95% CI, 51.6 to 63.1%) had good level of knowledge about TB almost all (90.2%) of them did not know the causative agent of TB. Farmer participants (OR = 2.18; 95% CI: 1.07 to 4.42) had low level of overall knowledge on TB. Almost all (98.98%) of the participants mentioned that TB is a treatable disease. The majority (96.44%) of the participants knew that TB can be transmitted from a patient to another person. The results of this study revealed that the community members in the present study area had little knowledge of the causative agent of TB and hence implementation of appropriate community-based health education is important to raise community's knowledge about TB.

Key words: Community knowledge, tuberculosis, Southern Ethiopia.

INTRODUCTION

Tuberculosis (TB) is a chronic infectious disease caused in most cases by *Mycobacterium tuberculosis* (M.Tb), an acid fast rod-shaped bacillus. Tuberculosis still affects mainly Asian and African countries, and Ethiopia is one of the top five affected countries in Africa (World Health Organization, 2010). In developing countries, about 7% of

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all deaths are attributed to TB which is the most common cause of death from a single source of infection among adults. Despite the measures taken, the burden of the disease is still high, especially in developing countries including Ethiopia. It is estimated that by 2020, there will be over 1 billion new TB infections and 200 million people will succumb to clinical disease and about 35 million will die if TB control is not further strengthened (World Health Organization, 2005). Poverty and lack of awareness are considered the most important factors that increase the risk of exposure to TB. Lack of knowledge about the cause, mode of transmission, and symptoms, as well as appropriate treatment of TB, not only affect the health seeking behavior of patients, but also could affect control strategy, thereby sustaining the transmission of the disease within the community (Legesse et al., 2010).

A study conducted in Kenya showed that TB is well known in the communities and perceived as a contagious 'sensitive' disease difficult to diagnose and treat. Community members believed that TB should be diagnosed and treated in a hospital or by a medical doctor and not at the periphery level. On the same study, traditional treatment was considered a valid alternative to modern treatment and believed to be as effective and takes much shorter time. Tuberculosis was attributed to be caused by factors such as smoking, alcohol, hard work, exposure to cold and sharing with TB patients. In contrast, many participants believed that TB was hereditary (Liefooghe et al., 1997).

Study conducted elsewhere in Ethiopia gave an idea about misconception on the cause, mode of transmission and prevention of TB. Furthermore, the knowledge of the participants was found to be influenced by the level of education, area of residence, and having health education at health institutions (Alemayehu, 2007; Mesfin et al., 2005; Abebe et al., 2010; Legesse et al., 2011). This part of the study looks for community perception and knowledge on TB and provides some solution for TB prevention strategies in communities within Shashemene area, Ethiopia.

METHODOLOGY

Study area and population

A cross-sectional study was conducted in Shashemene area, Ethiopia, to assess the community's knowledge about TB between March and May, 2011. Shashemene is located in West Arsi Zone of the Oromia National Regional State, approximately 250 km south of Addis Ababa, Ethiopia. It has ten urban kebeles and 37 rural kebeles. In the urban area of Shashemene, the ethnicity is diversified but in the rural area most people belong to Oromo ethnic group. The town is economically important and expanding quite rapidly compared to other towns. This is perhaps due to its location as a crossroad and a junction point for most towns located in the southern part of the country. According to Shashemene woreda health office report, the total population of Shashemene area was 239,011.

Sample size (n) was determined based on the assumption of 50% overall level of good knowledge of the community about TB, 0.05 expected margin of error (d) and 95% confidence level (Zα/2) and 10% contingency for non-response. A total of 422 participants were included in the study. The total number of households was proportionally allocated to four rural kebeles based on the number of households within each kebeles. The households in each kebele were selected using systematic random sampling technique, taking the list of households as the sampling frame. Any individual who was the resident of the area, age over 18 years old, apparently healthy and willing to volunteer to be interviewed during the study period was included in the study. Accordingly, the number of study subjects selected in each kebele was 79 from Turufe Kechema, 125 from Kerera Filicha, 118 from Fajii and 100 from Harabate kebele

The data was collected using structured questionnaire that was administered by data collectors (12th grade complete individuals) who were trained for this purpose. The participants were interviewed in their own local language (Oromiffa). Data consistency and completeness was checked throughout the data collection period, data entry and analysis. Data were coded and entered into computer using Stata version 16.8 Software. In the analysis, chi-square logistic regression analysis was performed to explore the association between outcomes and predictor variables. Overall knowledge of the study participants about TB was assessed using questioners. Overall knowledge of the study participants about TB was assessed using questions, such as source of information about TB, able to mention cause of TB, sign and symptoms of TB and mode of transmission of TB. For each question, a score of one was given to correct response and score of zero was given to the "do not know" response and incorrect answers. The overall knowledge score was obtained by summing these responses. The composite score was dichotomized using mean obtained from the data (that is, mean = 7.44). Individuals who have scored above and equal to the mean were categorized as having good level of knowledge and those who have scored below the mean knowledge score were classified as having poor level of knowledge.

The study protocol was approved by Aklilu Lemma Institute of Pathobiology (ALIPB) Institutional Review Board (IRB). The aim of the study was described to each study participant and verbal consent was obtained.

RESULTS

Socio-demographic characteristics of the study participants

A total of 422 participants from the four rural kebeles (age range 18 to 90, mean age 31.8 years) were interviewed and the response rate was 100%. Of these 79 (18.72%), 125 (29.62%), 118 (27.96) and 100 (23.7%) of participants were from Turufe Kechema, Kerera Filicha, Fajii and Harabate kebele, respectively. Of these, 213 (50.4%) were males and 209 (49.6%) were females. Fifty percent of the participants were between the age group of 15 to 29 years. The predominant ethnic group was Oromo (82.7%) and Muslims were the majority (65.4%). The majority of the participants were primary school (40.05%) and farmers (77.73%) by occupation (Table 1).

Knowledge about the mode of transmission and preventive methods of TB

Out of the 422 participants, 399 (94.6%) responded that

Table 1. Socio - demographic characteristics of the participants, and communities overall knowledge on TB Shashemene area, Southern Ethiopia, 2011.

Background characteristics		Number (%)	Level of knowledge score (max 13) good score (≥7.54)		P value	OR
			Know (%)	No know		
Sex	Male	213 (50.47)	122 (57.27)	91 (42.72)	0.00	1.13 (0.77, 1.67)
	Female	209 (49.6)	126 (60.28)	83 (39.72)		1
Age (in year)	18-30	252 (50)	143	109	0.44	0.51 (0.18, 1.47)
	31-40	91	63	28		0.23 (0.96, 0.91)
	41-50	44 (34.6)	25	19		0.51 (0.15, 1.67)
	51-60	20 (10.43)	11	9		0.55 (0.14, 2.12)
	60^{+}	15 (4.98)	6	9		1
Marital status	Married	335 (79.38)	197	51	0.11	0.99 (0.62, 1.6)
	others	87 (20.38)	138	36		1
Educational status	Illiterate	155 (36.73)	88	67	0.05	6.09 (0.74, 49.89)
	Read and write	21 (4.98)	8	13		13 (1.36, 124.29)
	Primary school	169 (40.05)	98	71		5.79 (0.71, 47.38)
	Secondary school	68 (16.11)	46	22		3.82 (0.45, 32.52)
	College	9 (2.13)	8	1		1
Occupation	Farmer	242 (57.3)	135	107	0.00	2.18 (1.07, 4.42)
	Merchant	10 (2.37)	5	5		2.75 (0.68, 11.2)
	Daily laborer	35 (8.29)	21	14		1.83 (0.71, 4.71)
	Gov't employee	4 (0.95)	2	2		2.75 (0.35, 21.75)
	House wife	86 (20.37)	52	54		1.79 (0.82, 3.96)
	students	45 (10.66)	33	12		1

they have heard about TB and the sources of information for the respondents were mainly from health workers 215 (53.9%) and from TB patients 73 (18.3%). Concerning their Knowledge on the transmission of the disease, only 39 (9.8%) participants mentioned that bacteria/germs are the causative agents of TB the rest of the participants mentioned other factors such as cold air 76 (19%), shortage of food 31 (7.8%) and smoking 18 (4.5%) as the cause of the disease (Table 2). There was no significant difference between the proportion of male and female study participants about knowledge on transmission of the disease ($p = 0.56$). More than 96% of the participants knew that TB is transmissible. The majority (68.9%) suggested cough for more than 2 weeks as the major symptom of TB (Table 2). There was no significant difference between the proportions

Table 2. Community knowledge about the cause and symptoms of TB, rural Shashemene, Southern Ethiopia, 2011.

Variable	Male No (%)	Female No (%)	Total No (%)	p-value
Have you heard about TB				
Yes	203(95.3)	196(93.8)	399(94.6)	0.490
No	10(4.7)	13(6.2)	23(5.4)	
Cause of TB				
Bacteria	16(7.5)	23(11)	39(9.2)	
Cold air	32(15.02)	44(21.05)	76(18.00)	
Shortage of food	20(9.9)	11(5.8)	31(7.9)	
Smoking	12(5.9)	6(3.1)	18(4.4)	
Alcoholism	22(10.8)	17(8.7)	39(9.8)	>0.05
Poverty	27(12.67)	28(14.3)	54(15.9)	
Dust	8(3.75)	7(3.35)	15(3.55)	
Climate change	8(3.75)	0(0)	8(1.9)	
Other	17(10.8)	15(10.2)	32(10.5)	
Do not know	47(22.06)	57(27.27)	104(26.64)	
Sign and symptoms of TB				
Cough for more than 2 weeks	137(67.8)	138(72.3)	275(70.0)	
Sputum with blood	28(13.9)	25(13.1)	53(13.3)	
Weight loss	17(7.98)	6(2.87)	23(5.45)	
Loss of appetite	10(4.69)	4(1.9)	14(3.31)	0.338
Fever/sweet	18(8.45)	18(8.45)	36(8.53)	
Chest pain	2(.93)	0	2(0.47)	
Do not know	4(1.87)	2(.96)	6(1.42)	

of male and female study participants who reported that the major sign and symptom of TB was cough for more than 2 weeks (67.82% vs. 72.25%, X^2 = 0.9168, P = 0.338). On the other hand, only 2 (0.51%) participants mentioned that chest pain is the symptom of TB. Furthermore, the others mentioned other signs and symptoms of the disease such as sputum with blood 53 (13.5%), weight loss 23 (5.9%) and fever/sweat 36 (9.2%) (Table 2).

Concerning the treatability of TB, the majority 389 (99%) of the participants knew that TB is treatable with modern drugs 366 (94.1%). Twenty three (5.9%) of the participants have suggested traditional medicine as the effective treatment for TB. Moreover, 94 (23.92%) participants reported that either themselves or their families had previously got TB and were treated with modern drugs at health facilities. High knowledge on the choice of modern drugs as the effective treatment for TB was significantly associated with educational level of the participants (AOR, 6.60; 95% CI, 1.16 to 37.63, p = 0.03).

The greater part (96.44%) of the participants knew that TB can be transmitted from a patient to another person: Breathing (40.1%) and sharing of drinking materials (34.6%) were the major modes of transmissions mentioned by the study participants. Thirty-nine percent of the study participants mentioned covering mouth while coughing as the most important method of preventing and control of TB. About 27% of the participants mentioned that they vaccinate their children with BCG to protect TB. Avoiding of smoking was indicated as a means of preventing TB by 27.2% of the study participants (Table 3).

Most of the study participants (67.2%) considered TB as a major public health problem in their areas. About 52.3% of the participants indicated that TB is becoming a major public health problem in recent years (Table 3). Among individuals who believed there has been a recent expansion of the disease, 23 (13.14%) respondents associated it with the spreading of human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) in the community. Others however, mentioned poverty (47.43%), climate change (28%), smoking and drinking (10.86%) and other factors. Most of the participants (69.0%) believed that TB can affect all

Table 3. Community's knowledge about mode of transmission and public health importance of TB, rural Shashemene, Southern Ethiopia, 2011.

Variable	Male (%)	Female (%)	Total (%)
Is TB transmissible			
Yes	192 (95.1)	187 (97.9)	379 (96.4)
No	5 (2.5)	2 (1.1)	7 (1.8)
Do Not know	5 (2.5)	2 (1.1)	7 (1.8)
Mode of TB transmission			
Cough	61 (28.63)	42 (20.09)	103 (24.4)
Sneeze	3 (1.4)	2 (0.96)	5 (1.18)
Breathing	70 (32.86)	82 (39.24)	152 (36.1)
Sharing Cups	67 (31.45)	64 (30.62)	131 (31.04)
Milk	1 (0.47)	0	1 (0.24)
Do Not Know	1 (0.47)	0	1 (0.24)
Is TB health problem			
Yes	134 (62.93)	130 (68.1)	264 (62.55)
Rare	41 (19.3)	29 (13.87)	70 (17.8)
No	21 (10.4)	26 (13.6)	47 (12.0)
Do not know	6 (3.0)	6 (3.1)	12 (3.1)
Preventive methods of TB			
BCG vaccination	61(31.6)	42(22.5)	103(27.2)
Keep Hygiene	5(2.3)	11(5.2)	16(3.8)
Vaccinate the children	54(23.3)	76(36.4)	130(0.8)
Avoid smoking	61(28.7)	53(25.21)	114(27.2)
Avoid drinking raw milk	1(0.46)	8 (3.8)	9(2.3)
Isolate patient with TB	12(5.6)	4(1.9)	16(7.8)
Cover mouth while coughing	69(32.4)	63(30.21)	132(31.27)

age groups.

Communities' overall knowledge about TB

Despite the fact that higher proportion of the study participants 243 (58.8%, 95% CI, 51.6% to 63.1%) had good level of knowledge about TB, almost all (90.2%) of them did not know the causative agent of TB. Farmer participants (OR = 2.18; 95% CI: 1.07 to 4.42) had low level of overall knowledge on TB. And relatively uneducated than being educated (OR = 13, 95% CI, 1.36 to 124.29, p = 0.05) had low level of overall knowledge about TB.

DISCUSSION

The results of this study show that TB is familiar to the rural communities for about 94.6% of the study participants (Table 2). However, few participants (9.2%) mentioned bacteria as the causative agent of TB. This finding is consistent with the studies conducted in other parts of Ethiopia (Legesse et al., 2010; Liefooghe et al., 1997; Alemayehu, 2007; Abebe et al., 2010) as well as elsewhere (Legesse et al., 2011; Mengesho et al., 2007; Karim et al., 2011). The majority of the respondents associated the cause of TB mainly with exposure to cold air, poverty, starvation, common cold, dust, frequent smoking/drinking alcohol or lack of hygiene. This finding is similar to beliefs found in a previous study in another part of Ethiopia (Legesse et al., 2010). While the community perception about the role of smoking and alcohol as the causative agent of the disease not neglected (Legesse et al., 2011), misconception about the correct cause of the disease could affect patient attitude towards health-seeking behavior and preventive methods (Liefooghe et al., 1997; Alemayehu, 2007;

Mesfin et al., 2005). Particularly, smoking could affect the care seeking behavior of smokers, as the smokers may perceive their prolong cough as the cause of smoking, but not TB which could lead to delayed diagnosis and treatment.

On the other hand, most of the study participants in the present study area (Shashemene rural area) had adequate awareness about the symptoms, mode of transmission and treatment of TB. This finding is in agreement with the results of the studies conducted in Ethiopia (Legesse et al., 2010; Liefooghe et al., 1997; Abebe et al., 2010) and in other countries (Legesse et al., 2011; Karim et al., 2011). The study participant's knowledge regarding the treatment of the disease using modern medicine was also very high compared to the results of previous studies conducted in other parts of Ethiopia (Legesse et al., 2010; Alemayehu, 2007), Tanzania (Mengesho et al., 2007) and Kenya (Legesse et al., 2011). Tuberculosis may be perceived by a community as a non-treatable disease due to inadequate knowledge about its appropriate treatments, which could lead to delayed diagnosis and treatment (Mengesho et al., 2007). However, based on the information obtained from the individual study participants' knowledge of early diagnosis and treatment, it seems to be poor in the communities in this study. This might be due to the fact that people may not suspect that early symptoms (coughing, fever, and sweating) are due to TB, unless accompanied by other severing symptoms (Legesse et al., 2010; Kaye and Frieden, 1996).

Moreover, the respondents from the study areas indicated that TB is one of the most important public health problems (67.1%) of the present study areas (Table 3), which is in consistence with the findings of the community based studies from other parts of Ethiopia (Legesse et al., 2010; Alemayehu, 2007; Abebe et al., 2010), as well as from Tanzania (Mengesho et al., 2007), Bangladesh (Karim et al., 2011), Kenya (Legesse et al., 2011), Vietnam (Hoa et al., 2009), and Tarlac city (Maria et al., 2009).

In this study, it was also noticed that rural communities' knowledge about the mode of transmission and preventive method of TB was high compared to previous findings (Legesse et al., 2010; Alemayehu, 2007; Abebe et al., 2010; Mengesho et al., 2007). Knowledge about those factors favoring TB transmission is important in protecting individuals living around TB patients. About sixteen present of the respondents considered poverty as a factor favoring TB transmission, which was higher compared to other factors like alcoholism and smoking. This result indicates that the majority of the respondents have wrong perception about factors that favor TB transmission. Although, the present study provides information on the level of community awareness about TB, it has limitations. One of the limitations is that the study was not supported by qualitative study which could provide additional information about the level of knowledge of the studied community about TB. The results of this study would be used as a baseline for further study to be conducted by the same researchers or other interested in a wider scope.

Conclusion

The findings of the study indicated that the majority of the rural community members in the study area had a basic awareness about TB. Nevertheless, there is a gap about the cause, mode of transmission, and preventive method of TB. Therefore, implementation of appropriate community-based health education is important to raise community's knowledge about TB. For this we recommend that the community awareness program about TB transmission through different communication media and health education program is necessary to raise communities' awareness about TB. Community workers should focus more on awareness creation programs through outreach activities to address knowledge about TB. As a shortcoming on this study we would like to recommend further qualitative study focusing on community knowledge of TB is important.

Conflict of interest

The authors have no conflict of interest

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Household location and self-assessed health among Brazilian adults living in large cities: A multilevel analysis

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This paper evaluated the effect of household location on self-assessed health among adults living in large cities, with adjustments for environmental characteristics inside and outside homes and for characteristics of the individual. The results showed that, in comparison with rural areas, urban areas were associated with better self-assessed health levels among adults. Although the adjusted analysis did not show any statistically significant difference in self-assessed health levels between the urban and rural areas, the study showed, independent of whether living spaces were urban or rural and the effect of living conditions in environments inside and outside homes, on self-assessed health levels.

Key words: Self-assessed health, household location, multilevel analysis.

INTRODUCTION

Urbanization is still considered to be the phenomenon with the greatest influence on socioeconomic and environmental conditions in developing countries (Martine and Mcgranahan, 2010). Different regions and states in a country present unequal urbanization and contrasts in population distribution between urban and rural areas (Giffoni, 2010). Rapid population growth with proper adaptation of infrastructure conditions is a threat to sustainable development and has consequences for urban populations such as pollution, environmental degradation, and unsustainability of production and consumption patterns (United Nations, 2014). Geib (2012) reinforced this idea by affirming that urbanization had worsened poverty and social exclusion, and had contributed towards maintenance of income inequalities and proliferation of poor-quality housing, thereby impeding development of the concept of healthy housing (Martine and Mcgranahan, 2010).

In developing countries, urbanization has taken place more rapidly and the rate of urbanization has presented a weaker correlation with economic growth than in developed countries (United Nations, 2013). While

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urbanization has brought positive opportunities for the population, especially in East and Southeast Asia, it has also brought negative effects for the health and well-being of the population, including that in Latin America, North and sub-Saharan Africa, the Caribbean, and South Asia (Muggah, 2014). From a systematic review, Eckert and Kohler (2014) concluded that in developing countries, urbanization is not significantly associated with greater life expectancy and that risk factors for chronic diseases are more prevalent in urban areas. These authors also highlighted higher mortality among children under the age of 5 years in urban areas, as indicators of worse quality of life.

Brazilian urbanization has been marked by profound spatial and social transformations characterized by a set of risk factors that include the following: unemployment, poor urban housing and working conditions, inadequate basic infrastructure conditions, and violence (Soares et al., 2014; Neto, 2011; Angel and Bittschi, 2014). These problems have tended to amplify the adverse effects on health, especially in the absence of any proactive attitude towards the population's needs (Martine and Mcgranahan, 2010).

Through the new paradigm for the health-disease process based on promotion and prevention, for which the expected result is improvement of the population's quality of life and well-being, studies within the field of public health that also take into account the attributes of urban spaces to explain health differences within urban populations have emerged over recent decades. However, the number of studies conducted in Brazil that have aimed to find associations between individual/contextual determinants of the housing location and self-assessed state of health remains small (Pavão et al., 2013). Thus, this point justifies conducting studies that take into account the environmental characteristics inside and outside homes, along with the individuals' characteristics.

This study had the objective of establishing the association between household location and overall self-assessed health, among adults in areas of high population in Brazil, using multilevel analysis. In evaluating this association, the control variables consisted of a set of characteristics relating to the individuals and the environments inside and outside their homes.

MATERIALS AND METHODS

National household sampling survey

The Brazilian National Household Sampling Survey (PNAD) is a series of complex sampling surveys of national coverage, conducted by the Brazilian Institute for Geography and Statistics (IBGE). For the 2008 survey, information on a probabilistic sample of 150,591 households and 391,868 individuals was gathered (IBGE, 2010).

The PNAD sample was planned such that representative estimates would be obtained for all of Brazil, major regions, federal states, and nine metropolitan regions. With regard to sample planning, PNAD was a cross-sectional study that used a complex sampling plan including stratification, unequal selection probabilities, and clustering of units into two or three selection stages, depending on whether the stratum was from self re-presentative or non-self-representative municipalities. For self re-presentative municipalities, the PNAD sampling plan was stratified according to municipality (stratum) and clustered into two stages, in which census tracts were the primary sampling unit and households were the secondary sampling units.

For non-self-representative municipalities, the sampling plan was stratified with strata formed by sets of non-self-representative municipalities according to size and geographical proximity, and clustered into three selection stages in which the non-self-representative municipalities were the primary sampling units, the census tracts were the secondary sampling units, and the households were the tertiary sampling units (Silva et al., 2002).

The PNAD sampling weights comprised the product of the natural weights of the design (the inverse of the selection probabilities at each stage) and an adjustment factor calculated as the ratio between the estimated and known (or projected) total populations (Silva et al., 2002).

Study population

The study population was formed by 92,745 Brazilian adults aged 20 years or more who declared what their overall state of health was. They were living in permanent private households located in large-population municipalities, that is, self-representative municipalities.

Multilevel ordinal logistic regression analysis

In this study, a multilevel ordinal logistic regression was fitted using the STATA 10 software. The model had four hierarchical levels, such that the adults were the first-level units, the households were the second-level units, the census tracts were the third-level units, and the municipalities were the fourth-level units (Carle, 2009). The hierarchical data structure corresponded to the characteristics of the PNAD sampling plan for the municipalities considered in this study, with the exception of the survey sample weights. Before fitting the multilevel model, an analysis was conducted to assess whether the sampling weights would be informative, that is, whether these weights would correlate with the outcome of interest in the presence of the structural variables of the sampling plan (Carle, 2009; Johnson, 2008).

To assess the need to fit a four-level multilevel model, a fitted model comparability test was also applied (chi-square test for pseudo-likelihood ratios).

The outcome from the model was self-assessed health, according to the following three-category ordinal scale: (1) poor/very poor; (2) fair; and (3) very good/good. Besides considering the household location, a set of 18 control variables that portrayed the characteristics of the individuals and the environments inside and outside their homes (census tract) were also considered in the linear structure of the model.

The characteristics of the adults (first-level unit) composed of 12 variables: sex, age group, color/race, schooling level, occupational situation, physical activity, smoking, self-reported morbidity, physical mobility, possession of a health insurance plan, consultation with a doctor within the last 12 months, and region of

residence. The characteristics of the households (second-level unit) composed of five variables: household registered with the family healthcare program, housing quality, possession of basic goods in the household, household occupation condition, and per-capita monthly household income. Lastly, the characteristics of the census tracts (third-level unit) consisted of the proportion of the households in the census tract that were considered to present adequate housing quality, that is, in relation to basic social services (water, sewage, garbage, and electricity), housing density, and housing construction standards. For the municipal level, no variable was included, other than identifying the municipality to incorporate and stratify the sample.

RESULTS

Among the adults living in large-population municipalities, 96.3% were living in households located in urban areas and the majority (72.3%) of them reported having a good/very good state of health, while 23.1% reported having a fair state of health and 4.6% reported having poor/very poor state. In relation to the control variable distribution, it can be highlighted that the greatest proportion of the adults lived in the southeastern region (51.7%), in households with the four basic goods (89.5%), and with adequate housing quality (66.3%). It was also observed that in these municipalities, there were greater proportions of adults who have never smoked (52,4%), who practiced physical activity (28.5%), who did not have any chronic diseases (53.7%), who did not have a health insurance plan (63.0%), who did not have physical limitations (65.6%), who had consulted a doctor within the last 12 months (76.3%), and who did not live in households registered with the FHP (66.1%) (Table 1).

In the preliminary analysis correlating the sampling weights with the outcome of self-assessed health among the adults, by means of multilevel modeling, it was observed, taking into consideration the hierarchical data structure (stratification and clustering of the units), that the sampling weights did not show any statistical correlation with the self-assessed health levels among the adults (p-value = 0.444), thus indicating that the sampling weights were uninformative and that there was no need to incorporate them into the analysis, in the case of this outcome in particular.

Table 2 presents the results from the fitted model comparability tests (chi-square test for pseudo-likelihood ratios). The results from the tests show that the multilevel model considering four hierarchical levels was the most appropriate one, that is, it was concluded that the random effects from the census tract and municipality separately (tests 1 and 4) or together (test 2) contributed significantly to the quality of the model. From test 3, it was also seen that the random effect of the household was significantly different from zero, when the other group effects (census tract and municipality) were kept in the model (χ^2=678.29; p-value<0.001).

From the four-level null model, that is, the ordinal logistic model that fitted only with the random intercepts at the levels of the households, census tracts and municipalities (Table 3), and variance partition coefficients (VPC) were obtained. Through the VPC calculation for the municipalities (fourth level), it was found that approximately 2.0% of the variation in the levels of self-assessed health was attributable to differences between the municipalities. The VPC for the census tracts (third level) indicated that 7.4% of the variation in the levels of self-assessed health was attributable to differences between census tracts within the same municipality. The VPC for the households (second level) was higher and showed that approximately 28% of the variation in the levels of self-assessed health was attributable to differences between households within the same census tract in the same municipality.

Although the proportion of the variation explained by differences between the municipalities was low (VPC≅2.0%), the municipal level was taken into account in analyzing the levels of self-assessed health because the considered municipalities represented the strata in the PNAD sampling plan.

In the multilevel model fitted only with the household location (Table 3), it was observed that the location presented a statistically significant effect on the levels of self-assessed health among the adults (OR=1.42; p-value<0.001). The odds ratio measurement of 1.42 indicated that the chance that the adults living in the considered municipalities would self-report a better state of health was 42% greater in the urban areas than in the rural areas. In comparison with the random part of the null model, it could be seen that the variance estimates of the random intercepts remained practically unaltered when the household location was introduced.

In fitting the multilevel model with the household location and all the 18 control variables that portrayed characteristics of the adults and the environments inside and outside the home, it was observed that only two variables of the environment inside the home (household occupation condition and FHP) did not present any significant effect. These were therefore excluded from the analysis, thus resulting in the model presented in Table 4. In controlling for the other variables, household location ceased to have a statistically significant effect on the levels of self-assessed health among the adults (OR=0.92; p-value=0.186).

In addition, after controlling for the association between household location and self-assessed health level using variables relating to the individuals and the environment inside and outside their homes (Table 4), it was observed that the variances of all the random intercepts of the model decreased, by the following percentages: 6.3% for the household level, 34.3% for the census tract level, and 35.7% for the municipality level. These reductions may have been due to differences in composition at house-

Table 1. Distribution of the adults according to the outcome of self-assessed health. The household location and the control (categorical) variables used in the multilevel analysis-large-population municipalities.

Variable	Distribution of the adults
Self-assessed health	
Poor/Very poor	4.6
Fair	23.1
Good/very good	72.3
Census tract location	
Urban	96.3
Rural	3.7
Region of residence	
North	6.6
Northeast	19.9
Southeast	51.7
South	13.6
Center-West	8.2
Sex	
Male	37.3
Female	62.7
Age group (years)	
20 to 29	21.8
30 to 39	22.6
40 to 49	21.2
50 to 59 y	16.4
60 and above	18.0
Color/Race	
White	51.5
Non-white	48.5
Schooling level (years)	
Illiterate or less than one year	7.3
1 to 7	30.3
8 to 14	50.5
15 and above	11.8
Information not provided	0.2
Per capita monthly household income	
No income or up to 1 minimum wage	40.8
More than 1 to 5 minimum wages	47.2
More than 5 minimum wages	8.2
Information not provided	3.8
Occupational situation	
Currently working	60.2
Unemployed	39.8

Table 1. Cont'd.

Physical activity	
Active	28.5
Not active	69.2
Information not provided	2.2
Smoking	
Smoker	14.0
Ex-smoker	16.3
Has never smoked	52.4
Information not provided	17.2
Self-reported morbidity	
At least one chronic disease	46.3
No chronic diseases	53.7
Physical mobility	
Very restricted	6.9
Restricted	11.9
Slightly restricted	15.6
Not restricted	65.6
Health insurance plan	
Yes	37.0
No	63.0
Medical consultation	
Yes	76.3
No	23.7
Family healthcare program	
Household registered in the FHP	33.9
Household not registered in the FHP	66.1
Household occupation condition	
Own	75.2
Rent	18.2
Ceded	5.9
Other	0.6
Household possession of basic goods	
Has the four basic goods	89.5
Does not have at least one basic good	10.5
Housing quality	
Adequate	66.3
Not adequate	33.7

hold, census tract, and/or municipality level, in relation to the variables added to the model.

In relation to the fixed part of the model fitted only with the main effects (Table 4), it was observed that the chance

Table 2. Results from the comparability test between a four-level null model (adult, household, census tract and municipality) and another null models with fewer hierarchical levels.

Comparability between null models with a four-level null model (AIC= 132,256.2)	Chi-square test for pseudo-likelihood ratios		AIC*
	χ^2	p-valor	
Test 1-Null model with three levels (adult household and census tract)	394.81	<0.001	132,649.0
Test 2-Null model with two levels (adult and household)	1,456.46	<0.001	133,708.7
Test 3-Null model with three levels (adult census tract and municipality)	678.29	<0.001	132,932.5
Test 4-Null model with three levels (adult household and municipality)	696.87	<0.001	132,951.1

* AIC: Akaike information criterion.

Table 3. Estimates for the ordinal logistic models of random intercepts with four levels for the outcome of self-assessed health among adults.

Model	Null model		Model with the variable census tract location		
	Odds ratio (OR)	Standard error	Odds ratio (OR)	Standard error	p-value*
Fixed part					
Census tract location	-	-	1.42	0.083	<0.001
Random part: Estimates for the variance of random intercepts					
2º level - Household	0.923	0.046	0.920	0.046	-
3º level - Census tract	0.251	0.012	0.248	0.012	-
4º level - Municipality	0.086	0.007	0.084	0.007	-

*Wald test.

of presenting a better state of self-reported health was 22.0% higher for women (OR=1/0.82=1.22; p-value<0.001) and became lower with increasing age group among the adults. The chance was 18% higher for the adults with white skin (OR=1.18; p-value<0.001), 21% higher for those with occupations (OR=1.21; p-value<0.001), 41% higher for those who had health insurance plans (OR=1.41; p-value<0.001), 85% higher for those who had not consulted a doctor within the last 12 months (OR=1/0.54=1.85; p-value<0.001), more than four times higher for those who did not have any chronic diseases (OR=1/0.23=4.3; p-value<0.001), 44% higher for those who practiced physical activity (OR=1.44; p-value=<0.001), 25% higher for nonsmokers in comparison with smokers (OR=1/0.80=1.25; p-value<0.001), and 19% higher for nonsmokers in comparison with former smokers (OR=1/0.84 =1.19; p-value<0.001).

It was also observed that the chance of self-reporting a better state of health was 6% higher for adults living in households with adequate housing quality (OR=1.06; p-value=0.027), and 28% higher for those living in households with all the basic goods (OR=1.28; p-value<0.001). Furthermore, it was found that the chance that an adult would report a better state of health increased by 35% with an increase of one percentage point in the proportion of households with adequate housing quality in the census tract (OR=1.35; p-value<0.001).

Taking the central-western region as the reference category, it was observed that in the northern region (OR=0.86; p-value=0.007) and northeastern region (OR=0.75; p-value<0.001), there was a lower chance that an adult would self-report a better state of health, while in the southern region (OR=1.10; p-value=0.076) and southeastern region (OR=1.07; p-value=0.155), there was a higher chance, although the association found for the last two regions was not significant. It was also observed that the chance of better self-assessed health among the adults increased with increasing schooling level and per-capita household income, and this decreased with increasing physical mobility problems.

DISCUSSION

This study using multilevel analysis sought to establish the relationships between self-assessed health levels and a set of factors relating to individuals and their environment, for a complex sample of adults living in large-population municipalities.

Table 4. Multilevel analysis on self-assessed health among adults: estimates for ordinal logistic models of random intercepts with four levels, including the significant main effects.

Variable	Model of random intercepts with four levels, including the significant main effects		
	Odds ratio (OR)	Standard error	p-value*
Fixed Part			
Census tract location			
Urban	0.92	0.061	0.186
Rural	1	-	-
Region of residence			
North	0.86	0.055	0.007
Northeast	0.75	0.047	<0.001
Southeast	1.07	0.047	0.155
South	1.10	0.053	0.076
Center-West	1	-	-
Sex			
Male	0.82	0.021	<0.001
Female	1	-	-
Age group			
20 to 29 years	1.49	0.039	<0.001
30 to 39 years	1.29	0.036	<0.001
40 to 49 years	1.01	0.033	0.772
50 to 59 years	0.82	0.032	<0.001
60 years or +	1	-	-
Color/race			
White	1.18	0.022	<0.001
Non-white	1	-	-
Schooling level			
Illiterate or less than one year	0.43	0.056	<0.001
1 to 7 years	0.46	0.047	<0.001
8 to 14 years	0.68	0.044	<0.001
15 years or +	1	-	-
Information not provided	0.41	0.224	<0.001
Per capita monthly household income			
No income or up to 1 minimum wage	0.51	0.056	<0.001
More than 1 to 5 minimum wages	0.68	0.052	<0.001
More than 5 minimum wages	1	-	-
Information not provided	0.68	0.074	<0.001
Occupational situation		-	-
Currently working	1.21	0.022	<0.001
Unemployed	1	-	-
Physical activity			
Active	1.44	0.025	<0.001

Table 4. Cont'd.

Not active	1	-	-
Information not provided	0.42	0.062	<0.001
Smoking			
Smoker	0.80	0.029	<0.001
Ex-smoker	0.84	0.027	<0.001
Has never smoked	1	-	-
Information not provided	0.96	0.027	0.091
Self-reported morbidity			
At least one chronic disease	0.23	0.025	<0.001
No chronic diseases	1	-	-
Physical mobility			
Very restricted	0.11	0.044	<0.001
Restricted	0.14	0.033	<0.001
Slightly restricted	0.37	0.028	<0.001
Not restricted	1	-	-
Health insurance plan			
Yes	1.41	0.025	<0.001
No	1	-	-
Medical consultation			
Yes	0.54	0.027	<0.001
No	1	-	-
Housing quality			
Adequate	1.06	0.028	0.027
Not adequate	1	-	-
Household possession of basic goods			
Has the four basic goods	1.28	0.030	<0.001
Does not have at least one basic good	1	-	-
Proportion of the households with adequate housing quality	1.35	0.052	<0.001
Random Part: Estimates for the variance of random intercepts			
2º level - Household	0.862	0.053	-
3º level - Census tract	0.163	0.013	-
4º level - Municipality	0.054	0.006	-

*Wald test.

The results showed that, in comparison with rural areas, urban areas were associated with better levels of self-assessed health among the adults. However, after controlling for variables relating to the individuals and the environment inside and outside their homes, the association between the household location and self-assessed health ceased to present any significant effect. Moreover, after controlling for these variables, it was observed that the variance estimates for the random intercepts of the model underwent reductions, thus show-

ing that there was a compositional effect from the housing location (municipality, census tract, and/or household) on the levels of self-assessed health among the adults. Like in this study, Oliveira et al. (2014) observed in their analysis that individuals living in urban areas had a greater chance of reporting a better state of health than those living in rural areas. In the same way, these authors did not find any significant association between the area in which the home was located and self-assessed health when they used an ordinal (that is, non-multilevel) logistic model that included variables of socioeconomic, demographic, and health-related nature.

In this study, only those adults who declared their state of health were taken into consideration. Those whose state of health was informed by other people living in the same household, or even by other people not living in the household, were excluded, given that the information provided by third parties could increase the chance of bias regarding the overall state of health. Self-assessed health is an indicator that has been surveyed in different population-based investigations within the field of healthcare, and this has been done for several reasons: its ease of measurement or application (Höfelmann and Blank, 2007); its reliability and validity as a measurement (Barros et al., 2009; Freitas et al., 2009; Peres et al., 2010); its capacity for international comparisons (Theme-Filha et al., 2008); its intrinsic subjective nature (Nogueira, 2008); its strong association with the real state of health (Camargos et al., 2009); and its capacity as a sensitive predictor of morbidity and mortality (Silva and Menezes, 2007; Idler and Benyamini, 1997).

Because of the hierarchical structure of the PNAD data, in which the adults are grouped in household units that are grouped in census tracts, which in turn are grouped in municipalities, a multilevel ordinal logistic regression model with four hierarchical levels (adult, household, census tract, and municipality) was used in this study. This model is appropriate for analyzing data from surveys that have some type of correlation structure, such as longitudinal surveys or those that use clustering, such as the PNAD surveys.

Multilevel analysis is one of the types of regression analyses that simultaneously takes into consideration multiple levels of aggregation, thereby making the standard errors, confidence intervals, and hypothesis tests correct (Laros and Marciano, 2008). In addition, this type of analytical approach does not only enables inclusion of random intercepts that represent the heterogeneity between the groups relating to the outcome of interest, but also makes it possible to consider random coefficients that, in turn, represent the heterogeneity in the relationship between the outcome and the explanatory variables (Rabe-Hesketh et al., 2011).

It also needs to be mentioned that some difficulty is involved in fitting this type of model in situations of complex samples, because of the need to incorporate not only information from the sampling plan (stratification, clustering, and sample weights), but also from the hierarchical data structure. Nevertheless, by taking into consideration only the adults living in the self-representative municipalities, the hierarchical levels of the variables were made to coincide with the survey clustering and stratification structure that was used in these municipalities. In fitting the model using the GLLAMM software, the municipal stratum was taken to be a random effect of higher level (Sterba, 2009).

In this study, it was found that there was no relationship between the sampling weights and the study outcome. It was thus concluded that the sample weights were uninformative (Asparouhov et al., 2004), and for this reason, they were not taken into consideration in the multilevel modeling.

One of the limitations of this study may lie specifically in the definitions of urban and rural areas that are used in Brazil, which are political-administrative definitions based on municipal laws. The other limitation relates to non-inclusion of other variables of importance for explaining the variation in adults' health levels, such as variables relating to nutrition and atmospheric pollution, since these did not form part of the PNAD supplement relating to health in 2008.

Independent of whether the living spaces were urban or rural, this study showed the effect of living conditions in environments inside and outside homes on self-assessed health levels among adults in these municipalities, that is, it concluded that adults who reported better health levels lived in homes of adequate housing quality, had all the basic goods, had higher per-capita household income, and lived in census tracts with higher percentages of homes of adequate housing quality. In relation to the housing question, Angel and Bittschi (2014) also obtained evidence of the effect of poor housing conditions on negative self-perceptions of health. In addition, they observed that the likelihood of suffering from chronic diseases was higher when housing problems accumulated over the course of time.

Furthermore, it was observed that there was an effect on self-reported health coming from individual factors (sociodemographic, health-related, and behavioral and lifestyle factors). Many of these factors were also shown to be associated with worse self-assessments of health in the study by Pavão et al. (2013), such as being in older age groups, having lower schooling levels, being a smoker or former smoker, not doing physical activity, and having a chronic disease.

Therefore, the need for urbanization to be guided through more effective governance is emphasized, with the aim of not worsening the social and environmental problems that exist in Brazilian cities. Urbanization should be accompanied by social and healthcare policies, so as to avoid its adverse effects on the population's health.

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Conflict of interests

The author(s) have not declared any conflict of interests.

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