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Full Length Research Paper

Determinants of modern contraceptive use among fertile women in Debark districts, North West Ethiopia

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This study examined and identified the determinants of modern contraceptive use among fertile women in Debark district. In order to meet the objective descriptive, multiple logistic regression and multilevel logistic regression statistical techniques were used for data analysis. The results of multiple logistic regressions showed that health center, place of residence, marital status, access to media, environmental condition, frequency of modern contraceptive use, type of modern contraceptive and HIV test are significant determinant factors of modern contraceptive use in Debark districts. The results of multilevel logistic regression analysis showed that the random intercept and the fixed coefficient model provided the best fit for the data under consideration. The variance of the random component related to the intercept term was found to be statistically significant, implying differences in the distribution of modern contraceptive use in the health center. It also found that place of residence, marital status, environmental conditions, access of media, frequency of modern contraceptive use, type of modern contraceptive and HIV test were significant determinant factors of distribution of modern contraceptive among health center.

Key words: Determinants, modern contraceptive use, debark.

INTRODUCTION

In Eastern and Southern Africa, injections and implants are the most popular methods, accounting for over 40% of contraceptive (Giusti and Vignoli, 2016). Traditional methods, generally not recommended as contraceptives because of their lower effectiveness in preventing pregnancy, are still commonly used in Middle Africa, West Africa, Western Asia and Eastern Europe, where 65, 37, 35 and 32%, respectively, of women of

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Table 1. Independent variables.

Variable	Representation of variables	Categories
Place of residence	x_1	0=Urban, 1=Rural
Marital status	x_2	0=Married, 1= Unmarried
Environmental condition	x_3	0=Cool, 1= Tropical
HIV test	x_4	0=No, 1=Yes
Frequency of modern contraceptive use	x_5	0=Never, 1=Rarely, 2=Quite often, 3=Always
Access of media	x_6	0=No, 1=Yes
Health center name	x_7	0=Dibbahir, 1=Adigagira, 2=Dawe, 3=Abayseqar, 4=Belles, 5=Trahiyina, 6=Seramidergemes, 7=Atamta, 8=Argnjona
Modern contraceptive type	x_8	0=No, 1= Condom, 2= Implanol, 3 = IUCD, 4 =Jadel, 5=Oral contraceptive

reproductive age who are married or in union and are currently using a method of contraceptive rely on a traditional method (Oyedokun, 2004). In Azerbaijan, for instance, 64% of contraceptive users rely on withdrawal (Short and Kiros, 2002). The relatively high birth rate in Nigeria, which has been accompanied by steady declines in death rates has resulted in high rates of population growth. Within the last four decades, there have been increasing pressures towards family limitations in Nigeria. These are results of rapid growth of the large towns, very great extension of educational facilities, and among the elite, the far greater difficulty of securing top jobs that have come with independence (Ebigbola and Ogunjuyigbe, 1998). Unfortunately, this is almost impossible to achieve since all the available evidence indicates that the rate of growth of the economy has been lower than the rate of growth of the population. Standards of living tend to worsen when the rate of population growth exceeds the rate of economic growth (Feyisetan and Bamiwuye, 1998).

The continuing growth of the world population has become an urgent global problem. Ethiopia, like most countries in sub-Saharan Africa, is experiencing rapid population growth. Currently, the country's population is growing at a rate of 3%, one of the highest rates in the world and if it continues unabated, the population will have doubled in 23 years, preventing any gain in the national development effort (Beekle and McCabe, 2006; Tizta et al., 2014).

Sexually active young women worldwide are at high risk of pregnancy, largely because they use ineffective methods or use contraceptive intermittently. Often those who use effective hormonal methods, the pill and the injectable as well as condoms, have high discontinuation rates (Pachauri and Santhya, 2003).

However, the implant, another hormonal method, which became available in the 1990s, has helped young women to use effective method successfully, contributing to recent declines in teenage pregnancy in the United States (Harper, 2004).

The use of modern contraceptive methods prevents unintended pregnancy, which is associated with many negative health consequences (White and Speizer, 2007). Everyday, more than 400,000 contraceptives taken around the world, of which about half are deliberate, while the other half is unintentional (Preston and Sapienza, 1990). This high level of unwanted fertility leads to high fertility and population growth rate that remain a significant impediment to development. In many developing countries, increase in population size coupled with low technological development contributed to deforestation, soil degradation and species loss. In other words, to support more people more food should be produced. To produce more food, more resources are required in food production, which causes depletion of natural resources (Preston and Sapienza, 1990).

The general objective of this study was to identify determinants of modern contraceptive use among fertile women in Debark districts. While the specific objectives are (1) to identify socioeconomic, demographic and other proximate determinants of modern contraceptive use methods among fertile women in Debark districts and (2) to examine the extent of variation in contraceptive use within and between the health center and an environmental condition of Debark districts as shown in Table 1.

MATERIALS AND METHODS

Source of data

The data for this study was taken from the 2015 Debark district health office (secondary data) collected in North Gondar zone health office. The data were analyzed using SPSS and Stata.

Dependent variable

The response variable of this study is status of modern contraceptive use of fertile women in Debark districts in the health center. The response variable for the i^{th} individual is represented by Y_i and it measures a type of modern contraceptive use and it is dichotomized with 0 women being short act modern contraceptive use (Pill or Oral contraceptive, Condom and injection) and 1 woman being long act modern contraceptive used (Implanol, IUCD, Jadel, etc.).

Independent variables

In this study, possible determinants of modern contraceptive use were grouped as demographic, socioeconomic, environmental and other related factors.

Experimental

In clinical situations, the status of a patient is assessed by the presence or absence of a disease. There are many factors to consider which may or may not correlate with the incidence of the disease. There has been numerous retrospective medical research studies published each year that review past medical records and charts of former patients to help determine some of the risk factors (or causing agents) of diseases that are of interest. Finding the determinants and the potential factors can help to know and prevent the attitudes of contraceptive users. All the diseases and nearly all of the risk factors considered are categorical variables (variables taking on two or more possible values) (Hosmer and Lemeshow, 1989).

Logistic regression is a statistical technique for predicting the probability of an event, given a set of predictor variables. The procedure is more sophisticated than the linear regression procedure. The binary logistic regression procedure empowers one to select the predictive model for dichotomous dependent variables. It describes the relationship between a dichotomous response variable and a set of explanatory variables. The explanatory variables may be continuous or discrete. The logistic model, as a non-linear regression model, is a special case of generalized linear model where the assumptions of normality and constant variance of residuals are not satisfied (Mccullagh and Nelder, 1989).

Generally, when the dependent variable is dichotomous (such as presence or absence, success or failure, etc.), binary logistic regression is used. The logistic regression is also preferred to multiple regression and discriminant analysis as it results in a meaningful interpretation, it is mathematically flexible and its distribution is easy to use and it requires fewer assumptions (Hosmer and Lemeshow, 1989).

The best approach to the analysis of multilevel data is an approach that represents within-group as well as between group relation within a single level analysis, where ‘group’ refers to the units at the higher levels of the nesting hierarchy (Snijders and Bosker, 1999).

RESULTS

A total of 1084 fertile women were included in the study from Debark districts. The initial population consists of 26714 women who were modern contraceptive users on their background characteristics as well as reproductive health issues. Out of which 1084 women have complete measurements and were considered in this study and others were excluded due to the major socioeconomic and demographic background characteristics of the respondents are incomplete of data on the variables which are considered in the analysis shown in Table 2. Among 1084 fertile women, 57.6% reside in the urban area and 42.4% are residing in the rural area. Higher short-term modern contraceptive use occurred in a woman who resides in an urban area (53.3%) as compared to women who reside in rural areas (38.6%).

Table 2 also shows that, among the total respondents, 66% of them had lived in tropical environmental conditions and higher short-term modern contraceptive use was observed (63%), while 55.1% of women were short-term modern contraceptive users. The proportion of frequency of modern contraceptive use is also considerably higher for women (7.9%) in the short term as compared to those who are always in the long term. Furthermore, the proportion of women who have got the access to media about modern contraceptive use varied by media access. The majority of respondents, 84.9% of them had no media access well.

The majority of respondents (85.6%) were married. While only 80.1% married were short-term modern contraceptive user and 5.5% of the married women were long-term modern contraceptive users.

Likelihood-Ratio test

Under model summary in Table 3, it was observed that -2Log likelihood statistics were 49.133[a]. This statistic showed us how much improvement is needed before predictors provide the best possible prediction of the response variable, the smaller the statistics the better the model. The statistics for only intercept model is $-2\text{LLo} = 525.381 + 49.133\text{a} = 574.514\text{a}$.

The inclusion of the parameters reduced the $-2\ \text{Log Likelihood}$ statistics by, 525.38, which is reflected Chi-square for the omnibus test. The result ($\chi^2 = 525.381,\ \text{d.f} = 16$, p-value<0.001), showed that the model is adequate, meaning that at least one of the predictors is significantly related to the dependent variable. That of the null hypothesis is that there is no difference between the model with only a constant and the model with independent variables was rejected

Table 2. Distribution of socioeconomic, demographic, environmental and health-related determinant of modern contraceptive in Debark districts.

Variable	Categories	Counts (%)	Women use of modern contraceptive		Df	Chi-Square	P-Value
			Long [No. (%)]	Short [No. (%)]			
Health center	Dibbahir	112 (10.3)	7 (0.6)	95 (8.9)	8	56.382	0.000
	Adigagra	128 (11.9)	5 (0.5)	122 (11.3)			
	Dawe	101 (9.4)	8 (0.7)	8.7% (93)			
	Abayseqar	117 (10.8)	7 (0.6)	110 (10.1)			
	Belles	57 (5.3)	13 (1.2)	44 (4.1)			
	Trahina	369 (34)	0.9% (10)	359 (32.8)			
	Seramidergemes	68 (6.3)	0.6% (6)	62 (5.4)			
	Atamta	71 (6.5)	1.5% (16)	55 (5)			
	Argnjona	61 (5.6)	2.1% (23)	38 (3.5)			
Place of residence	Urban	624 (57.6)	42 (3.9)	582 (53.3)	1	3.369	0.032
	Rural	460 (42.4)	46 (4.2)	414 (38.6)			
Environmental condition	Cool	369 (34)	55 (5.1)	28.9% (314)	1	37.363	0.009
	Tropical	715 (66)	33 (3)	682 (63)			
HIV test	No	408 (37.6)	9 (0.8)	399 (38.8)	1	30.659	0.048
	Yes	676 (62.4)	79 (7.3)	597 (55.1)			
Modern contraceptive method used	Oral contraceptive	969 (89.4)	2 (0.2)	967 (89.2)	5	8.537E2	0.000
	Condom	3 (0.3)	(0)	3 (0.3)			
	Implanol	60 (5.5)	38 (3.5)	22 (2)			
	Jadell	4 (0.4)	2 (0.1)	2 (0.1)			
	Iucd	2 (0.2)	(0)	2 (0.3)			
	No	46 (4.2)	46 (4.2)	(0)			
Frequency of modern contraceptive use	Never	43 (4)	34 (4)	0	3	8.061E2	0.000
	Rarely	66 (6.1)	40 (3.7)	26 (2.4)			
	Quite often	889 (82)	5 (0.5)	884 (81.5)			
	Always	86 (7.9)	0	86 (7.9)			
Access of media	No	920 (84.9)	82 (7.6)	838 (77.3)	2	5.15	0.005
	Yes	164 (15.1)	7 (0.6)	157 (14.6)			
Marital status	Married	928 (85.6)	60 (5.5)	868 (80.1)	2	23.609	0.047
	Unmarried	156 (14.4)	28 (2.6)	128 (11.8)			

Table 3. Model summary of binary logistic regression model.

-2 Log likelihood	Cox and Snell R Square	Nagelkerke R Square
49.133[a]	0.404	0.939

Table 4. Omnibus tests of model coefficients.

Variable		Chi-square	df	Sig.
	Step	525.381	16	0.000
Step 1	Block	525.381	16	0.000
	Model	525.381	16	0.000

Table 5. Hosmer and Lemeshow test.

Chi-square	Df	Sig.
21.104	8	0.007

Another method of assessing the overall fit of the logistic regression model is an Omnibus test of model coefficients. Based on the results in Table 4, the null hypothesis shows that there is no difference between the model with only a constant and the model with independent variables was rejected.

Hosmer and Lemeshow test

Since Table 5 shows the p-value as 0.007 which is less than 0.05, then we reject the null hypothesis that there is no difference between observed and model predicted values, implying that the model fitted the data well.

Two additional descriptive measures of goodness of fit presented in Table 3 are R^2 indices defined by Cox and Snell (1989) and Nagelkerke (1991). These indices are variations of the R^2 concept defined in the ordinary least square regression model. The NagelkerkeR^2 was 93.9% indicating that the explanatory variables were useful in predicting the presence or absence of modern contraceptive in Debark district.

Classification table

The classification of Table 6 showed that 98.7% of the women in long-term modern contraceptive were correctly classified, whereas 99.7% of the women in short-term modern contraceptive user were correctly classified. The overall correct prediction was 99.6%, which is an improvement over the chance level.

Multiple logistic regression analysis

Health center, place of residence, marital status, environmental condition, HIV test, the frequency of modern contraceptive use, access of media and the type of modern contraceptive use found to be significant predictors for the determinant of modern contraceptive use at 5% level of significance. Thus, the estimated model is given by:

$$\text{logit}(\pi(X)) = \beta_0 + \sum_{i=1}^{9} \beta_{1i}\text{hlce}_i + \sum_{i=2}^{2} \beta_2\,\text{PlR}_1 + \sum_{j=1}^{2} \beta_{3j}\text{marSta}_j + + \sum_{l=1}^{5} \beta_{4l}\,\text{co1tyi}_l + \sum_{i=2}^{2} \beta_5\,\text{AcMe}_{1i} + \sum_{m=1}^{4} \beta_{6m}\text{FeqCo}_m + \sum_{n=1}^{2} \beta_{7n}\text{EnvCon}_n \sum_{i=1}^{2} \beta_{8n\ \text{HIVT}}$$

where $\pi(X)$ = predicted modern contraceptive use term, β_0 = constant, PlR_1 = place of residence of women at level 1, wel1in_k = women of wealth index level i, marSta_j = marital status of women at level j, co1tyi_l = contraceptive type of women at level i, AcMe_1 = access media of women at level 1, EmSt_1 = employment status of women at level 1, EnvCon_n = environmental condition at the level of 1, FeqCo_m = frequency contraceptive of level *m*.

The final logistic regression equation consisting of the significant variables is given by:

$$\text{logit}(\pi(X)) = 47.724 + 2.447\text{Hl}_1 + 2.890\text{Hl}_2 + 2.287\text{PlR}_1 - 4.441\text{EnvCo}_1 - 46.598\text{Cont}_1 - 46.598\text{Cont}_2 + \cdots\cdots\cdots - 20.143\text{Cont}_2 + -3.534\text{HIVT}_1 - 46.598\text{Freq}_1 + \cdots\cdots\cdots\cdots - 20.143\text{FreqC}_2 - 3.506\text{AcMe}_1 - 1.326\text{MaSta}_1$$

The logistic model showed that the likelihood of having determinant of modern contraceptive was significantly associated with the geographical health center. Women who live in the Atamta Health Center were 105.606 times more likely to have modern contraceptive use than Dibbahir Health Center controlling other variables in the model (OR=105.606; 95% CI: 0.183-6.082E4). Similarly, women who lived in the Dawe Health Center were 17.985 times more likely to have modern contraceptive use than Dibbahir Health Center controlling other variables in the model (OR=17.985; 95% CI: 0.524 - 617.440). Moreover, women who live in Trahina and Argnjona were more likely to have modern contraceptive use than Dibbahir Health Center. Unlike the odds of having modern contraceptive use among women who live in Adigagra, Abayseqar, Seramedergemes and Bellese, they are not significantly different from those of women who live in the Dibbahir Health Center.

Place of residence has a significant association with the determinant of modern contraceptive use. Women who reside in a rural area were 9.848 times less likely to have modern contraceptive than those who reside in urban area controlling for other variables in the model (OR=9.848; 95% CI: 0.285-346.277). Women who live in tropical environmental condition were 1.8% less likely to have modern contraceptive use than women who had a cool environmental condition (OR=0.012; 95% CI: 0.000-4.342).

Furthermore, access to media is also a significant factor associated with the determinant of modern contraceptive use. Women who get access of health center were 84.4% less likely not to access media as compared to women who cannot get access to media from their homes, controlling for other variables in the model (OR=5.833; CI: 0.016 - 0.300).

Multilevel logistic regression analysis

A Chi-square test statistic was applied to assess heterogeneity in the proportion of women who had determinants of modern contraceptive use among the nine health centers. The test yield $\chi^2 = 56.382$, df = 8, P < 0.001. Thus, there is an evidence for heterogeneity with respect to the distribution of modern contraceptive use among health center.

Multilevel logistic regression model comparison

Table 7 shows the predicted probability of modern contraceptive use by health center with predictors, place of residence, environmental condition, wealth index, the frequency of modern contraceptive use, type of modern contraceptive use, marital status and access of media, and HIV test. Then the maximum health center varied for predicted probability range as observed among variables in the short term of modern contraceptive. These variables have high random effects on modern contraceptive as compared to the other predictor variables and they are also used in the random coefficient model.

Multilevel empty with random intercept logistic regression analysis

The deviance-based Chi-square (χ^2=82.32, P-value<0.0001) shows empty with random effect better than the empty model without random effect (Table 8). According to the result of Table 9, the variance of the random factor $(\text{Estimate} = -25.75024, \text{S.E} = 6.68879)$ and the Wald test statistic is the square of Z, where $Z^2 = (-25.75024/6.68879)^2 = 14.82066$ which is compared with a chi-squared distribution with 1 degree of freedom becoming a p-value less than 0.05. This can be further interpreted as the average probability of modern contraceptive use in health center as: $\exp(-1.451899)/[1 + \exp(-1.451899)] = 0.126$; the intra-region correlation coefficient (rho) is a measure of variation of the determinant of modern contraceptive use among fertile women within the health center. The intra health center correlation (intra correlation coefficient) in intercept-only model is (ICC=0.1288), meaning that 12.88% of the variation in the distribution of the determinant of modern contraceptive use can be explained by grouping in Debark district health centers (higher level units). The remaining 87.12% of the variation is explained within Debark district health centers (lower level unit).

Multilevel random intercept logistic regression analysis

In multilevel random intercept logistic regression model, the probability of the determinant of modern contraceptive use was allowed to vary across health center, but assumed that the effects of explanatory variables are the

Table 6. Classification table of model with predictor variable.

Observed		Predicted		
		Contraceptive term		Percentage correct
		Long	Short	
Contraceptive term or acting	Long	87	1	98.7
	Short	3	993	99.7
Overall Percentage		-	-	99.6

Table 7. Distribution of modern contraceptive use in Debark districts.

Variable	Categories	B	S.E	Wald	Df	Sig.	Exp(B)	95.0% CI for EXP(B)	
								Lower	Upper
Health centre	Dibbahir (Ref)	-	-	5.076	8	0.651	-	-	-
	Adigagira	2.447	2.524	0.940	1	0.332	11.554	0.082	1.627E3
	Dawe	2.890	1.804	2.565	1	0.109	17.985	0.524	617.440
	Abayseqar	17.099	2.777E3	0.000	1	0.995	2.667E7	0.000	-
	Belles	16.741	2.145E3	0.000	1	0.994	1.864E7	0.000	-
	Trahina	15.836	-	-	1	0.000	-	-	-
	Seramidergemes	13.641	4.352E3	0.000	1	0.997	8.396E5	0.000	-
	Atamta	4.660	3.243	2.065	1	0.151	105.606	0.183	6.082E4
	Argnjona	-3.179	1.505	4.462	1	0.035	0.042	0.002	0.795
Place of residence	Rural (Ref)	-	-	-	-	-	-	-	-
	Urban	2.287	1.807	1.602	1	0.206	9.848	0.285	340.277
Environmental condition	Cool (Ref)	-	-	-	-	-	-	-	-
	Tropical	-4.441	3.015	2.170	1	0.141	0.012	0.000	4.342
Modern contraceptive method used	No (Ref)	-	-	0.000	5	1.000	-	-	-
	Condom	-46.598	5.559E3	0.000	1	0.993	0.000	0.000	-
	Implanol	-16.675	3.029E3	0.000	1	0.996	0.000	0.000	-
	Iucd	-20.143	1.167E4	0.000	1	0.999	0.000	0.000	-
HIV test	No (Ref)	-	-	-	-	-	-	-	-
	Yes	3.534	1.865	3.592	1	058	34.270	0.886	1.3253
Frequency of modern contraceptive use	Never (Ref)			0.000	3	1.000			
	Rarely	-46.598	5.559E3	0.000	1	0.993	0.000	0.000	.
	Quite often	-16.675	3.029E3	0.000	1	0.996	0.000	0.000	.
	Always	-20.143	1.167E4	0.000	1	0.999	0.000	0.000	.
Access of median	No (Ref)								
	Yes	-3.506	1.452	5.833	1	0.016	0.030	002	.517
MarSta	Married (Ref)	-	-	-	-	-	-	-	-
	Unmarried	-1.326	1.213	1.195	1	0.274	0.266	025	2.861
Constant	-	47.724	1.489E4	0.000	1	0.997	5.322E20	-	-

Table 8. Summary of multilevel logistic regression model selection criteria based on deviance based chi-square test statistics.

Variable		Empty model	Random intercept model	Random coefficient model
Model selection criteria	-2*log likelihood	34.902	75.2228	557.7424
	Deviance Based Chi-square test	82.32	42.61157	2.326708
	P-value	0.0000*	0.0000*	0.0000*
Model fit diagnosis	AIC	38.9038	121.2231	603.742
	BIC	128.6952	204.0262	608.731

Table 9. Results of random intercept multilevel logistic model analysis.

Fixed effect covariates		Coefficient	P-value
Place of residence	Urban (Ref)	-	-
	Rural	-0.181649	0.036*
Marital status	Married (Ref)	-	-
	Unmarried	0.5354292	0.008*
Access of media	No (Ref)	-	-
	Yes	0.9842702	0.040*
HIV test	No (Ref)	-	-
	Yes	-1.181649	0.003*
Frequency of modern contraceptive use	Never (Ref)		
	Quite often	24.12678	0.021*
	Rarely	-1.672184	0.973*
	Always	-0.4038004	0.001
Modern contraceptive type	No (Ref)		
	Condom	-1.610273	0.000*
	Implanol	-0.2548795	0.864
	Iucd	-2.5487021	0.020
	Jadel	-0.5016098	0.004
	Oral contraceptive	0.7844987	0.082
Environmental condition	Tropical (Ref)		
	Cool	-0.5354292	0.011*
Constant		1. 26334	0.019

Random part	**Estimate**	**S.E**	**Z-value**	**P-value**
Level-two variance(σ^2_0=Var(u_{0j}))	0.429147	0.2496218	9.32	0.000

Model selection criteria		
Deviance	75.2228	
Deviance Based Chi-square	426.1157	0.019
AIC	121.2231	

Table 10. Results of empty random intercept multilevel logistic regression model analysis.

Fixed part	Coefficient	S.E	Z-value	P-value
$\beta_0 = \text{intercept}$	-1.4518998	0.036585	-3.87	0.000*
Random part	**Estimate**			
Level two variance (σ^2_0=Var(u_{0j}))	-25.75024	6.648879	-4.8123	0.0241*
Intra-region correlation (rho)	0.1288	-	-	-
Deviance Based Chi-square	82.32	-	-	0.000*
Deviance	71.427	-	-	-
AIC	450.014	-	-	-

same for each health center. That is, the random intercept varies across health center, but levels of explanatory variables are fixed across health center in predicting determinant of modern contraceptive use in Debark district health center (Table 10).

According to the result of the random intercept model, the fixed part showed that place of residence, marital status, environmental condition, access of media, frequency of modern contraceptive use, modern contraceptive type and HIV test were found to be significant determinants of variation in the determinant of modern contraceptive use among health centers. The random part of empty random intercept multilevel model showed that the intercept variance of the random effect is -25.75024, whereas the intercept variance of the random intercept model is 0.429247. The variance of random effect of the intercept multilevel model decreased as compared to the random effects of the intercept of the empty random intercept model. The reduction of the random effect of the intercept variance is due to the inclusion of fixed explanatory variables. That is, taking into account the fixed independent variables which can provide extra predictive value on the determinant of modern contraceptive in each health center.

DISCUSSION

This study aims to identify some determinants of modern contraceptive based on Debark district health office 2015 data. Accordingly, descriptive analysis, binary logistic regression, and multilevel logistic regression techniques were used. In general, the results from this study were a little consistent with most previous studies in terms of the determinants of modern contraceptive use among fertile women. The results which were obtained were discussed in the following. The descriptive analysis of this study shows that the distribution of modern contraceptive users was 95.8%. Based on the result of this study, a woman who lives in Dibbahir (10.3%), Abayseqar (10.8%), Dawe (9.4%), Tirahina (34%), and Adigagira (11.9%) health centers were more likely to have modern contraceptive than women who live in the Belles health center.

This study found that the determinant of modern contraceptive use among fertile women were significantly associated with marital status. Women whose marital status is married were 85.9% less likely to the determinant of modern contraceptive use than fertile women whose marital status is unmarried.

The finding also showed that place of residence was significantly associated with the determinant of modern contraceptive use among fertile women. This result is in agreement with Fengyu et al. (1999) who suggested that major determinant factors for modern contraceptive use were to prevent unwanted pregnancy. Similarly, the finding is consistent with Hasinur et al. (2011) who found that women had little or no access to modern contraceptive, the result revealed that the urban women were the mostly attended on regular modern contraceptive use.

The result of this study indicates that the determinant of modern contraceptive use among fertile women was significantly associated with access to media. Women who do not get the access of media were more likely to be determinant of modern contraceptive use than those who have access to media. This result is consistent with Abdurahman et al. (2014) who found that the major determinant of modern contraceptive was not getting access to media. Similarly, the findings show that women who do not have access to media were 84.6% times more affected by determinant of modern contraceptive among fertile women than those who have access to media for modern contraceptive use among fertile women.

The study showed that the likelihood of women who do not get access to media were 5.603 times more likely to affect modern contraceptive use than those women who have access to media.

The finding also shows that modern contraceptive types were significantly associated with the determinant of modern contraceptive use among fertile women. Women who use IUCD and condom were less likely than

for those determinants of modern contraceptive use. This result is in agreement with [3] who suggested that major determinant factors for modern contraceptive use were to prevent unwanted pregnancy. This study found that IUCD and condom were significantly associated with the determinant of modern contraceptive use and the users of condom and IUCD were less likely to be fertile.

The model of this study revealed that the likelihood of having the determinant of modern contraceptive use among fertile women who had HIV test were 1.659 times more likely to have short-term modern contraceptive use than fertile women who had a long-term modern contraceptive use. This finding is consistent with a study done in Uganda (Saurabh et al., 2013) that revealed that the determinant of modern contraceptive use occurred in women who had an HIV test.

Conclusions

The study identified that demographic, socioeconomic, environmental and health-related variables have an important effect on determinants of modern contraceptive use in Debark district.

According to this study, multiple logistic regression showed that health center, place of residence, marital status, environmental condition, access to media, the frequency of modern contraceptive use, and modern contraceptive type were all important factors to determining the determinant of modern contraceptive use among fertile women in Debark districts.

From the results of multilevel logistic regression analysis among all the three models, the random intercept multilevel model provided the best fit for the data under consideration. It showed that the distribution was varied among health centers. Additionally, in empty with random intercept model and random intercept and fixed coefficient models, the overall variance of the constant term was found to be significant, which reflects the existence of differences in the distribution of modern contraceptive use among fertile women across health center. The significant determinant factors for the variations of distribution of modern contraceptive among health center were an environmental condition, place of residence, marital status, access of media, HIV test, the frequency of modern contraceptive use and modern contraceptive type.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are forwarded:

(1) Awareness has to be given to the society on the use of modern contraceptive.

(2) To improve the media access, awareness has to be given to the society in order to address the risk of unwanted pregnancy, the risk of abortion, use of modern contraceptive, type of modern contraceptive, the frequency of modern contraceptive, and the importance of family planning.

(3) Health officers should test the women on HIV/AIDS status before they give modern contraceptive drug because the drug has an adverse effect on those long-term users.

(4) Debark districts health office should be addressed the health centers for all kebeles because it is difficult for the user to move from one health center to another.

LIMITATIONS OF THE STUDY

The major limitations of the study are:

(1) The study is conducted based on secondary data which might have incomplete and biased information.

(2) Some important variables like discussion about modern contraceptive, weight or number of children were not included in the study due to missing values, non-response and absence of these variables in Debark district health office 2015 data.

(3) The data used in this study are from Debark district health office 2015 data. Thus, the results may not necessarily reflect the current situation of Debark district health centers because all the variables of the study were not available.

ABBREVIATIONS

AIC/BIC, Akaike/Bayesian information criterion; **ACSA,** Central Statistical Agency; **E/DHS,** Ethiopian/ Demographic and Health Survey; **FGAE,** Family Guidance Association of Ethiopia; **FHD,** Family Health Department, **HIV/AIDS,** human immune virus/acquired immune deficiency syndrome; **ICC,** intra class correlation coefficient; **MDGs,** millennium development goals; **NGO,** non-governmental organizations; **SPSS,** Statistical Package for Social Science; **SSA,** Sub-Saharan Africa; **UNICEF,** United Nation Children's Fund; **USAID,** United States Agency for International Development; **WHR,** World Health Report; **LAPMCs,** long acting and permanent method contraceptive; **DHS,** Demographic Health Survey Agency; **UNFPA,** United Nations Family Planning Agency; **DEPO,** Depo-Provera; **POP,** progesterone only pill; **COC,** combined oral contraceptive.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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Statistical model of weight outcome among college students

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The issue of weight outcome is a common problem across all ages in the world, regardless of being a male or female. Studies show that its cause is more associated with insufficient physical activities due to technological addicts and improper eating habits. However, this study sought to find out whether the predictors by authorities are in existent among college students in this part of the country. In a cross sectional survey which was a cohort study on 308 subjects, predictors like gender, age, eating habits and physical exercise were tested on weight outcome as the dependent variable (DV) that was categorized into two (normal and abnormal weight), which is *dichotomous*. The abnormal weight is made up of underweight, overweight and obese. Test of association was computed and Pearson Chi-square value was found to be $x^2 = 6.662$ with significance value of 0.01 < 0.05. The result revealed that since the significance value is less than the alpha value, then gender is associated with a weight problem. The logistic regression model (LRM) was used to analyze the epidemiological behaviour of the problem. The Hosmer and Lemeshow test computed, displayed a significance value of 0.291 which is by far greater than the 5% significance level and hence affirm that the data used was good to fit the model. It was also maintained that overall, 63.0% of the subjects were correctly classified. It was further revealed from the LR table that gender had p – value 0.014: C.I = 1.288 – 9.292; age, p = 0.001: C.I. = 2.173 – 8.132; eating habits, p = 0.021: C.I = 0.323 – 0.913 and physical exercise, p = 0.001: C.I. = 2.303 – 20.232, this establishes that each of these independent variables IVs is <0.05, hence significant to predict weight outcomes (problem).

Key words: Weight outcome, physical exercise, eating habits, odds ratio, risk.

INTRODUCTION

The prevalence of weight problem is now a common issue across all age groups in the world. According to Laquatra (2004), the cause of this increase prevalence is in two folds: (1) food is more readily available to everyone and (2) the physical activities of people are reduced with increasing urbanization and economic development leading to high energy gain from dietary intake. Observations made by the research further explain why many people in Ghana today pay much attention to work/studies and forget about exercise and in turn take

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more fast foods which are full of fat and oil. Unfortunately, these foods are mostly consumed in the night, which obviously is divergent to good health practices. As earlier stated, weight problem is alarming all over the world. According to Popkin (1994), an Africa country like South Africa who is experiencing economic transition shows an increase in overweight and obese, this is due to their economic condition changes. WHO (2000) also reported that about 6 to 8% of the population in Nigeria is obese and over 6% men and 13% women in Brazil are obese. Studies have also shown that apart from being overweight or obese, underweight problem is as equal as overweight and obese problems. Its cause was found to be associated with malnutrition among others and this problem is as a result of weight loss (Swinburn et al., 2004). The results of such weight-loss activities might lead to the development of under-nutrition and underweight (Keski-Rahkonen, 2003). Malnutrition is a condition caused by improper diet or nutrition, and can occur in conjunction with both under and over consumption of calories (World Food Programme, 2008; Rahman and Hakim 2016). It was also reported by Choi (2013) that negative attitudes towards obesity and socio-cultural preferences for thinness can even tempt persons who are already underweight to attempt weight control and both under-nutrition and overweight occur in institutional care. Body mass index (BMI) categorizes individuals as underweight (<18.5 kg/m^2), normal weight (18.5 to 24.9 kg/m^2), overweight (25.0 to 29.9 kg/m^2) and obese (≥30.0 kg/m^2) (Laquatra, 2004; WHO, 2013; Rahman and Hakim 2017), showing that both underweight and overweight/obesity represent serious public health challenges worldwide. Research has shown that Ghana is one of the African countries that made considerable progress over the past few decades'advancements in improving the health and well being of its citizens (Khawaja, 2008). In spite of this progress, there is still a need to educate more individual on problems especially, the young ones. Young ones because, observation of the lifestyle of people within the ages of 18 – 25 years, showa that they have bad eating habit and find it difficult to take part in physical activities. For example, they are interested in picking taxi over walking distance. It is against this background that we want to investigate the possible variables that are associated with weight problems.The scope of this study was delimited only to college students in the Hohoe Municipality.

METHODS

Study area

Hohoe Municipality is one of the Districts/Municipalities in Volta region and it is located in the central part of the region. It is bounded on the North by Jasikan District, South by Ho – West district, East by Republic of Togo and West by Kpando District. The municipality covers an area of 1172 sq. km. Consisting of 174 communities with a population of 184,743 from the 2010 National Population Census. The population growth rate is 1.9%. There are several institutions in the municipality at various levels on the academic ladder ranging from basic schools to tertiary Institutions. There are 156 Kindergartens, 167 Primary schools, 104 Junior High Schools, 14 Senior High Schools, 6 Technical/Vocational Schools, 2 Colleges of Education, 1 Midwifery College and a satellite campus of University of Health and Allied Science (UHAS). There are about 40% farmers, 35% traders and 25% government workers.

Study design

This study was conducted in 2016, using data from students in various colleges of education including males and females. The preliminary data on subjects such as gender, age, height and weight were gathered, which enable us to calculate the BMI of subjects. Other variables like eating habits, kind of food eaten and physical activities were also obtained. Subjects were captured from December, 2015 to Novermber, 2016.

Data collection

Data was retrieved on subjects with weight problems through an interview. A primary data was obtained from the college students in order to gather first hand information that would reflect the problem among the students.

Data analysis

The data collected was entered into SPSS and analyzed anonymously. A descriptive statistical analysis was done using a Chi-square test which was computed for independent variables (IV) using a 2 × 2 contingency table. Chi-square which is originally known as the Pearson's Chi-square, according to Howell (2011) is referred to both statistical distribution and to a hypothesis testing procedure that produces a statistic test that is approximately distributed as the Chi-square distribution. This test again serves as a "goodness-of-fit" test, where the data are categorized along one dimension, which is commonly known as "contingency table". The categorization is across two or more dimensions. The expected frequencies are computed as $(R_j \times C_k)/N$ where R_j and C_k represent as row and column marginal totals, respectively and *N* is the grand total. The standard Pearson Chi-square statistic is defined as $x^2 = \sum\sum \frac{(O_{ij}-E_{ij})^2}{E_{ij}}$, where *i* and *j* are indexes in the row and column of the contingency table. The resulting test statistics is approximately distributed as x^2 on $(r-1)(c-1)$ degrees of freedom. The likelihood ratio Chi-square builds on the likelihood of a data under null hypothesis relative to maximum likelihood. This is defined as $G^2 = 2\sum O_{ij} \log \frac{O_{ij}}{E_{ij}}$. One of the advantages of the likelihood ratio when using Chi-square is that the $H2$ for large dimensional matrix can be nicely decomposed into smaller components (matrices).

The logistic regression model

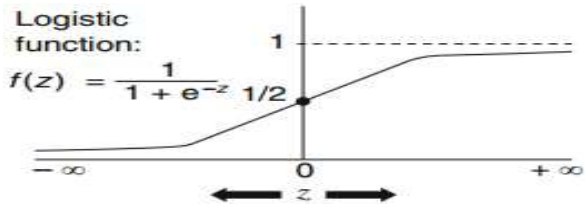
To explain the popularity of logistic regression, the logistic function was shown here, which describes the mathematical form on which

Table 1. The frequency distribution of variables.

Variables	Items	Frequency (%)
Weight outcome	Normal weight	164(53.2)
	Abnormal weight	144(46.8)
Gender	Female	241(78.2)
	Male	67(21.8)
Age	Below 18	50(16.2)
	18 – 29	189(61.4)
	30 – 40	69(22.4)
Eating habit	Below 3 times daily	89(28.9)
	3 Times daily	99(32.1)
	More than 3 times daily	120(39.0)
Physical exercise	No	93(30.2)
	Yes	215(69.8)
Location	Urban	271(88.0)
	Rural	37(12.0)

the logistic model is based. This function, called *f*(*z*), is given by 1 over 1 plus e to the minus *z*. The values of this function was plotted as *z*

varies from $-\infty$ to $+\infty$.



The fact that the logistic function *f*(*z*) ranges between 0 and 1 is the primary reason the logistic model is so popular. The model is designed to describe a probability, which is always some number between 0 and 1. In epidemiologic terms, such a probability gives the risk of an individual getting a disease. The logistic model, therefore, is set up to ensure that whatever estimate of risk we get, it will always be some number between 0 and 1. Thus, for the logistic model, we can never get a risk estimate either above 1 or below 0. This is not always true for other possible models, which is why the logistic model is often the first choice when a probability is to be estimated. The following equations are used to guide and give clear understanding on the logistic model. To obtain the logistic model from logistic, we need to defined the *z* as a linear sum as:

$$z = \alpha + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n \quad (1)$$

Having denied the *z*, we can now write the model as a function of *z*,

$$f(z) = \frac{1}{1 + e^{-z}} \quad (2)$$

We now substitute the linear sum expression for *z* to obtain

$$f(z) = \frac{1}{1 + e^{(\alpha + \sum \beta_i X_i)}} \quad (3)$$

Where, α and β are coefficient of the independent variable *X*, this can be expressed mathematically in more epidemiological term as $P(D = 1|X_1, X_2, \ldots\ldots, X_n)$.

RESULTS

The results of this study are presented in two folds. The first part explained the descriptive statistics of the data analyzed, this includes the percentage distribution of the variables in and cross tabulation of variables like gender and age, while the second part described the logistic model which gives the inferential statistics of the data and determined the predictors of BMI.

It can be observed from Table 1 that, the dependent variable weight has two outcomes namely normal and abnormal weight. The abnormal weight constitutes under-weight, overweight and obese. Out of 308 subjects, 164 (53.2%) had normal weight, while 144 (46.8%) had abnormal weight. In all, five independent variables (gender, age, eating habit, physical exercise and location) were considered, of this, 241 (78.2%) were females and 67 (21.8%) were males, subjects under 18 years were 50 (16.2%), 189 (61.4%) of them were 18 – 29 years and 69 (22.4%) were within ages of 30 to 40 years. Similarly, 89

Table 2. Cross tabulation of gender and weight outcome.

Parameter			Gender		Total
			Male	Female	
Weight outcome	Normal weight	Count	45	119	164
		Expected count	35.7	128.3	164.0
	Abnormal weight	Count	22	122	144
		Expected count	31.3	112.7	144.0
Total		Count	67	241	308
		Expected count	67.0	241.0	308.0

Table 3. Chi-square test.

Paramater	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.662	1	0.010
N of Valid Cases	308		

Table 4. Binary logistic regression predictors of weight outcome.

Variables	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
							Lower	Upper
Gender	1.241	0.504	6.063	1	**0.014**	3.460	1.288	9.292
Age	1.436	0.337	18.197	1	**0.000**	4.204	2.173	8.132
Eating	-0.610	0.265	5.312	1	**0.021**	0.543	0.323	0.913
Location	-0.128	0.362	0.126	1	0.723	0.879	0.432	1.789
Physical Exercise	1.921	0.554	12.007	1	**0.001**	6.826	2.303	20.232
Constant	-2.123	0.476	19.869	1	0.000	0.120		

(28.9%) had the habit of eating less than three times daily, 99 (32.1%) had the habit of eating three times daily and 120 (39.0%) had the habit of eating more than three times daily. 93 (30.2%) said they had no physical exercise for about a month, while 215 (69.8%) responded yes, meaning they had physical exercise in a month, 271 (88.0%) were residence in the cities, while 37 (12.0%) were residence in villages.

Below is the cross tabulation using a 2×2 contigency table and Chi – square test was computed to determine the association of independent variable (gender) of the dependents variable (weight).

From Table 2 where a cross tabulation of gender and weight outcome was calculated, a total of 67 males and 241 females can be seen. This indicates that more females have a weight problem than males. Table 3 computed the Chi-square test depending on the outcome of Table 2 and the Pearson Chi-square values was found to be $x^2 = 6.662$ with signicance value of 0.01 < 0.05. The study revealed that since the signicance value is less that the alpha value then gender is associated with a weight problem with regard to sample used for the study. That is considering the Hohoe municipality.

Table 4 present the result for the possible predictors of weight outcome for the IV's. The logist model was obtained as:

$$\text{Logit}_{[P(D=1)]} = -2.123 + 1.241\text{Gender} - 1.436\text{Age} - 0.610\text{EH} + 1.921\text{PE}$$

Where, EH is eating habi and PE is physical exercise.

Testing the model, for example, A male who is 18 years, eats 3 times a day and do not do any physical exercise. From Equation 3, we can determine the risk level of subjects having a weight problem. This is computed as:

$$logitP[P(D=1) = \frac{1}{1+e^{-[-2.123+1.241(\text{gender})-1.436(\text{age})-0.601(\text{EH})+1.921(\text{noPE})]}}$$

Table 5. Hosmer and Lemeshow tests.

Chi-square	df	Sig.
6.161	5	.291

Table 6. Model summary.

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
389.923	0.110	0.146

$$logitP[P(D=1) = \frac{1}{1+e^{-[-2.123+1.241(0)-1.436(0)-0.601(1)+1.921(0)]}}$$

$$logitP[P(D=1) = 0.061 \cong 6\%$$

For example, A female who is 18 years, eats 3 times a day and do not take part in any physical exercise.

$$logitP[P(D=1) = \frac{1}{1+e^{-[-2.123+1.241(\text{female})-1.436(\text{age})-0.601(\text{EH})+1.921(\text{no PE})]}}$$

$$logitP[P(D=1) = \frac{1}{1+e^{-[-2.123+1.241(1)-1.436(0)-0.601(1)+1.921(0)]}}$$

$$logitP[P(D=1) = 0.184 \cong 18\%$$

The epidemiological analysis of controlling predictors established that, comparing the two examples, females within the age of 18 who had the habit of eating 3 times daily and do not take part in any physical exercise were three times at higher risk of having a weight problem than their male counterparts who have an estimated risk of only 6% as compared to females with 18% risk.

The Hosmer and Lemeshow test was computed to assess the model fitting. The null hypothesis were set as hypothesized model that fits the data while an alternate hypothesis were set as hypothesized model does not fit the data. The result from Table 5 indicates that, Chi-square value of 6.161 with degree of freedom of 5 has a significance value of 0.291 which is far more that 5% significance level, hence it is concluded that the null hypothesis was rejected or we failed to accept the null hypothesis. With regard to the analysis using epidemiological description, we can say that there was enough evidence to show that the hypothesized model fits the data set used in predicting variables that are associated with weight problems of college students. This therefore maintains that the overall model fit is good. The study further presents the summary of the model where the logs of the likelihood and variances level of prediction are done.

It was identified and deduced from Table 6 that Pseudo R – square stated 14.6% of the variance in predicting whether or not students have a weight problem considering the following variables: gender, age eating habit, physical exercise and location (place of residence). Classification table was also computed to determine the overall percentage predicted outcome of a weight problem and its associated contributing factors among college students.

The classification result of predicted percentage is shown in Table 7. It displays that about 80.5% could be predicted as normal weight, while 43.1% could be predicted as abnormal weight. It is also proper to establish that 63.0% of the overall subjects were correctly classified.

DISCUSSION

The findings of the study are identified and presented in two folds. First of all, a descriptive discussion was done followed by the presentation of the logistic model. It should be noted that there were 164 subjects with normal weight, while 144 of them had abnormal weight (weight problem) and when considering gender, there were more females in the study that their male counterparts. The ages of subject's ranges from 17 to 38 and it was categorized into three groups. 16.2% of the subjects were

Table 7. Classification table.

Observed		Predicted		
		Weight outcome		Percentage correct
		Normal weight	Abnormal weight	
Weight outcome	Normal weight	132	32	80.5
	Abnormal weight	82	62	43.1
Overall percentage				63.0

under 18 years, 22.4% were within 30 to 40 years, while 61.4% constituting majority of the subjects were within 18 to 29 years. In like manner, 28.9% create a habit of eating less than 3 times daily, 32.1% eats 3 times daily and 39.0% eat more than 3 times daily. It was also maintained that 30.2% were not involved in physical exercise and as many as 69.8% involved themselves in physical exercise and the majority of them were residing in the towns and cities, while only 12.0% were in the rural communities.

Cross tabulation of 2 by 2 was computed for gender as a cofounder to check the test of association of weight problem. It was deduced from the test that a Chi–square of 6.662 was computed with a degree of freedom of 1 showing a significance value of 0.01 which less than 5% significance alpha value, therefore gender is associated with weight outcome holding for other variables in the test. This was followed by the logistic model table which presents all the IV's tests for the DV's in the study. It was indicated that gender, age, eating habits and physical activities were variable found in the model and only location (place of residence) was not found in the model. It implies that the IV's found in the model are contributing factors to the DV's and that location was not a possible predictor of weight problem.

Conclusion and recommendation

The findings maintained that although there might be other predictors surrounding weight outcome, four (4) variables out of five in this study were proven to be the possible factors associated with weight outcome among the subjects sampled for the purpose of this study. These predictors are gender, age, eating habits and physical exercise. An epidemiological example reveals that a female who is 18 years, that eats normally and do not do any physical exercise is at a higher risk of weight problem as compared to the male counterpart. Furtheremore, theoretical factors according to Strong et al. (2008) have been reported as influential in exploratory health behaviors and behavior change among young adults. In addition, Ha and Caine-Bish (2009) reported a higher incidence in college students adopting unhealthy eating behaviors such as skipping meals, frequent snacking on calorie-dense food, and engaging in unhealthy weight-loss or weight-gain methods. It is therefore recommended that, since gender, age, eating habits and physical exercise were part of the model, thus significant to this study, every individual must be watchful about his/her weight outcome depending on the number of times they eat without doing any exercise. Moreover, the model was tested and shows that females are more vulnerable as compared to their male counterpart considering age.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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Full Length Research Paper

Factors associated with birth preparedness and complication readiness among antenatal clinic attendants in selected public Hospitals in Addis Ababa, Ethiopia: Institution based cross sectional study

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Birth preparedness and complication readiness is a comprehensive strategy aimed in promoting timely access to skilled maternal and neonatal services. It also facilitates active preparation and decision making for delivery by pregnant women. The aim of this study was to assess birth preparedness and complication readiness plans of antenatal clinic attendees in selected public Hospitals of Addis Ababa. Institution based cross-sectional design was used. Single population proportion formula was used to calculate sample size for the study. Bivariate and multivariate logistic regression analysis used to identify the association between the dependent and independent variables. This study revealed, among the study participants 72.60% stated that they were prepared for birth and its complication. Birth preparedness and complication readiness was found to have a statistically significant association with family income (AOR= 4.167, 95% CI, (1.092, 15.89) and knowledge about preparation for birth and its complications. In conclusion, majority of the study participants had planned birth preparedness and complication readiness but their preparation was not all rounded. Birth preparedness and complication readiness has statistically significant association with family about preparation for birth and its complication. Community education about birth preparation and its complication readiness; and improvement of the community economic status are recommended.

Key words: Birth preparedness, complication readiness, ante natal clinic attendants, public hospitals, cross sectional study.

INTRODUCTION

Globally, an estimated 211 million pregnancies and 136 million births occur every year. Among those pregnancies 529,000 deaths occur worldwide, from those deaths sub-Saharan covers 1 in 16, whereas the developed

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country covers 1 in 2800 pregnancies. In Ethiopia, the levels of maternal and infant mortality and morbidity are among the highest in the world, with 673 maternal deaths for every 100,000 live births (Luchia, 2011; Gurmesa, 2007; Hailu, 2011).

Complications of pregnancy and childbirth are the leading causes of disability and death among women in the reproductive age groups in developing countries. The causes of maternal death are remarkably consistent among the developing world. Direct obstetric complications account for 80% and indirect obstetric complications account for 20% of maternal deaths. An obstetric complication constitutes one of the world's most urgent and intractable health problems (Hailu, 2011).

Despite the great potential of birth preparedness and complication readiness in reducing the maternal and newborn deaths, its status is not well known in most of sub-Saharan Africa. Birth preparedness and complication readiness also reduces delays in receiving appropriate care. It calls on providers and facilities to be prepared attend to births and ready to treat complications. Birth preparedness has been globally endorsed as an essential component of safe motherhood programs to reduce delays for maternal care (Luchia, 2011; Mihret, 2008).

Birth preparedness is not easy to achieve. Many people in developing countries live on less than US $1 a day, which is hardly sufficient for them to feed and clothes themselves let alone put aside money for the possibility of an obstetric emergency. In rural areas, the situation is even more complex: even if transportation (and the money to pay for it) is available in the case of an obstetric emergency, distance and lack of maintained road may still cause delays sufficient to put the life of the woman in danger (WHO, 2006).

According to Ethiopian Demographic and Health Survey of 2011 only 10% of births in the past five years were delivered by a skilled provider. More than six women in every ten stated that a health facility delivery was not necessary, and three in every ten stated that it was not customary (CSA, 2011). When complications occur, the unprepared family will waste a great deal of time in recognizing the problem, getting organized, getting money, finding transport and reaching the appropriate referral facility.

Majority of pregnant women and their families do not know how to recognize the signs of complications, nor do they know what to do and where to get help. Delay in decision to seek care: lack of information about problems/warning signs, social factors, and delay in reaching care: having transportation, road conditions delay in receiving care: lack of equipment or personnel at facility, lack of funding, poor attitude of personnel. These delays can be addressed by birth preparedness and complication readiness plan, as time of labor or time of emergency is not the time to decide what to do (Luchia, 2011; Markos, 2014; Yared, 2003).

Therefore, this research is designed to assess the plan for birth preparedness and complication readiness and factors associated with the planning among antenatal care clients, in selected public hospitals Addis Ababa.

Operational definitions

Birth preparedness and complication readiness

A woman was considered as prepared for birth if she can identified place of delivery, arrange mode of transportation and saved money.

Knowledge of birth preparedness and complication readiness plan

A woman was considered as knowledgeable if she can identify the place of delivery, arrange mode of transport and save money otherwise she is not knowledgeable.

METHODOLOGY

Study area

Addis Ababa, the capital city of Ethiopia, is located in central part of Ethiopia. This city is currently serving as the federal capital city of Ethiopia. It is chartered city stretching on an area of 540 Km^2, between 9 degrees latitude and 38 degrees east longitude with altitude ranging from 2200 to 2800 meters above sea level (Argomal, 2010). Addis Ababa has three layers of Administration: City Government at the top, 10 Sub City Administrations in the Middle, and 116 Woreda administrations at the bottom. The city has 49 hospitals of which 6 are owned by Addis Ababa Health Bureau (AAHB), 4 by federal ministry of health, 1 by Addis Ababa University (AAU), 3 by non-governmental Organizations (NGO's), 3 by defence force and Police and 32 by the private owners. There are 69 health centers of which 63 are owned by the city administration, 5 by NGO's and 1 by the public (Moran, 2006).

Study design and study period

Institution based cross-sectional study was carried out from March 1st to 30th March, 2015.

Source population and study population

All antenatal clinic attending mothers in all public hospitals in Addis Ababa were considered as source population while pregnant mothers who were attending antenatal clinics of the public hospitals and selected for the study were considered as study population.

Sample size determination

The required sample size was determined by using single population proportion and taking into account the major associated

factors with birth preparedness and complication readiness. Moreover, the following assumptions were considered 95% CI, 5% marginal error (d) and 22% proportion (p) of birth preparedness and complication readiness (CSA, 2011), and 5% non-response rate. Then final sample size was 277.

Sampling procedure

All ANC providing public Hospitals in Addis Ababa were considered for this study. The sample size for each public hospital were allocated based on the proportion to size of pregnant mothers enrolled in each public hospital for ANC follow up. The individual study participant was selected by using systematic random sampling technique. Sampling frame was prepared based on estimated client flow of each hospital for one month and the sampling interval (k) was obtained by dividing the sampling frame (N) to the total number of sample size (n) from each public hospitals. Every (k) clients who satisfies the inclusion criteria were included until the required sample size was reached in each hospital.

Study variables

Dependent variable

Plan for birth preparedness and complication readiness.

Independent variables

Socio demographic and socioeconomic factors (age, educational status, marital status, monthly income, occupation, religion), parity, knowledge about birth preparedness and complication readiness, complication experience, husband and family influence, prior experience to the health facility, availability and cost of transportation, and availability and cost of health facility

Data collection tool and data collection procedure

Questioner was adopted after reviewing relevant literature. The questionnaire was pretested on 15% ANC attending mothers of public hospital which was not the study area. The findings from the pre-test was used to modify and made an adjustment for the data collection tool and interviewing technique. Data collection tool was translated to Amharic language back to English to check for its consistency. Four diploma were deployed for data collection and two BSc nurses were deployed for supervision of data collections process. After recruitment of the data collectors and supervisors two days training was given on the objectives of the study, data collection tools and data collection techniques.

Data processing and analysis

Data entry was done by using Epi info version 3.5 and data analysis was done using statistical package for social sciences (SPSS) version 20. A descriptive analysis was conducted to get summary values of birth preparedness and complication readiness plan as well as to check for outliers, inconsistencies and missed values. Moreover, bivariate and multivariate logistic regression analyses performed to identify factors associated with birth preparedness and complication readiness, to multivariate logistic regression. Whereas, the variables in multivariate logistic regression, P ≤0.05 was considered as significant.

Data quality control

The data collection questionnaires were pretested and revised based on the feedback obtained from pre-test. Data collectors and supervisors were trained for two days on the data collection tool and data collection procedure. The principal investigator and the supervisors strictly followed the overall data collection process. After collection of the data, each questionnaire was thoroughly reviewed for completeness and consistency by the supervisors and researchers. Missing and inconsistent data was checked by the data collectors and the supervisors whereas the outlier data was checked by the researchers. Entered data was checked for any skips and errors by the investigator, and this was corrected before running data analysis.

Inclusion criteria and exclusion criteria

Pregnant mothers who were attending ANC in the selected public hospitals were included in the study whereas ANC attending mothers who were attending ANC in public hospitals who are not physically and mentally capable for being interviewed were excluded from the study.

Ethical clearance

Ethical clearance and approval for this study was obtained from the Jimma University Ethical Committee. Written permission letter from Addis Ababa regional health bureau to the selected public Hospitals was also obtained. In addition, client's privacy, and confidentiality of the information obtained during interview are carefully explained before the administration of questionnaires and their verbal consent was sought.

RESULTS

Socio demographic characteristics of mothers

Out of the total 277 pregnant women planned for the study, 270 were successfully interviewed yielding the response rate of 97.47%. Most of the respondents were between the age group of 20 and 25 years (127(47.0%)) with a mean age of 27.4 (SD ± 4.5) years. Orthodox Christian religion followers accounted for 42. 6% and among the study participants most of them were housewife (155 (57.4%)) and government employee (47 (17.4%)) while 117 (43.3%) were Amhara by ethnicity. Three fourth of the study participants had attended primary school and secondary school, 124 (45.9%) and 98 (36.3%) respectively. Of the study participants, 239 (88.5%) of them were married. The mean family size of the participants was 2.8 (SD± 1.1) and the monthly income of the majority of the participants were less than 1000 ETB (Table 1).

Table 1. Socio demographic characteristics of ANC attendees in public hospitals of Addis Ababa, March 1st to 30th 2015.

Variable	Category	Frequency (n=270)	Percentage
Age	20-25	127	47.0
	26-30	61	22.6
	31-35	72	26.7
	36-40	10	3.7
Marital status	Married	239	88.5
	Single	31	11.5
Religion	Orthodox	115	42.6
	Protestant	84	31.1
	Muslim	42	15.6
	Catholic	29	10.7
Ethnicity	Amhara	117	43.3
	Oromo	95	35.2
	Tigre	50	18.5
	Gurage	8	3.0
Occupation	Housewife	155	57.4
	Govt. employee	47	17.4
	Private employee	22	8.1
	Business	41	15.2
Educational Status	Illiterate	15	5.6
	Primary school	124	45.9
	Secondary school	98	36.3
	Higher education	33	12.2
Monthly family Income	< 300	34	12.6
	301 – 500	79	29.3
	501 – 1000	94	34.8
	> 1000	63	23.3
Family size	1-2	119	44.1
	3-5	144	53.3
	6 and more	7	2.6

Obstetric characteristics of the respondents

Among the study participants, 142 (52.6%) were in third trimester and 107 (39.6%) of the women were primi gravida (pregnant for the first time). Two-fifth of the study participants were nulli parous 110 (40.70%) and one out of ten mothers had one still birth experience 28 (10.40%) (Table 2).

Knowledge about Birth preparedness and complication readiness

From the study participants, majority of them had heard about BP/CR 266 (98.5%). Half of the study participants get the information from the health professionals (137 (51.5%) and one-third of them get information from mothers (85 (32.0%) (Table 3).

Plan of respondents regarding birth preparedness and complication readiness

Of the 270 participants, 196 (72%) of them had planned for birth and its complication which was computed based on identifying place of delivery, arranging mode of transportation and saved money. Regarding plan of birth preparedness and complication readiness, 246 (91.1%)

Table 2. Obstetric characteristics of ANC attendees in selected public hospitals of Addis Ababa, March 1st to 30th 2015.

Variable	Category	Frequency(n=270)	Percentage
Gestational age in months	First trimester (1-3 months)	8	3.0
	Second trimester (4-6 months)	120	44.4
	third trimester (7-9 months)	142	52.6
Total number of pregnancy (Gravidity)	1	107	39.6
	2-3	151	55.4
	4 and above	12	4.4
Total number of birth (Parity)	0	110	40.7
	1-2	149	55.2
	3 and above	11	4.1
Total no of live birth	0	153	56.7
	1	14	5.2
	2 and above	103	38.1
Total number of still birth	0	227	84.1
	1	28	10.4
	2 and above	15	5.5

Table 3. Knowledge about birth preparedness and complication readiness among ANC attendees in public hospitals of Addis Ababa, March 1st to 30th 2015.

Variable		Frequency (n=270)	Percentage
Have you heard of BP/CR?	Yes	266	98.5
	No	4	1.5
Source of information	Health professional	137	51.5
	TTBA	21	7.9
	CHW	23	8.6
	Mothers	85	32.0
Knowledgeable on BP/CR	-	214	79.3
Not knowledgeable on BP/CR	-	56	20.7

TTBA-Trained Traditional Birth Attendant; CHW- Community Health workers; BP/CR- Birth Preparedness and Complication Readiness.

reported that they save money, 228 (84.4%) identify place of delivery, 212 (78.5%) identify mode of transportation and only 11 (4.1%) prepare blood donor (Table 4).

Factors associated with birth preparation and complication readiness

The factors associated with birth preparedness and complication readiness plan was family income and knowledge about birth preparation and complication readiness. Women who have income greater than 1000 Ethiopian Birr (ETB) per month were 4 times more likely to be prepared for birth and its complication when compared with women who have income less than 1000 ETB (AOR= 4.167, 95%CI (1.092,15.89). Women who were not knowledgeable about birth preparedness and complication readiness were 99% times less likely to be prepared for birth and its complication when compared with those who had knowledge (AOR=0.004, 95%CI (0.001,0.021) (Table 5).

Table 4. Actual birth preparedness and complication readiness practice among ANC attendees in public hospitals of Addis Ababa, March 1st to 30th 2015.

Variable		Category	Frequency	Percentage (%)
Plan of BP/CR		Prepared	192	72
		Not prepared	78	28
Birth prepared by:	Identify place of delivery	Yes	228	84.4
		No	42	15.6
	Save money	Yes	246	91.1
		No	24	8.9
	Prepare essential items for clean delivery and postpartum period	Yes	34	12.6
		No	236	87.4
	Identify skilled provider	Yes	67	24.8
		No	203	75.2
	Being aware of the signs of an emergency and the need to act immediately	Yes	152	56.3
		No	118	43.7
	Designating decision maker	Yes	14	5.2
		No	256	94.8
	Arranging emergency funds	Yes	105	38.9
		No	165	61.1
	Identify a mode of transportation	Yes	212	78.5
		No	58	21.5
	Arranging blood donors	Yes	11	4.1
		No	259	95.9
	Identifying the nearest institution that has 24 h functioning EmOC services	Yes	93	34.4
		No	177	65.6

BP/CR- Birth preparedness and complication readiness; **EmOC-** Emergency and Obstetric care.

Table 5. A multivariate logistic regression analysis for factors associated with birth preparedness and complication readiness plan, ANC attendees in selected Public Hospitals of Addis Ababa, March 2015.

Variable	Category	BP/CR		COR (95% CI)	AOR (95% CI)
		Yes	No		
Educational status	Illiterate	7	8	1	1
	Primary education	83	41	2.314 (0.785,6.821)	1.633 (0.219,12.191)
	Secondary and above	106	25	4.846 (1.607,14.61)*	2.221 (0.280,17.611)
Income	<1000 birr/Month	138	69	1	1
	>1000 birr/Month	58	5	5.800 (2.225,15.12)*	4.167 (1.092,15.89) **
Occupation	House wife	42	5	12.60 (1.680,945.27*	7.916 (0.156,401.442)
	Government employee	99	56	2.652 (0.430,16.349)	3.273 (0.047,228.652)
	Private employee	19	3	9.500 (1.091,82.725*	11.67 (0.031,136.365)
	Business women	34	7	1	1
Knowledge of BP/CR	Knowledgeable	193	21	1	1
	Not knowledgeable	3	53	0.006 (0.002,0.021) *	0.004 (0.001,0.021) **

N.B ** statistically significant at P- Value <0.05.

DISCUSSION

Among the study participants, 72% were prepared for birth and its complication. This finding was consistent with the study conducted in Addis Ababa (Luchia, 2011). The knowledge of respondents about birth preparedness and complication readiness is good indicator of the outcome. This might be attributed to presence or absence of relevant intervention to promote birth preparedness and complication readiness as well as utilization of health care service.

Among the study participants, 98.5% of them heard the term birth preparedness and their source of information from health professionals (51.1%), mothers (32.0%), health extension workers (8.6%) and Trained traditional birth attendants (7.9%). On a study conducted in Kenya, 60% heard it from health professionals (Mutiso, 2008). But a study conducted in Goba, 2011, 53.6% heard about birth preparedness and complication readiness, and 61% of them have heard it from health extension worker (Markos, 2014). This discrepancy might be the current study is conducted in the central part of the country and health professional's number is higher in the study area. The other reason might be because the study conducted at Goba was community based. The slight improvement may be due to the conference of safe mother hood which was healed at every facility one month prior to data collection time.

The most commonly mentioned practice in the study were saving money (91.1%), this finding was higher than the study conducted in Kenya and a study conducted in Addis Ababa (Luchia, 2011; Mutiso, 2008). Whereas, the finding of this study was higher than the study conducted in Adigrat (Mihret, 2008). This might be the fact that this study was conducted in the central part of Ethiopia where better access of health care is available, and the respondents who are attending ANC, have access for information.

Even though when money is available, it can be difficult to secure transportation at the last minute after a complication has occur. Arranging transport earlier reduces the delay in seeking and reaching service. Among the study participants, 78.5% of the respondents were identifying mode of transportation. It is comparable with a study conducted in Kenya (Mutiso, 2008). But the finding of this study was lower than the study conducted in Addis Ababa (Luchia, 2011). Regarding place of delivery, 84.4% of the respondents identified place of delivery. This finding was higher than the study conducted in India and in Addis Ababa (Luchia, 2011; Argomal, 2010).

Women who have monthly income greater than 1000ETB per month were more likely prepared for complication when compared with those receiving less than 1000 ETB per month (AOR= 4.167, 95%CI, (1.092, 15.89). This finding is consistence with the study conducted in Jimma town (Gurmesa, 2014). This might be due to the fact that the family income matter most for the preparations and also those with low income spend most of their time engaging in their daily activities.

Women who were not knowledgeable about birth preparedness and complication readiness are less likely to be prepared for birth and its complication when compared with those who had knowledge (AOR=0.004, 95% CI (0.001, 0.021). This finding is consistence with the study conducted in Goba district (Markos, 2014). This might be related to the awareness that makes them curious and prepare for the complications.

Conclusions

Majority of study participants had plan of birth preparedness and complication readiness but their preparation was not all rounded. Birth preparedness and complication readiness was found to have a statistically significant association with family income and knowledge about preparation for birth and its complication. Addis Ababa health office should incorporate the birth preparedness and complication readiness task with urban health extension program and Addis Ababa Micro and small enterprise development office, NGOs and other stake holders should work on the improvement of economic status of the community.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Cancer survival in Brazil: Estimate through the mortality to incidence ratio

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Information about cancer incidence, mortality and survival is one of the pillars for disease monitoring. In Brazil, only a few studies show population-based survival. The mortality to incidence ratio (M:I) is an indirect measure of cancer survival and can be used to estimate a population cancer survival. To calculate the mortality to incidence ratios (M:I), an official information for incidence and mortality rates in Brazil during 2002 to 2014 was used. A complement to the age-adjusted cancer mortality to incidence ratios [1-(M:I)] as a 5-year survival estimate for all cancers, excluding non-melanoma skin, breast, lung, prostate, cervical, colo-rectal and stomach cancers were calculated. The median survival estimate for all tumors was 52% for males and 56% for females. The lowest survival estimates, in both sexes, can be observed in North and Northeast regions for lung and stomach cancer. For colo-rectal cancer, the survival estimates were similar for both sexes, varying between 50 and 65%. Prostate and breast cancer had the highest survival estimates (79 and 74%, respectively). The survival estimate for cervical cancer in Brazil was 64%. Despite the limitation, the study showed that the methodology can be a simple predictor for calculating 5-year survival rates.

Key words: Brazil, incidence, mortality, neoplasm, survival.

INTRODUCTION

Cancer survival is the key piece of information that is useful in terms of controlling this disease. Even so, there are few studies in Brazil that evaluate the 5-year populational cancer survival. The available studies show survival data based on patients managed at some hospitals that are cancer reference units, though these studies are not population-based (Ayala, 2012; Brito et al., 2009; Carneseca et al., 2013; Corrêa et al., 2016). This paper intends to present 5-year survival estimates by using the methodology of the mortality to incidence ratio (M:I) for the most recent years available on the official information systems, covering the first decade of the 21st Century. The study hopes to throw more light on this issue to expand knowledge about

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cancer and strategies for controlling it in our country.

Information about cancer incidence and mortality, and thus survival, is one of the pillars for monitoring the disease (Bray et al., 2012). Owing to changes in human behavioral patterns, lifestyles, industrialization and urbanization, all of which have contributed to populational aging, the rise of chronic diseases, including cancer, is an important part of Public Health concerns (Duchiade et al., 1999). The incidence of cancer in the world rose from 12.7 million new cases in 2008 to 14.1 million in 2012, with 8 million cancer deaths recorded in 2012. With the rise in the world's population and the aging thereof, if the same conditions are maintained, this upward trend should continue to rise by approximately 75%, which will lead to a figure somewhere near 25 million cancer cases in the next two decades (Ferlay et al., 2015). Cancer is already the principal cause of death in developed countries, and with the improvement in the social, economic and healthcare conditions and decline in cardiovascular diseases in developing countries, cancer will shortly be the leading cause of death among all the world's populations.

In populations where there is deficient information on the occurrence of cancer, being knowledgeable about mortality can aid in understanding the epidemiological pattern of the disease among the population. For tumors that are most lethal, such as lung and stomach cancers, the mortality rate allows us to approximate what the incidence would be. The magnitude of the mortality rates for lung cancer closely approximates the incidence rates (19.7 and 23.1 per 100,000 inhabitants, respectively), such that in the absence of information regarding incidence, mortality data can be used as a reference for actions and decision-making (Ferlay et al., 2015). Even so, having only such information available may not permit real knowledge about cancer, chiefly because there are important differences in terms of lethality and survival for each tumor. Nevertheless, for those tumors where prognosis is easier, for example prostate and breast cancer, using such inference is inappropriate. This is because there is a real difference in magnitude between the incidence and mortality rates (Parkin and Bray, 2009; Vostakolaei et al., 2011). According to the latest world estimate, the rate of incidence noted for breast cancer stands at around 43.3 for every 100,000 women, whereas, for mortality, there are 13 deaths for every 100,000 women (Ferlay et al., 2015). In this sense, knowledge about all these parameters is important for identification of populational risks. Moreover, such knowledge will further contribute to the formulation of strategies for allocating resources for prevention, early detection, assistance and control of cancer.

Estimates of survival are fundamental to monitor aggressiveness of the disease, effectiveness of treatment and access to the healthcare system. The best way of obtaining information about cancer survival is actively following the cohorts of individuals diagnosed with the disease (Vostakolaei et al, 2011). Although understanding has improved in the oncologic area in Brazil over the years, there is still little information on populational survival from the disease in the country.

One indirect measure of cancer survival is the use of mortality to incidence ratio (M:I). This indicator compares the number of deaths due to a specific type of cancer during a given period with the number of new cases of such cancer registered in the same period. When the mortality data is considered sufficient in terms of quality, chiefly regarding preciseness as to cause of death, and incidence and survival are relatively stationary, that is, without major up- or down-swings, the M:I ratio is an approximate indicator of populational survival that can be reliably used (Parkin and Bray, 2009). Accordingly, 5-year survival is estimated as one less than the ratio between mortality and incidence [1-(M:I)]. Furthermore, M:I is also an indicator used to evaluate the incompleteness of Population-Based Cancer Registries (PBCR) (Parkin and Bray, 2009).

For this, application of this methodology requires that the information, both regarding incidence and, above all, mortality, be at an acceptable quality level (Bray and Parkin, 2009; Jensen et al., 1991; Parkin and Bray, 2009). According to Parkin and Bray (2009), 5-year survival is possible if there are no significant alterations in the incidence trend, as well as if the death certificate information is accurate (Parkin and Bray, 2009).

In populations where studies of population survival are rare, such as in Brazil, using an alternative methodology is a valid strategy to estimate populational survival from cancer. The methodology applied allows us to arrive at approximate 5-years survival, since actively researched populational cancer survival is low in Brazil. Despite this, caution is required to analyze the information, as such methodology may not be valid for all types of cancer. According to Vostakolaei et al. (2011), survival estimates for some cancer may be biased by 10%. This bias may be random or systematic, according to the cancer, for over- or underestimating survival. Survival statistics regarding oral cavity and liver cancer appear to be overestimated, whereas the estimates for bone, breast, prostate and stomach cancers, as well as leukemia, are under-estimated (Vostakolaei et al., 2011).

MATERIALS AND METHODS

Brazil is geopolitically divided into five regions (North, Northeast, Southeast, South, and Middle-West) and each one is composed of three or more states/provinces. This division considers geographic, social and economic factors. The data were grouped in these regions. Official incidence and mortality information was used, as available on the web-page of the Brazilian National Cancer Institute (*Instituto Nacional de Câncer José Alencar Gomes da Silva* – INCA - www.inca.gov.br/vigilância).

Information on incidence was provided by 22 Population-Based Cancer Registries – PBCR: Aracaju/SE (2008-2012), Belém/PA (2006-2010), Belo Horizonte/MG (2005-2009), Cuiabá/MT (2003-2007), Curitiba/PR (2008-2012), Vitória/ES (2008-2012), Barretos/SP (2009-2013), Florianópolis/SC (2008-2012), Fortaleza/CE (2002-2006), Goiânia/GO (2007-2011), Jahu/SP (2010-2014), João Pessoa/PB (2006-2010), Manaus/AM (2002-2006), Natal/RN (2001-2005), Palmas/TO (2008-2012), Poços de Caldas/MG (2007-2011), Porto Alegre/RS (2002-2006), Recife/PE (2008-2012), Roraima (2006-2010), Salvador/BA (2001-2005), São Paulo/SP (2009-2013) and Teresina/PI (2002-2006). The incidence rates referred to the average values for the last 5-year period for each PBCR. The mortality rates were obtained for the same PBCR locations and for the same time periods.

The mortality to incidence ratios (M:I) were calculated based on data on incidence and mortality rates adjusted for the world population standard, as modified by Doll et al. (1966). The M:I reflects the disease's lethality and is considered an indirect measure of survival. Values of close to 1 indicate that the disease is highly lethal. Then we calculated a complement to the age-adjusted cancer mortality to incidence ratios [1-(M:I)] as a 5-year survival estimate for the following topographies:

1. All cancer, but non-melanoma skin cancer (C00-C97;D46/C44);
2. Breast cancer (C50);
3. Lung cancer (C33-34);
4. Prostate cancer (C61);
5. Cervical cancer (C53);
6. Colo-rectal cancer (C18-C21);
7. Stomach cancer (C16).

As Brazil does not have nation-wide incidence data, the median was used to measure central tendency in order to obtain an overall assessment of the distribution of the M:I ratios to the nation's survival estimate. The median M:I ratios were calculated for geographic regions and Brazil, by sex. The use of such methodology was only possible since the present information on incidence and mortality in Brazil has already reached a regular quality standard (http://globocan.iarc.fr/old/method/method.asp?country=076).

The results obtained are presented in table format with all the information regarding the study, allowing us to find the median 5-year survival estimate per type of cancer, geographic region and nation-wide total. The figures present the variability of the distribution of the values for each survival for cancer and geographic region, along with the distribution of the survival values.

RESULTS

Table 1 shows the survival estimate by sex, geographical location and cancer. The median survival estimate for all tumors was 52% for males and 56% for females. Among men, the lowest survival estimate was observed in the North region of Brazil (Manaus and Roraima - 25%) while the highest survival estimate was in the Middle-West and South regions (Goiânia and Florianópolis - 63 and 67%, respectively). Among the women, the lowest survival estimates were in the North and Southeast regions (Roraima and Grande Vitória - 33 and 38%, respectively), while the highest was again in Florianópolis (76%). Concerning lung cancer, the lowest survival estimates, in both sexes, can be observed in such North region locations as Manaus and Roraima, and in the Northeast (Recife, Salvador and Teresina). Once again, the highest were in the South (Porto Alegre). For colo-rectal cancer, the survival estimates were similar for both sexes, varying between 50 and 65%. Florianópolis showed survival estimates above those noted in the rest of Brazil, for both genders (76% in men and 73% in women). The lowest survival estimates for stomach cancer were in Manaus and Barretos, for both sexes and in Sao Paulo for men only. Prostate and breast cancer had the highest survival estimates (79 and 74%, respectively). For Brazil overall, the survival estimate for cervical cancer was 64%.

Figure 1 shows the variation of the survival estimates among the geographic regions and Brazil, for prostate cancer and for female breast cancer. The overall median survival estimate for prostate cancer was 79% with the North region having the lowest survival rate. For breast cancer, a huge variation is noted in the survival estimates between geographic regions. The Southeast region has the highest survival estimate, followed by the Middle-West region, while the North region has the lowest survival estimate.

Likewise, regional differences were observed for colo-rectal, lung, stomach and all cancers (Figure 2). Despite the regional differences, the survival estimate between the sexes in relation to colo-rectal cancer was similar. For lung cancer, the medians were 14% in men and 18% in women. The highest survival estimates for lung cancer were observed in the South, Southeast and Middle-West regions of the country. Stomach cancer had the lowest median survival estimates for both male and female (30 and 35%, respectively). The median survival estimates for all tumors, in males and females were greater in the Middle-West, Southeast and South regions than in entire country. On the other hand, the North and Northeast regions posted survival estimates below those noted for the country as a whole. We have not presented the graph of the survival estimate for cervical cancer, since in Brazil there are still problems in filling out death certificates in relation to this tumor.

DISCUSSION

With the rise in the population's life expectancy, one of the consequences anticipated is an increase in the occurrence of cancer. Such a situation creates challenges for healthcare system, from diagnosis to treatment and management, but chiefly in terms of maintenance of the patient's quality of life index (QLI). This is because cancer, considered a chronic disease, can lead to major side-effects in an individual. Such challenges are greater, however, in low- and middle-income countries such as Brazil (Duchiade, 1999). Knowledge of population survival is highly important, not just from an individual standpoint,

Table 1. Estimated survival, all cancer*, lung, colo-rectal, stomach, prostate, breast and cervical, by gender, region and period.

Local	All cancer		Lung		Colo-rectal		Stomach		Prostate	Breast	Cervical
	Male	Female	Male	Female	Male	Female	Male	Female			
North Region	**0.36**	**0.42**	**0.09**	**0.09**	**0.45**	**0.49**	**0.21**	**0.18**	**0.66**	**0.68**	**0.61**
Belém[1] (2006-2010)	0.47	0.44	0.16	0.11	0.56	0.47	0.33	0.29	0.76	0.68	0.63
Manaus (2002-2006)	0.25	0.41	0.02	-0.03	0.34	0.33	0.11	0.09	0.54	0.67	0.58
Palmas (2008-2012)	0.56	0.57	0.24	0.31	0.66	0.69	0.32	0.26	0.78	0.81	0.71
Roraima (2006-2010)	0.25	0.33	0.03	0.07	0.30	0.51	-0.02	-0.06	0.57	0.56	0.60
Northeast Region	**0.47**	**0.54**	**0.09**	**0.16**	**0.57**	**0.58**	**0.24**	**0.38**	**0.74**	**0.73**	**0.68**
Aracaju (2008-2012)	0.59	0.62	0.14	0.19	0.60	0.70	0.44	0.49	0.82	0.72	0.58
Fortaleza (2002-2006)	0.47	0.55	0.22	0.24	0.57	0.56	0.24	0.39	0.74	0.75	0.74
Joao Pessoa (2006-2010)	0.42	0.54	-0.14	-0.02	0.58	0.60	-0.02	0.32	0.72	0.73	0.76
Natal (2001-2005)	0.54	0.61	0.17	0.21	0.63	0.66	0.36	0.42	0.82	0.81	0.68
Recife (2008-2012)	0.44	0.53	0.09	0.11	0.49	0.53	0.24	0.34	0.73	0.72	0.73
Salvador (2001-2005)	0.53	0.54	0.07	0.16	0.57	0.54	0.28	0.38	0.80	0.77	0.59
Teresina (2002-2006)	0.40	0.48	0.09	0.08	0.53	0.58	0.19	0.16	0.65	0.70	0.59
Middle-West Region	**0.59**	**0.60**	**0.16**	**0.26**	**0.62**	**0.64**	**0.42**	**0.39**	**0.83**	**0.78**	**0.69**
Cuiaba[2] (2003-2007)	0.56	0.59	0.13	0.24	0.64	0.66	0.41	0.35	0.79	0.78	0.70
Goiânia (2007-2011)	0.63	0.61	0.19	0.28	0.61	0.61	0.43	0.44	0.88	0.79	0.67
Southeast Region	**0.55**	**0.61**	**0.15**	**0.21**	**0.59**	**0.57**	**0.26**	**0.36**	**0.80**	**0.79**	**0.53**
Barretos (2009-2013)	0.43	0.50	0.00	-0.28	0.56	0.52	0.09	0.17	0.79	0.79	0.66
Belo Horizonte (2005-2009)	0.61	0.64	0.20	0.25	0.62	0.64	0.40	0.47	0.86	0.79	0.70
Grande Vitória[3] (2008-2012)	0.29	0.38	0.18	0.16	0.49	0.46	0.16	0.23	0.60	0.61	0.55
Jahu (2010-2014)	0.53	0.64	0.20	0.26	0.63	0.59	0.36	0.76	0.80	0.80	0.51
Poços De Caldas (2007-2011)	0.61	0.64	0.13	0.37	0.61	0.73	0.35	0.50	0.90	0.84	0.44
São Paulo (2009-2013)	0.56	0.58	-0.32	-0.06	0.51	0.55	0.05	0.25	0.80	0.74	0.52
South Region	**0.52**	**0.59**	**0.21**	**0.27**	**0.50**	**0.56**	**0.33**	**0.35**	**0.80**	**0.72**	**0.65**
Curitiba (2008-2012)	0.40	0.51	-0.04	0.00	0.44	0.50	0.21	0.27	0.70	0.72	0.61
Florianopolis (2008-2012)	0.67	0.76	0.21	0.27	0.76	0.73	0.51	0.60	0.88	0.84	0.79
Porto Alegre (2002-2006)	0.52	0.59	0.31	0.40	0.50	0.56	0.33	0.35	0.80	0.65	0.65
Median	**0.52**	**0.56**	**0.14**	**0.18**	**0.57**	**0.57**	**0.30**	**0.35**	**0.79**	**0.74**	**0.64**

* Exclude non-melanoma skin cancer (C44); 1. Belém e Ananindeua; 2. Cuiabá e Várzea Grande; 3. Cariacica. Fundão. Guarapari. Viana. Vila Velha. Vitória e Serra. Sources: Brazilian Population-based Cancer Registries; MS/SVS/DASIS/CGIAE/Sistema de Informação sobre Mortalidade – SIM; MP/Fundação Instituto Brasileiro de Geografia e Estatística - IBGE; MS/INCA/Divisão de Vigilância e Análise de Situação.

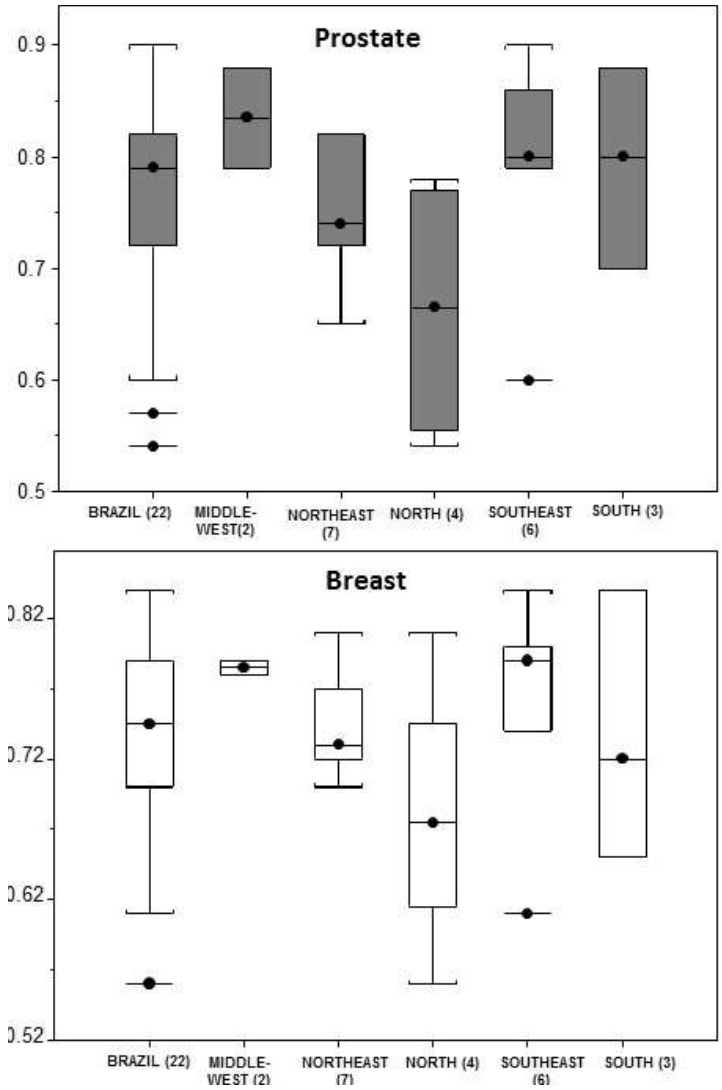

Figure 1. Survival estimates for prostate and breast (female) cancer by geographic region.

but also in relation to public health. The survival estimate based on the complement of the mortality and incidence ratios is an alternative given the absence of comprehensive population survival studies (Vostakolaei et al., 2011). Nonetheless, it is no substitute for actively researched survival studies, as it only allows us to find out the order of magnitude of survival, in the absence of such studies.

The information on the M:I ratio for cancers published by INCA in 2012 is quite similar to what is reported in this paper for all types of cancer analyzed, except for lung cancer in men. In the INCA study, the survival estimate for lung cancer was 5%, whereas, in this study, the survival estimate was 14%. Such a difference can be partly explained by the updating of the period analyzed, as well as the improvement in the quality of the lung cancer mortality rates (Health Ministry of Brazil, 2012).

The study conducted by Justo et al. (2013) analyzed healthcare related to breast cancer in Latin America using the M:I ratio. In their study, the authors used the incidence and mortality information taken from Globocan 2002 (Parkin et al., 2005) and Globocan (2008) (Ferlay et al., 2010) to appraise the potential change in the behavior of the lethality of breast cancer. For Brazil, the results obtained in calculation of these M:I ratio showed that the country had the least progress in caring for breast cancer (Justo et al., 2013).

Allemani et al. (2015) published data on survival of different populations around the world, including Brazil (CONCORD-2 study). The results presented for the 5-

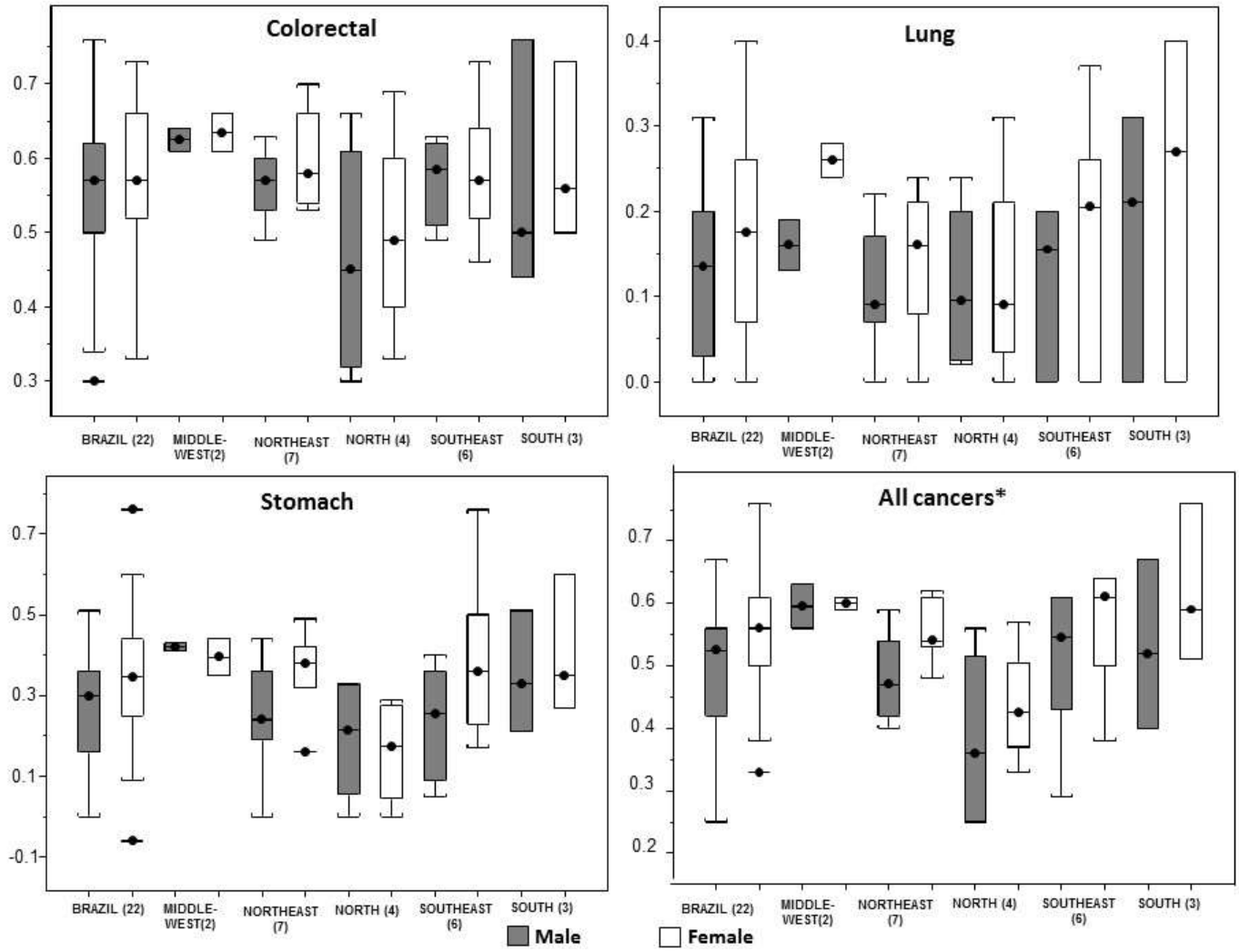

Figure 2. Survival estimates for colo-rectal cancer, lung cancer, stomach cancer and all cancer by gender and geographic region. *C00-C97;D46/C44

year survival rate for the last period analyzed (2005-2009) in Brazil were for lung (18%), colon (58%), rectum (56%), stomach (25%) and cervical (61%) cancers, and were quite similar to those found in this study. However, for breast (87%) and prostate (96%) cancers, the survival rates showed in CONCORD-2 were higher than those shown in this study (Allemani et al., 2015). This fact is corroborated based on certain studies showing the limitation of using such parameter as a survival rate predictor. The study conducted by Janssen-Heijnen et al. (2007) emphasized the importance of fulfilling the requisites for which such measure is best applied and thus reaching the closest possible actual survival. Such requisites consider significant changes in the time tendency of the tumor, mortality or incidence, upwards or downwards, over time; rise in the mortality risk rate after 5 years of survival; and the level of preciseness and completeness of the disease registries (incidence and mortality) (Janssen-Heijnen et al., 2007). Bore et al. (2005) shows that for some types of tumors, such as prostate and breast cancers, for instance, such conditions may not be valid, meaning that the alternative measure [1-(M:I)] underestimates the survival rate. In the case of prostate cancer, for example, most men diagnosed with the disease do not die of it, even though their official cause of death may be considered as prostate cancer, such that there is a classification error. This can overestimate the mortality rates and of course underestimate the survival rate (Bore et al., 2005).

Another important issue that should be taken into consideration is registration of the disease. For some cancer, a relapse or even a metastasis may be

misconstrued as a new diagnosis, as in the case of oral cavity and liver cancers. Such inconsistencies in registration may lead to false information, both regarding incidence and mortality, thus making it difficult to use the alternative method to calculate survival (Vostakolaei et al., 2011). Some considerations can be speculates about possible explanations for the negative values noted for stomach cancer and, above all, for lung cancer. Since lung cancer has a great potential for metastases, registration on the death certificate of this type of tumor tends to get overestimated.

In colo-rectal cancer, a similar pattern was noted between the sexes, which corroborate what is described in the literature on the subject. This tumor does not feature differences between the sexes in terms of its etiology. According to data in the study conducted by Jemal et al. (2017), the survival rate for colo-rectal cancer on US registers (SEER) was 66.2% in the 2006 to 2012 period.

The major difficulty of the methodology encountered for this study was related to cervical cancer. It is known that the North and Northeast regions of Brazil feature the greatest levels of inequality in relation to socio-economic conditions and therefore health statistics. The differences among Brazil's regions in the health-care area have been the target of study in the medical literature (Martins Júnior et al., 2011). Survival estimates for cervical cancer have been hampered owing to the under-estimation of mortality due to this cancer. According to Girianelli et al. (2014), the mortality rates for cervical cancer are in fact higher than those disclosed in the nation's Mortality Information System (SIM), if they are corrected by the death certificates that give ill-defined causes and, moreover, cases classified as deaths due to malignant neoplasm of the uterus, which are unspecified. According to Gamarra's study, after correction for ill-defined causes and the unspecified portion of the uterus, cervical cancer mortality rates have actually risen by no less than 103.4% for Brazil overall. The North and Northeast regions were those requiring the highest corrections. The adjusted mortality rates noted in these two regions in the 1996 to 2005 period were 8.1/100,000 and 4.8/100,000, respectively. With the correction, the mortality rates rose to 15.6/100,000 in the North and 14.8/100,000 in the Northeast. Such variations represent an overall increase of 93.1% in the mortality rate in the North and an enormous 209.3% in the Northeast (Gamarra et al., 2010). It is believed that such correction is a possible explanation for the results obtained in this study, where a false better survival estimate was noted for the North and Northeast regions of the country.

An important limitation of this study has been the fact that analysis has been based on second-hand information. It should be borne in mind that there still are considerable differences in relation to the information on mortality between locations and the respective periods analyzed.

It is important to highlight, nonetheless, that in Brazil the SIM is nation-wide in scope and has been in effect since 1979, with information gathered, stored and analyzed in an ongoing and systematic manner. Since 2005, the Ministry of Health has been pro-actively trying to upgrade the quality of death certificate completeness, and since 2010 Brazil has less than 10% of its deaths attributed to poorly defined causes (Health Ministry of Brazil, 2017; França et al., 2014). According to França et al. (2014), in the year 2010, no less than roughly 20% of the poorly defined death certificates were cancer-related re-classified. Cancer-related deaths rose by 17% due to the correction of the certificates showing death due to poorly defined causes. Besides the work on improving the SIM information, the Federal Health Ministry has also been striving over the last two decades to enhance the quality of the Brazil's Population-based cancer registries [PBCR]. Such improvements can be noted in recent publications regarding world cancer incidence [Cancer in Five Continents – International Association of Cancer Registries (IARC)] (Curado et al., 2007; Forman et al., 2013; Parkin et al., 2002). With this, it is believed that in the forthcoming updates of the databases, both SIM's and those of the RCBP's, this methodology can be used more frequently to obtain the magnitude of cancer survival statistics, in the absence of active research studies.

Conclusion

Even so, despite the limitations and certain differences encountered between the survival rates informed through active research studies and the results in this study, it is concluded that the [1-(M:I)] can be a simple predictor for calculating 5-year survival rates. It should be emphasized, however, that such alternative measure may not be so valid for tumors involving low lethality, or for those tumors that pose difficulty in terms of codification, regarding mortality, and for those considered rare among the general population.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Health problems related to algal bloom among seaweed farmers in coastal areas of Tanzania

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There is a scarcity of research-based data on the factors associated with skin irritation due to algal blooms in seaweed farming. Changes in temperature with an increase in nutrients levels lead to the growth of harmful algal blooms, which produce many active metabolites, some of which induce toxic responses in human including skin irritation. The objective of this study was to identify health problems experienced by seaweed farmers and the seasons when they occur, and how these are treated. A cross-sectional study design was used to gather data using structured questionnaire, focus group discussions and key informant interviews. The study was conducted between June and August 2015, in six villages, two from Mainland, and four from Zanzibar Islands, Tanzania. Study revealed that seaweed more than 50% of farmers experienced skin irritation problem, followed by 30.4% who had eye related problems, and only 19.6% had respiratory disorders as the most serious. Hot season, which is associated with algal blooms, was the period with the highest occurrence of skin irritation. No specific medication was used to treat the health problems reported. In some severely affected areas, farmers could not tend to their farms for months, a situation which affected their income. It is suggested that the findings from this study would reduce this knowledge gap and motivate stakeholders especially the policy makers to implement measures, which reduce the health problems observed due to algal blooms in the seaweed farmers.

Key words: Algal blooms, cyanobacteria, seaweed farming, seaweed farmers, skin irritation, Tanzania.

INTRODUCTION

Seaweeds are a group of photosynthetic non-flowering plant-like organisms (called macroalgae) that live in the sea. They are categories into three major groups based on their dominant pigmentation: red (Rhodophyta), brown

(Phaeophyta) and green (Chlorophyta). Seaweed is currently the most significant aquatic plant that has contributed to the development of an alternative aquaculture activity globally (FAO, 2010; Chipo et al, 2013).

Worldwide, its farming has been increasing from 19.9 million Metric Tons (MT) in 2010 to 23.8, 27 and 30.5 million MT in 2012 and 2013 and 2015 respectively (FAO 2015; 2013; Amosu et al., 2012). Seaweed industry provides a wide variety of products for human uses and it is estimated to have a total value of US$10 billion per year (Bixler and Porse, 2011; FAO, 2013). In addition, humans consume seaweeds directly as vegetables, Seaweed production for human consumption as food is estimated to constitute about 83% (Craigie, 2011). Seaweeds are eaten dried or fresh for its nutritional value or for flavouring (Kilinc et al., 2013). And the remaining is used as fertilizers, animal feed additives, medical applications ((Gilby et al., 2011). And biotechnological applications (McHugh, 2003). It has been reported that seaweed is among the best health food on the planet and it is very nutritious that contains vitamins and several minerals (Kim et al., 2017).

In Tanzania, seaweed farming started in Zanzibar in 1989 with two species namely *Eucheuma denticulatum* (Spinosum) and *Kappaphycus alvarezii* (Cottonii). In 1994 and 1995, seaweed farming spread to mainland Tanzania as an integrated coastal management project, in order to improve the socioeconomic status of coastal communities. In Zanzibar, seaweed farming is the third most important economic activity in terms of foreign exchange earnings after tourism and clove trade.

Furthermore, it has been contributing over 90% of Zanzibar's marine exports (Department of Fisheries and Marine Resources (DFMR) database 2015). United States of America, France, Denmark, Spain, China and Chile have been the main importers of seaweeds from Zanzibar (FAO, 2013). Available data from the Zanzibar Exporters Association show that, about 15,087 tons of dry weight seaweed were exported in 2012, followed by a drop to 11,000 tons in the preceding years (Neish and Msuya, 2015).

Cyanobacteria are photosynthetic bacteria that normally grow free in water or attached themselves on substrate such as macroalgae like seaweed, its rapid growth and spatial expansion is caused by change in climatic and environmental stimuli (such as increased water temperature or nutrient load) that can lead to the formation of extensive, monospecific blooms that dominate the benthic community (Paerl et al., 2011; Paerl and Otten, 2013). Cyanobacteria produce many active metabolites, some of which induce toxic responses,in human, fish, crabs, and other animals (Arthur et al., 2006; Ahern et al., 2007). These blooms, also have been linked to ecosystem and human health issues including smothered corals and seagrass, reduced grazing by fish and invertebrates, as well as dermatitis and breathing difficulties in humans who comes into contact with them (Panek, 2012).

In Tanzania, seaweeds are generally cultivated in shallow subtidal areas including lagoons or sheltered bays where fluctuations in temperature, salinity and sometimes nutrients contribute to eutrophication and algal blooms. Since 2012, skin irritation has been reported as the major health problem facing Tanzanian seaweed farmers (Msuya, 2013a) and it is suggested that algal blooms may cause these problems (Msuya, 2013b). This suggestion is supported by previous reports, which have associated exposure of humans to cyanobacteria with irritant contact dermatitis, as well as eye and respiratory problems (Osborne et al., 2001).

Similar problems such as swelling and reddening of the eyes, breathing difficulties and skin irritations have also been shown in Tanzanian seaweed farmers (Fröcklin et al., 2012). As the first of its kind in Tanzania, these problems were seen to be a barrier to some farmers to continue working on seaweed farms, reducing the production of seaweed and hence affecting people's livelihood. No study has ever been conducted to address these problems, therefore, the present study aimed at describing symptoms and diseases affecting seaweed farmers, and identifying possible factors associated with skin irritation and other related health problems to seaweed farmers in selected coastal villages of Tanzania.

MATERIALS AND METHODS

Study sites

Study sites included six villages, two from mainland Tanzania, namely; Kijiru in Tanga Region and Songosongo in Lindi Region, and four from Zanzibar Islands, namely Bweleo, Paje and Chwaka in Unguja Island and Tumbe in Pemba island. These villages were chosen based on reported high prevalence of skin irritation, which has negatively affected seaweed farmers (Msuya, 2013b).

Sample size and sampling technique

Epi tools (http://epitools.ausvet.com.au/) were used to calculate the

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sample size. The resources in the project were limited, and we tried to optimize design to enable us to present joint measures across villages, but also identify important differences between villages and mainland/ Zanzibar.

Basically, we estimated we could bring in approximately 250 farmers in these 6 villages. After consulting with an experienced epidemiologist, we took the following approach to decide on sample size: Given a total population of 11456 seaweed farmers (BSN 2012), a confidence level of 90%, the resources we had were sufficient to describe our population at a precision of +/- 5% at a prevalence of 50%, and at +/-2/ at a prevalence of 5%. We decided a sample size of 40 in each village, and a total sample size of 240. With this sample size, we would have limited power to detect differences between the villages. However, given specific factors would influence the pattern, we would be able to find variables of high importance to explain the variability. Due to this limited power, statistical models were established only for health problems with a frequency exceeding 10% in the whole population.

The study was a cross-sectional study conducted between June and August 2015. Forty seaweed farmers were randomly selected from each of the six villages, forming a total sample size of 240. The farmers were selected based on their experience in seaweed farming (above 5 years in seaweed farming) in order to get more information on disease history. Seaweed farmer identification was done with the help of the village leaders and seaweed group leaders in some areas. The selected seaweed farmers were interviewed in their farms, houses and market centres, where they normally sold their seaweed or attended meetings related to seaweed production. Two local fisheries officers from each study sites were used as enumerators to assist in conducting a survey, and Swahili language was used to translate the questions to ease understanding by farmers. Verbal consent was obtained from all the respondents before they were interviewed.

Data collection methods

Structured questionnaire

The questionnaire was composed by the demographic characteristics of the farmers, farming history, clinical signs or history of the farmers and the period when disease erupt as well as medical treatment. Prior to the actual data collection, a questionnaire was developed and reconnaissance visits were done to pre-test and check for accuracy of the questions to avoid ambiguity of the questions. This was then followed by conducting the actual survey in all study sites to get information on skin irritation and other related diseases that has been affecting seaweed farmers (occurrence, severity and treatments), as well as seaweed production trends. Apart from questionnaire testing, other activities done during this survey included meetings with the Village Executive Officers (VEO) or Shehas, elders and leaders of the key groups that were involved in seaweed farming activities to introduce the study, establish contacts, as well as familiarizing with the study sites.

Focus group discussions (FGDs)

Focus group discussions were done and information was recorded using a tape recorder. The discussions involved experienced seaweed farmers and cluster leaders who were chosen by the farmers themselves with the help of village leaders. A single group from each site comprised of 6 people of mixed ages and gender were participated in the discussion.

Direct observations

Direct observations of skin problems in farmers was done at seaweed farms and market centres, to observe the extent and to validate what was discussed during interviews and focus group discussions. However, we did not have a checklist for the observation because we had only two conditions to observe and that was skin rashes and eye problem on the open part of the hands and legs of the farmers from each study site.

Secondary data

Secondary information on seaweed production trend was obtained from different sources (websites, books and articles) as well as fisheries officers at each fisheries department in all study sites. These were reviewed and sorted to give information on general and specific issues related to seaweed production, and the problems that seaweed farmers faced. This secondary information was used in validating and improving the reliability of information gathered from the interview.

Data management and analysis

The questionnaire was coded and data entered in a database using Microsoft Excel®. After cleaning and removing errors, the data were transferred to the statistical package for social sciences (SPSS) statistical package (version 20, IBM Analytics, Armonk, NY). Data were coded, and quantitative data as age was coded into categories to enable a simple statistical comparison. The data was examined using tables and graphs while Chi square test was used to compare the variables across the six villages. We also examined the health problem profile of each village using a radar plot in Microsoft Excel. Then we attempted to link individual health problems to explanatory factors using a logistic regression platform. Before the logistic regression, variables were recoded to enable large enough groups for statistical comparison. Notably, farming stage participation was recoded into three groups (farming, harvesting and other). Statistical models were established only for health problems with a frequency exceeding 10% in the whole population (skin irritation, body itching, skin sores, eye irritation, eye swelling, headache, vomiting) while the rest (stomach problems, respiration failure, vomiting) were not followed up. In modelling we focused on geographical (village), demographic (age, education, marital status) and exposure (farming stage participation) variables. A backward selection strategy was used in model building, with a Likelihood Ratio test at $p<0.005$ as inclusion criteria in models.

The qualitative data was analysed manually using thematic content analysis. In this case, components of the verbal discussions held with the key informants and focus groups were analysed in an objective and systematic manner. The recorded dialogue with group participants was then broken down into small and meaningful units of information of themes and tendencies, which helped in establishing values and attitudes of the respondents.

RESULTS

Socio-demographic characteristics of seaweed farmers

According to Table 1, the majority of the seaweed farmers were females aged between 31 to 40 years old, although 45% of farmers in Tumbe village were aged

Table 1. Socio - demographic characteristics of seaweed farmers in the study villages.

Varriable		Number (%) of respondents						p-value
		Songosongo (n=40)	Tumbe (n=40)	Kijiru (n=40)	Paje (n=40)	Bweleo (n=40)	Chwaka (n=40)	
Age	20–30 (n =63)	9 (22.5)	18 (45.0)	9 (22.5)	8 (20.0)	9 (22.5)	10 (25.0)	*p* <0.01*
	31 -40 (n=88)	18 (45.0)	13 (32.5)	16 (40.0)	9 (22.5)	2 (30.0)	20 (50.0)	
	41– 50 (n= 69)	11 (27.5)	8 (20.0)	10 (25.0)	14 (35.0)	17 (42.5)	9 (22.5)	
	51-60 (n=20)	2 (5.0)	1 (2.5)	5 (12.5)	9 (22.5)	2 (5.0)	1 (2.5)	
Gender	Male (n=53)	6 (15.0)	14 (35.0)	12 (30.0)	8 (20.0)	3 (7.5)	10 (25.0)	*p* <0.05*
	Female (n=187)	34 (85.0)	26 (65.0)	28 (70.0)	32 (80.0)	37 (92.5)	30 (75.0)	
Marital status	Married (n=164)	24 (60.0)	34 (85.0)	33 (82.5)	23 (57.5)	24 (60.0)	26 (65.0)	*p* >0.05
	Single(n=10)	2 (5.0)	2 (5.0)	0 (0.0)	1 (2.5)	2 (5.0)	3 (7.50)	
	Divorced (n=26)	7 (17.5)	2 (5.0)	2 (5.0)	6 (15.0)	5 (12.5)	4 (10.0)	
	Widowed (n=40)	7 (17.5)	2 (5.0)	5 (12.5)	10 (25.0)	9 (22.5)	7 (17.5)	
Education level	Not educated (n=98)	12 (30.0)	29(72.5)	17 (42.5)	15 (37.5)	16 (40.0)	9 (22.5)	*p* <0.001*
	Educated (n=142)	28 (70.0)	11(27.5)	23 (57.5)	25 (62.5)	24(60.0)	31 (77.5)	
Main livelihood activity	Seaweed farming (n=194)	37(92.5)	32 (80.0)	24 (60.0)	31 (77.5)	35 (87.5)	35 (87.5)	*p* <0.001*
	Seaweed sellers (n=5)	1(2.5)	3(7.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)	
	Fishing (n=10)	2 (5.0)	0(0.0)	3 (7.5)	3 (7.5)	0 (0.0)	2 (5.0)	
	Agriculture (n=10)	0 (0.0)	5(12.5)	2 (5.0)	1 (2.5)	1 (2.5)	1(2.5)	
	small business (n=18)	0 (0.0)	0(0.0)	11(27.5)	3 (7.5)	3 (7.5)	1(2.5)	
	Animal husbandry (n=3)	0 (0.0)	0(0.0)	0 (0.0)	2 (5.0)	1(2.5)	0 (0.0)	

between 20 to 30 years old. Most of the farmers were married (>80 %) with a few widowed (25%) especially in Paje village. Moreover, there was significance difference in education levels (p<0.05) between seaweed farmers across the villages. However, more than 50% of farmers were educated (from primary to secondary level of education). Additionally, more women than men significantly performed seaweed farming activities across the villages (p< 0.05). More than 60% of the famers depend on seaweed farming as the main livelihood activity, most expressed in Songosongo village (92.5%). Small businesses (27.5%) were least observed in Kijiru village followed by agriculture (12.5%) and fishing activities (7.5%). There were very few cases of animal husbandry (5%) and seaweed value addition and trading (7.5%) observed in all study sites. Seaweed farming was the main livelihood activity to the farmers (80.8%) across the villages. Also, statistical analysis showed highly significant differences between these parameters and the study population.

Health problems

Results for health problems faced by seaweed farmers (Table 2) showed that a majority of the farmers (>50%) in all study sites reported having skin irritation problems. The highest occurrences were reported in Kijiru (80%), Songosongo (70%), and Paje (65%) and the least in Bweleo (25%). Body itching was frequently reported in all villages, especially in Kijiru (67.5%) and Songosongo villages (62.5%), followed by skin sores. Eye irritation problems (30.4%) were the second most frequently reported together with swelling of face and eyes as well as headache. Very few cases on digestive problems such as vomiting and diarrhoea (2.5%) were reported in Paje and Chwaka villages, while death was only reported by 3 (7.5%) farmers in Paje village. There were significant differences in health problems such as skin irritation, eyes and respiratory problems across the villages (p<0.05). Body itching (p<0.05), skin sores (p<0.05) and swelling of eyes (p<0.05) were among health problems which showed significant difference across the villages.

Season and stage of farming when skin irritation and other problems occur

Results on the seasons when the health problems occur and the time of occurrence during the whole farming process are indicated in Table 3. Health problems during the hot season (January to February) was frequently

Table 2. Analysis of reported health problems in the study villages.

Health problems	Diseases		(%) of respondents per village n=240 Songosongo (n=40)	Tumbe (n=40)	Kijiru (n=40)	Paje (n=40)	Bweleo (n=40)	Chwaka (n=40)	p-value
Skin	Irritation	P (n=135)	28 (70.0)	21 (52.5)	32 (80.0)	26 (65.0)	10 (25.0)	18 (45.0)	$p<0.001$*
		A (n=105)	12 (30.0)	19 (47.5)	8 (20.0)	14 (35.0)	30 (75.0)	22 (55.0)	
	Itching	P (n=119)	25 (62.5)	17 (42.5)	27 (67.5)	22 (55.0)	8 (20.0)	20 (50.0)	$p<0.001$*
		A (n=121)	15 (37.5)	23 (57.5)	13 (32.5)	18 (45.0)	32 (80.0)	20 (50.0)	
	Skin sores	P (n=80)	16 (40.0)	9 (22.5)	12 (30.0)	21 (52.5)	7 (17.5)	15 (37.5)	$p<0.01$*
		A (n=160)	24(60.0)	31(77.5)	28 (70.0)	19 (47.5)	33 (82.5)	25 (62.5)	
Eye	Irritations	P (n=73)	19 (47.5)	2 (5.0)	20 (50.0)	12 (30.0)	6 (15.0)	14 (35.0)	$p<0.001$*
		A (n=167)	21(52.5)	38 (95.0)	20 (50.0)	28 (70.0)	33 (82.5)	26 (65.0)	
	Swelling of face/eye	P (n=61)	17(42.5)	1 (2.5)	14 (35.0)	10 (25.0)	7 (17.5)	12 (30.0)	$p<0.001$*
		A (n=179)	23 (57.5)	39 (97.5)	26 (65.0)	30 (75.0)	33 (82.5)	28 (70.0)	
Digestive	Vomiting and diarhea	P (n=7)	4 (10.0)	0 (0.0)	1 (2.5)	0 (0.0)	1(2.5)	1(2.5)	$p>0.05$
		A (n=233)	36 (90.0)	40 (100.)	39 (97.5)	40 (100.0)	39 (97.5)	39 (97.5)	
	Stomach ache	P (n=8)	3 (7.5)	2.50 (1)	2 (5.0)	0 (0.0)	1(2.5)	1(2.5)	$p>0.05$
		A (n=232)	37 (92.5)	97.5 (39)	38 (95.0)	40 (100.0)	39 (97.5)	39 (97.5)	
	Death	P (n=3)	0(0.0)	0 (0.0)	0 (0.0)	3 (7.5)	0 (0.0)	0 (0.0)	$p<0.01$*
		A (n=237)	40 (100.0)	40 (100.0)	40 (100.0)	40 (100.0)	40 (100.0)	40 (100.0)	
Respiratory	Failure to breath	P(n=14)	4 (10.0)	3 (7.50)	1 (2.5)	0 (0.0)	1 (2.5)	5 (12.5)	$p<0.001$*
		A (n=226)	36 (90.0)	37 (92.5)	39 (97.5)	40 (100)	39 (97.5)	35 (87.5)	
Fever	Headache	P(n=42)	12 (30.0)	4 (10.0)	6 (15.0)	6 (15.0)	8 (20.0)	6 (15.0)	$p>0.05$
		A (n=198)	28 (70.0)	36 (90.0)	34 (85.0)	34 (85.0)	32 (80.0)	34 (85.0)	

"P= present" "A=absence" *p- value in Pearson Chi Square test.

reported in Songosongo (83.3%) and Paje villages (95%), followed by Bweleo (90%), Kijiru (85%) and Tumbe (82.582.5%), while fewer cases were reported during long rains season (March to May), 4.2%.

Regarding the stages of the seaweed farming when the problems were experienced, farmers reported to have high occurrence (37.5%) during the actual farming time itself (planting). About 32% of farmers from Songosongo village indicated that they got the problems during harvesting. However, majority of the farmers in Bweleo village (60%) could not specify exactly at which stage of farming they experienced health problems. There was a significant difference ($p<0.05$), between seasons when health problems occurred and farming stages across the villages.

The response of interviewees on what farmers did when they got health problems are shown in Table 4. There were differences between villages regarding what the farmers did when they get the seaweed farming related health problems. A majority of farmers either went to nearby hospitals or dispensaries for medical treatment or did nothing while waiting for natural recovery (Figure 3).The highest percentage of those who went to nearby hospitals was observed in Songosongo (60.0%) while the least was observed in Bweleo. Very few cases of farmers (12%) reported to seaweed experts when they experience health problems, all of them were from Kijiru.

The logistic regression models showed a stable pattern for the most common health problems. As shown in Table 3, participation in farming was a factor for all health problems. Village was important for skin problems, while age was more important for eye problems. Farmers (44%) reported that no medication they got when they visited hospitals/dispensaries were only given painkillers,

Table 3. Results from the multivariable logistic regression analyses for associations between the most common health problems and potential risk factors. Results shown as Odds ratio (OR) with 95% Confidence intervals and corresponding p-values. For each model, the area of the Receiver Operating Curve is also shown.

Participating in culturing vs. not	Skin irritation (ROC=0.75)	Body itching (ROC=0.77)	Skin sores (ROC=0.68	Eye irritation (ROC=0.78)	Eye swelling (ROC=0.75)	Haedache (ROC=0.71)
	OR=6.31 (3.0-13.4); *p*<0.001	**OR=6.5 (3.3-13.1); *p*<0.001**	**OR=2.4 (1.3-4.5); *p*<0.01**	**OR=2.8 (1.5-5.4); *p*<0.001**	**OR=2.3 (1.2-4.5); *p*<0.01**	**OR=4.3 (2.0-8.9); *p*<0.001**
Bweleo	OR=1.00	OR= 1.00	OR= 1.00	OR= 1.00	OR= 1.00	OR= 1.00
Chwaka	OR=1.9 (0.65-5.3); *p*>0.05	3.4 (1.15-10.2); *p*<0.05	OR=2.5 (0.87-7.4); *p*>0.05	OR=2.9 (0.92-9.1); *p*>0.05	OR=1.7 (0.56-5.1); *p*>0.05	OR=0.51 (0.15-1.8); *p*>0.05
Kijiru	OR=11.0 (3.5-34.0); *p*<0.001	OR=7.9 (2.6-23.9); *p*<0.001	OR=1.7 (0.56-5.0); p>0.05	OR=5.8 (1.9-17.8); *p*< 0.001	OR=2.1 (0.72-6.3); *p*>0.05	OR=0.50 (0.14-1.7); *p*>0.05
Paje	OR=5.6 (1.72-13.9); *p*<0.001	OR=5.4 (1.8-16.1); *p*<0.005	OR=4.8 (1.6-13.8); *p*<0.005	OR=2.6 (0.82-8.3); *p*>0.05	OR=1.5 (0.5-4.5); *p*>0.05	OR=0.59 (0.17-2.0); *p*>0.05
Tumbe	OR=4.9 (1.7-13.9); *p*<0.005	OR=4.3 (1.4-12.9); *p*<0.01	OR=1.6 (0.53-5.1); *p*>0.05	OR=0.40 (0.07-2.2); *p*>0.05	OR=0.14 (0.015-1.2); *p*>0.05	OR=0.54 (0.14-4.2); *p*>0.05
Songosongo	OR=6.5 (2.2-18.7); *p*<0.001	OR=6.3 (2.1-18.9); *p*<0.001	OR=2.8 (0.97-8.1); p>0.05	OR=5.1 (1.7-15.6); *p*< 0.001	OR=3.1 (1.05-8.9); *p*<0.05	OR=1.4 (0.46-4.2); *p*>0.05
20-30 years	OR= 1.00	OR= 1.00	OR= 1.00	OR= 1.00	OR= 1.00	OR= 1.00
31-40 years	OR=2.1 (0.99-4.7); *p*≤0.05	OR=1.6 (0.73-3.3); *p*>0.05	OR=1.5 (0.7-3.1); *p*>0.05	OR=2.6 (1.08-6.1); *p*<0.05	OR=2.7 (1.1-6.7); *p*<0.05	OR=1.4 (0.56-3.6); *p*>0.05
41-50 years	OR=1.4 (0.64-3.2); *p*>0.05	OR=1.4 (0.61-3.0); *p*>0.05	OR=1.5 (0.68-3.4); *p*>0.05	OR=3.4 (1.4-8.5); *p*<0.01	OR=2.1 (0.81-5.4); *p*>0.05	OR=1.6 (0.61-4.4); *p*>0.05
51-60 years	OR=1.8 (0.55-5.9); *p*>0.05	OR=0.87 (0.26-2.9); *p*>0.05	OR=1.7 (0.52-5.3); *p*>0.05	OR=1.1 (0.28-4.5); *p*>0.05	OR=2.0 (0.53-8.6); *p*>0.05	OR=0.93 (0.17-5.3); *p*>0.05

Bolded p-values are significant.

vitamins and injections to supress irritation pains (Figure 4). However, most farmers (25%) reported to only using traditional treatments for instance coconut oil mixed with natural herbs such as mangrove roots to reduce irritations.

We were not able to reach any stable logistic regression model explaining the individual health problems and potential explanatory variables.

Thus, it seems like the difference observed is not explained by factors we have included in this study, notably the large variability of health problems across villages.

DISCUSSION

In the current study, majority of seaweed farmers were relatively young (31 to 40 years old), and hence the potential to make the seaweed industry grow bigger. Among those, majority were women who have little alternative livelihood and currently enjoying better economic positions and respect in the society while reducing dependency on family income usually brought by men (Msuya, 2011a). In some villages, such as Tumbe village in Pemba, quite a good number of men were observed to participate in seaweed farming after seeing the benefits in terms of income made by their wives.

According to Msuya (2011) and Zamroni and Yamao (2011), some men on Unguja started participating in seaweed farming as an alternative livelihood activity after failing in their main livelihood activities like fishing. Contrary to the men from Pemba Island, Zanzibar Island has fewer alternative income generating activities. Nevertheless, most of respondents reported that seaweed farming was their main income generating activity for their livelihood in all the study sites. This is probably due to the fact that fishing activity has now become a problem for the coastal people and they are turning into seaweed farming as the alternative livelihood activity especially in Songosongo (Msuya and Porter, 2014) and Zanzibar Islands.

Fisheries in coastal areas of Tanzania are artisanal. With the increasing human populations, the areas are overfished and the fishing per unit effort has been decreasing continuously (Media, 2015) leading to problems such as fishing juveniles and other destructive fishing methods. Further to that, population density in Zanzibar is 530 per km^2 (URT, 2013) compared to the overall Tanzania's density which was projected to be 62.3 per km^2 by 2016 (http://data.un.org/CountryProfile.aspx). Seaweed farming has proven to be an important livelihood to the people living in Songosongo as their area is too small for other economic activities such as agriculture (Tobisson, 2014). According to Msuya

Table 4. Analysis on the time (season) when seaweed farmers experiencing health problems.

Variable	(%) of respondents per village n=240						
	Songosongo (n=40)	Tumbe (n=40)	Kijiru (n=40)	Paje (n=40)	Bweleo (n=40)	Chwaka (n=40)	*p*-Value
Seasons (Months) when health problems occur							
Hot (Jan-Feb) n = 200	38 (95.0)	33 (82.5)	36 (85.0)	38 (95.0)	36 (90.0)	21 (52.5)	
Windy/Dry (Jun-Sept) n=21	1 (2.5)	6 (15.0)	0 (0.0)	1 (2.5)	2 (5.0)	13 (32.5)	
Longrains (March-May) n=10	1 (2.5)	0 (0.0)	1 (2.5)	0 (0.0)	2 (5.0)	5 (12.5)	$p < 0.001$*
Shortrains (cold) (Oct-Dec) n= 4	0 (0.0)	0 (0.0)	0 (0.0)	1 (2.5)	0 (0.0)	0 (0.0)	
None (n=5)	4 (10.0)	1 (2.5)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	
Stages in Seaweed farming processes when problems were experienced							
Farming (n=73)	15 (37.5)	5 (12.5)	17 (42.5)	13 (32.5)	8 (20.0)	15 (37.5)	
Harvesting (n=42)	13 (32.5)	11 (27.5)	4 (10.0)	7 (17.5)	2 (5.0)	5 (12.5)	
Drying (n=2)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (5.0)	$p< 0.0001$
Wholefarm period (n = 44)	3 (7.5)	8 (20.0)	12 (30.0)	8 (20.0)	6 (15.0)	7 (17.5)	
None (n=79)	9 (22.5)	16 (40.0)	7 (17.5)	12(30.0)	24(60.0)	11 (27.5)	

*p- Value in Pearson Chi square test. Significant values at < 0.05.

and Porter (2014), in small island like Songosongo, the farmers have few economic alternatives and eagerly adopted seaweed farming from the beginning when it was first introduced to Songosongo Island in 1996. Therefore, if problems that interfere with this activity such as the health problems reported persist, most of the livelihood will be affected. It should be noted here that the industry employs 26,000 farmers whose livelihood will be affected, Also, the study showed majority of seaweed famers were educated by completing primary level of education and most of them were married, this is typical for coastal societies were they normally have low education level and higher rate of marriages, as reported by other researchers (Sahu et al., 2011).

Literature on health problems associated with seaweed farming is scanty. Seaweed farmers in Zanzibar have shown to have more incidences of allergies, respiratory problems and eye related problems as reported by Stockholm Resilience Centre (2012), Fröcklin et al. (2012) and Msuya (2013c). Undesirable skin conditions including itching, scarring and marking, darkening of colour, skin that shrinks and changes in its firmness or condition and skin irritations were reported by Msuya (2012).

Furthermore, according to Msuya (2015) toxic algal blooms of cynobacterium (*Lyngbya*) have been observed in Zanzibar and were suggested as a potential etiological factor for these dermatological and other health problems among seaweed farmers. Among the health problems that affect seaweed farmers, skin irritation showed high prevalence in all study sites, although significant differences were found across the villages for all health problems except for stomach problems. Incidences of body itching and skin sores were common among the farmers, and the symptoms could be so severe that the workers were not able to work in the farms. Other health problems were respiratory and eye problems. According to Rzymski and Poniedziałek (2012), cyanobacteria in the genus *Lyngbya* produce lyngbyatoxins, which are indole alkaloids causing skin problems such as itching, redness, burning, blistering and swelling of genital, perineum and perianal areas, ears (sores, discharge) and eyes (sores). Other health problems farmers faced included headache due to high fever as well as digestive problems which includes stomach ache, nausea, vomiting and diarrhoea and sometimes death cases due to eating the sea turtle that was contaminated by some cyanotoxins. The onset of the symptoms ranges from few minutes to hours after exposure and may last for more than 10 days as reported by Jiang et al. (2014).

Skin problems and other condition may also be attributed to exposure to the algae toxins during storage, because the farmers reported that the children, who do not do the actual seaweed farming, showed symptoms like coughing and fever when the seaweed were stored at home (Torre-Castro, 2006; Stefan Fors, 2010). Sores eyes (Moorea et al., 2010) and skin problems may also be related to strong sunlight and its reflection in the water. However, the normal skin and eye lesions from excess sunlight exposure differ significantly from those lesions observed in seaweed farmers (Torre-Castro, 2006; Fröcklin et al., 2012). Therefore, health problems raised a concern from the farmers through the Department of Fisheries of the Ministry of Agriculture,

Figure 1. Skin lesions on seaweed farmers in Songosongo, Tanzania (permission for display was obtained from the filmed farmer).

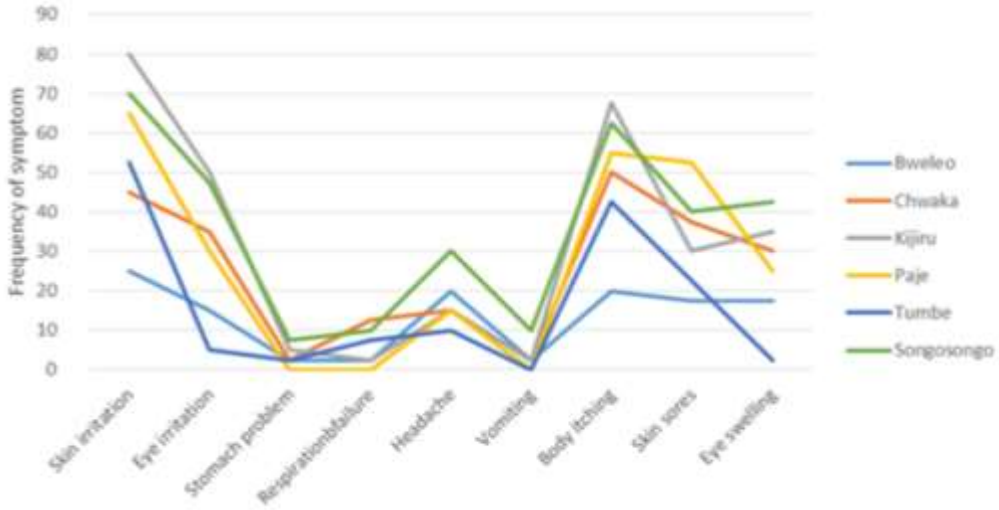

Figure 2. The frequencies of health problems at each study site.

Natural Resources, Livestock and Fisheries who put the issue to scientists at Institute of Marine Sciences to be investigated in 2013.

The first identification of *Lyngbya* toxin as a potential etiological factor for the skin and eye problem among seaweed farmers was first reported in 2012 (Msuya, 2013b; Msuya, 2015), while the farming has been going on since the late 1980s. The adverse health effects among the seaweed farmers (Figure 1) are different than the common water itch and most common water reflection eye sores, stomach ailments and skin irritations resulting from common microbes and irritations due to ultra violet light (Leventhal and Tlougan 2012).

The results from the present study showed that the hot season is the period when people experience skin irritation. This could be due to farmers tending to spend more time in water and expose themselves to direct sunlight, higher salinity and temperature. According to Belsito (2005) and Jöhnk et al. (2008), a combination of hot weather and wet working conditions may led to maceration of the skin, which increase the ability for toxins to penetrate the dermal barriers and cause skin diseases. During the hot dry season, which is December to February, there is an increase in sea surface water temperature, salinity and the nutrients concentration due to evaporation thereby increasing the environmental condition supporting blooms of the harmful cyanobacteria. In addition, direct sun burning and the time spent in salt water may reduce the protection barrier of skin, which may further increase the susceptibility of cyanobacteria toxins materials.

The farmers reported the uses of traditional medication that is, applied virgin coconut oil, charcoal ashes to the areas with skin irritation problems or reported to the

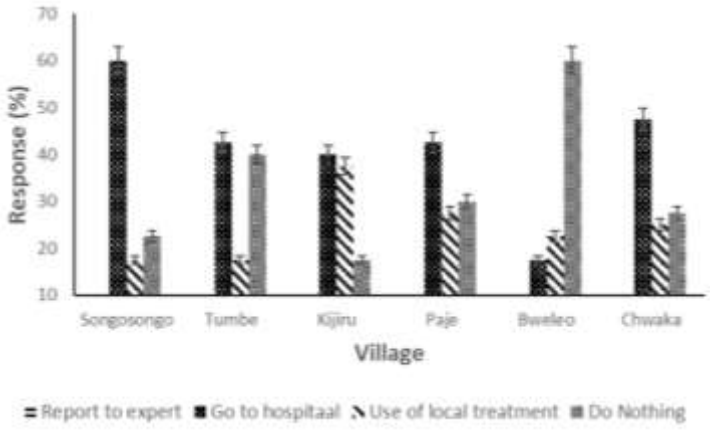

Figure 3. Action taken by farmers when experiencing health problems across study sites.

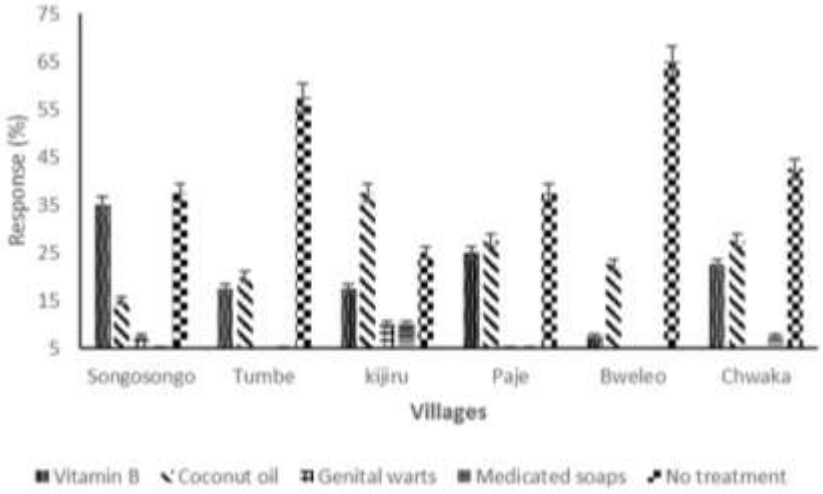

Figure 4. Types of medication used by farmers when experiencing health problems across study sites.

nearby dispensaries where they are treated with pain killers, vitamin, and injections B probably because they do not know the cause of the rashes. Further studies are needed to increase awareness of skin irritation related cause in health personnel and propose the medication for it.

Conclusion

Skin irritation is the main health problem faced by the seaweed farmers in the study sites. In terms of direct effects to farmers this study indicated that during the hot season, the farmers and seaweed farms are affected by the algal blooms and stakeholders should develop management/mitigation measures against the problems. Furthermore, the study indicated that there is no proper treatment for the ailments but with identification of the causative agents it is now time to start working on proper treatment of the illnesses. There is an obvious need to carry out further scientific investigation, on the main causes of skin irritations and the related health problems faced by seaweed farmers.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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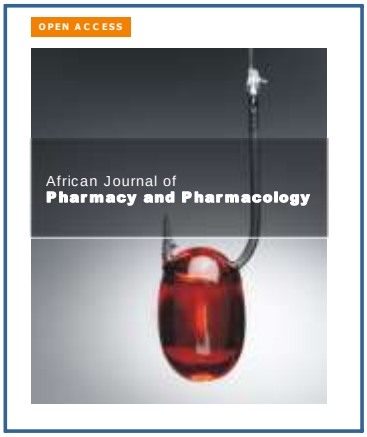

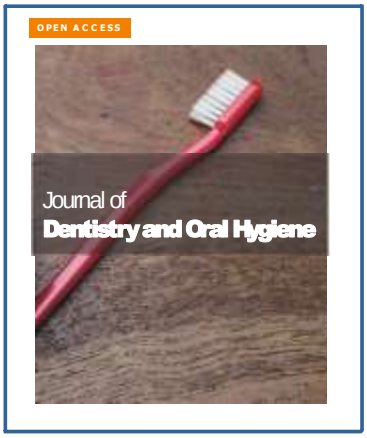

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