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FRUIT AND VEGETABLE CONSUMPTION BY ECOLOGICAL ZONE AND SOCIOECONOMIC STATUS IN GHANA

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Summary. The disease burden in both developed and developing countries is moving towards higher proportions of chronic diseases, and diseases such as cancers are now considered to be of public health concern. In sub-Saharan Africa, healthy behaviours such as fruit and vegetable consumption are recommended to reduce the chances of onset of chronic diseases. This paper examines the determinants of fruit and vegetable consumption in Ghana with particular emphasis on consumption by ecological zone. Data were from the 2008 Ghana Demographic and Health Survey ($n = 4916$ females; $n = 4568$ males). Univariate and multivariate analyses were performed using basic descriptive and Poisson regression. The main independent variable was ecological zone and the dependent variables were levels of fruit and vegetable consumption. The mean number of fruits and vegetables consumed in a week was higher among females (fruits: 7.5, 95% CI = 7.3–7.7; vegetables: 8.1, 95% CI = 7.8–8.3) than males (fruits: 6.2, 95% CI = 6.0–6.4; vegetables: 7.9, 95% CI = 7.7–8.2). There were significant differences in consumption by ecological zone. Respondents in the Savannah zone consumed less fruit than those in the Coastal and Forest zones, but the differences in fruit and vegetable consumption between the Coastal and Savannah zones were not consistent, especially for vegetable consumption. The findings suggest that one of the key interventions to improve fruit and vegetable consumption could lie in improving distribution systems since their consumption is significantly higher in the Forest zone, where the production of fruit and vegetables is more developed than in the Savannah and Coastal zones. The findings relating to household wealth challenge conventional knowledge on fruit and vegetable consumption, and rather argue for equal consideration of spatial differences in critical health outcomes.

Introduction

In sub-Saharan Africa and many other developing countries, where animal and dairy sources of nutrients are often insufficient, fruit and vegetables have been proposed as

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an important alternative source of micronutrients (Ali & Tsou, 1997). However, the *per capita* intake of fruit and vegetable is still considered far below the 400 g *per capita* per day suggested by WHO and FAO (Vaino & Bianchini, 2003; Asfaw, 2008). The World Health Survey (WHO, 2002a), which was conducted in 52 countries, indicated that Ghana had the lowest proportion of fruit and vegetable intake (36.6% and 38% among men and women respectively) among the surveyed countries compared with countries such as Pakistan, where about 99.2% of men and 99.3% of women consumed fruits and vegetables daily (Hall *et al*., 2009). In the 2008 Ghana Demographic and Health Survey, only 28% of women and 21% of men consumed fruit on a daily basis, and about a quarter (24%) of women and 30% of men consumed vegetables daily.

Increasingly, however, lifestyles in several African countries, including Ghana, are changing towards those typical of Western countries due to improving incomes, urbanization and other factors. As Doku *et al*. (2013) pointed out, increased urbanization in African countries has resulted in a shift from a typical agrarian economy to a service-based economy. This shift in economic activity has resulted in changes in lifestyle from more intensive physical activity to sedentary activities, the increased use of cars and an explosion in the number of cinemas and fast-food restaurants. These changes have the potential to increase the burden of non-communicable diseases. Indeed, de Graft Aikins (2007) observed this in Ghana, largely arising from the changing lifestyle patterns in the country. The World Health Report (WHO, 2002b) pointed out that an insufficient intake of fruit and vegetables has been one of the factors accounting for the high rates of chronic diseases and mortality globally. Lock *et al*. (2005) estimated that approximately 2.6 million deaths could be averted by adequate fruit and vegetable consumption. Further, increasing the total consumption of fruit and vegetables to about 600 g per day could potentially result in a 1.8% reduction in global disease burden. The potential reduction increases to 31% in the case of ischaemic disease and 19% for all incidences of stroke (Kamphuis *et al*., 2006).

In response to the changing patterns of diseases in Ghana – from infectious diseases towards more chronic non-communicable diseases – the Ministry of Health started a regenerative health programme (Regenerative Health and Nutrition (RHN)). The main objective was to transform lives and health for national development. The essential features of the programme were to contribute towards reducing the prevalence of diseases and disorders among individuals, households and communities so as to ensure a healthy and productive population capable of creating wealth. Fruit and vegetable consumption was indicated to be key to achieving the objectives (Ghana Statistical Service *et al*., 2009).

Traditional and current economic theory of consumption patterns argues that individual or household consumption behaviours pass through several trajectories, including income (economic ability), preferences and market prices of goods and services (Asfaw, 2008). The income argument posits that there is a linear relationship between income and fruit and vegetable consumption since poor households would want to avoid hunger because fruit and vegetables are not energy proficient. Poor households normally concentrate first on satisfying hunger with energy-proficient diets before considering low-energy foods whose health effects are not immediate but cumulative (Asfaw, 2008). Prescott & Pradham (1999) found in Cambodia that certain fruit and vegetables were about 100 times more expensive than a unit of rice. Studies conducted in the UK

have also found higher fruit and vegetable intake in households of higher wealth status (Shohiami *et al*., 2004).

Several broad socioeconomic factors also shape preferences, for example internalized tastes and preferences (Domel & Thompson, 2002; Cullen *et al*., 2003; Lallukka *et al*., 2010); parental controls, especially maternal modelling (Gibson *et al*., 1998); sensory appeal; familiarity and habit; social desirability; convenience and food ideology (Pollard *et al*., 2002). Other factors that have been observed to influence fruit and vegetable consumption include extent of exposure to media productions on fruit and vegetable (Cullen *et al*., 2000; Boynton-Jarrett *et al*., 2003; Story & French, 2004) and socioeconomic factors such as marital status, age and educational attainment (Oliveira *et al*., 2013; Franchini *et al*., 2013). Fruit and vegetable consumption is also correlated with urbanization: urban settings tend to have better transportation, modern supermarkets and cold storage facilities thereby helping to increase the stock of fruit and vegetables in those areas (Azagba & Sharaf, 2011).

The main question this study addresses is how region of residence (ecological zone) determines fruit and vegetable consumption among women (15–49 years) and men (15–59 years) in Ghana. While the study is not directly designed to evaluate the successes or otherwise of the RHN programme because of lack of baseline data for comparison, it will provide some understanding of factors that correlate with fruit and vegetable consumption among Ghanaians. Boeing *et al*. (2012) justified national campaigns promoting fruit and vegetable consumption following a critical review of the relationship between fruit and vegetable consumption and the prevention of chronic diseases. But in spite of the importance of fruit and vegetables for regenerative health, only a few studies (Doku *et al*., 2013), to the best of the authors' knowledge, have examined fruit and vegetable consumption in Ghana in a nationally representative sample. For instance, Doku *et al*.'s (2013) study was limited to adolescents in schools from three southern regions of Ghana (Greater Accra, Volta and Eastern regions).

This paper tests the hypothesis that fruit and vegetable intake has no relationship with ecological zone. Some prior studies (Kamphuis *et al*., 2006; Yen *et al*., 2011; Lazzeri *et al*., 2013; Tak *et al*., 2013; van Ansem *et al*., 2013) suggested that local availability (for example, access to one's own vegetable garden and high food security, accounted for by factors such as local climate, vegetation and soil quality) is an important factor in fruit and vegetable consumption. It must be stated, however, that by this assumption, it was not intended to follow a deterministic ideology. Rather, the study deals with only prevailing conditions, which are subject to possibilities, nonetheless. Nevertheless, individual socioeconomic characteristics could also determine fruit and vegetable consumption, and these are used to control for the anticipated ecological effects.

Data and Methods

Setting

The Republic of Ghana is centrally located on the West African coast and has a total land area of 238,537 km^2. Ghana is a lowland country except for a range of hills on the eastern border where Mt Afadjato – the highest (884 m) point above sea level –

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is found. Ghana can be divided into three ecological zones: the sandy coastline backed by a coastal plain, which is intersected by numerous rivers and streams; the middle belt and some sections of the western parts of the country with relative dense forest with streams and rivers; and a northern savannah, which is drained by the Black and White Volta Rivers. The country has a tropical climate with temperatures and rainfall varying according to distance from the coast and elevation. With an annual temperature of approximately 26 °C (79 °F), there are two distinct rainy seasons: April to June and September to November. In the north, however, the rainy season begins in March and lasts until September. Annual rainfall ranges from about 1015 mm (40 inches) in the north to about 2030 mm (80 inches) in the south-west. Food and crop production generally follows this pattern with tree crops rarely doing well in the savannah areas (Ghana Statistical Service *et al.,* 2009). The vegetation of the Savannah zone is characterized by wooded savannah with trees such as baobab, acacias and shea trees, which have adapted to the environment over time (Dickson & Benneh, 1988).

Data

The 2008 DHS data form part of the on-going waves of demographic and health surveys conducted at five-year intervals under the auspices of the Ghana Statistical Service and Macro International. The 2008 GDHS is the 5th in the series. As has been the norm for DHSs, a multistage probability sampling technique was used for the 2008 version. For each household selected, all eligible women (15–49 years) and men (15–59 years) were interviewed, yielding a total of 4916 females and 4568 males. The survey was executed from early September to late November 2008. The quality of the DHS data for such national-level analysis is widely acknowledged and has consequently been used for several studies (e.g. Gyimah, 2006, 2007). Data from the GDHS provide a representative sample of Ghanaians within the age categories selected. The accompanying survey weights were taken into consideration during the analysis. Typical of nationally representative data sets, survey weights are used to adjust for effects of under- and over-sampling, and such survey biases have the potential to affect the generalizability of the findings. Sample weights are adjustment factors used to account for differences in probability of selection and interview between cases as a result of survey design or chance and specifically; here, probability weight (*pweight*) was applied to correct for the sampling design effect (Ghana Statistical Service *et al*., 2009). The DHS data also provide important geographic and socioeconomic variables such as age, household poverty index, religion and place of settlement, which are possible confounders of fruit and vegetable intake. Ethical clearance for the use of the data set by this study was not required since it was drawn from an existing data source. Permission for its use was, however, secured from Measure DHS.

Measurement

This paper centres on four dependent variables: ‘days of eating fruit in a week’; ‘servings of fruit on days when fruit is eaten’; ‘days of eating vegetables in a week’; and ‘servings of vegetables on days when vegetables are eaten’. To derive the main out-

come variable (frequency of fruit and vegetable consumption) the number of servings of fruit and vegetables was multiplied by seven to obtain the number of times each (fruit and vegetables) was consumed in a week. In order to derive the maximum benefit from fruit and vegetable consumption, a minimum of five servings of fruit and vegetables a day is recommended. Therefore, the recommended number of fruit and vegetable servings per week is 35, although a few of the respondents reported having seven servings of fruit or vegetables per day.

Statistical analysis

A three-outcome variable was created for region of residence to capture the broad ecological zones coded as follows: Northern, Upper East and Upper West regions were coded as the 'Savannah zone'; the Brong-Ahafo, Ashanti and Eastern regions were designated as the 'Forest zone'; while the Western, Central, Greater Accra and Volta regions were coded as the 'Coastal zone'. Wealth quintile was coded as: poorest = 1; poorer = 2; average = 3; richer = 4; and richest = 5. The following other factors were considered conceptually relevant in determining fruit and vegetable consumption: education, urban–rural residence, occupation, religion, ethnic background and exposure to media (magazines/newspapers, radio and television). A number of behavioural change communication programmes have been rolled out by the Ghana Health Service to reach out to as much of the population as possible on fruit and vegetable consumption through the three major channels of media for communication: newspaper/magazine, radio and television. This was the main reason for including media variables in the analysis in order to identify those that may be useful for health behavioural change communication. Religion and ethnicity were included in the estimations as proxies for culture. In Ghana, there are some cultural interpretations associated with fruit and vegetable consumption that may present obstacles to their intake. For example, in some Ghanaian communities, fruit consumption is linked to whether one is satisfied or not, particularly, after dinner, making the practice a matter of satisfaction rather than a health need. Similarly, vegetable consumption is perceived to be a Western habit, particularly consumption of exotic varieties such as cabbage, cucumber, carrots and lettuce (Awusabo-Asare, personal communication). From this, ethnicity and religion probably best capture the variable 'culture' (e.g. Gyimah, 2006). These variables were included to examine their various effects, and whether or not they alter the magnitude and direction of effects of ecological characteristics on fruit and vegetable consumption.

Poisson regression was used because the main dependent variable (frequency of fruit and vegetable consumption in a week) was captured as a count variable. Besides, there was no indication of over-dispersion as none of the variances was greater than any of the means. Poisson regression models are constructed on the assumption of independence of subjects, but the GDHS is hierarchical in nature and respondents are layered within survey clusters with a potential of biasing standard errors. To overcome this, the Huber–White technique for dealing with clustering was applied to derive robust standard errors. All the data analyses were conducted with STATA version 12 (STATA Corp, College Station, TX, USA). The regression coefficients were transformed into incident risk ratios through exponentiation aimed at simplifying interpretation of the results.

Results

About 38%, 35%, 27% of the female sample ($n = 4916$) were resident in the Coastal, Forest and Savannah zones, respectively, and for males ($n = 4548$) the respective distribution was 38%, 33% and 29%. The proportions of respondents (both males and females) in poorest and richest households were fairly similar: approximately the same proportion of females and males belonged to each of the categories. Typical of developing countries, whereas a greater proportion of females had no formal education compared with males, males outnumbered females at all other levels of education (see Table 1). The proportion of females occupied in the sales and service sector (36.6%) was far higher than that of males (9%), which is consistent with the results from the 2000 and 2010 censuses (Ghana Statistical Service, 2000), an indication of the representativeness of the Ghanaian population data. As for media exposure, radio was the highest with approximately 50% of females and 70% of males reporting exposure. The culture of reading in Ghanaians is poor, and this is shown in the proportion of females (2.6%) and males (7.8%) who read newspapers/magazines 'almost every day' (data not shown).

Overall, the mean number of fruit and vegetables consumed in a week was slightly higher among females (fruit: 7.5, 95% CI = 7.3–7.7; vegetables: 8.1, 95% CI = 7.8–8.3) than males (fruits: 6.2, 95% CI = 6.0–6.4; vegetables: 7.9, 95% CI = 7.7–8.2). Importantly, education and wealth show a positive correlation with fruit intake for both sexes, but for vegetable consumption, education and wealth show negative correlations (data not shown).

Fruit and vegetable intake, however, varied by ecological zone. While fruit consumption varied between zones for females and males, vegetable consumption had a positive correlation with ecological zone. Female respondents from the Savannah zone reported the lowest number of fruit servings in a week, whereas for males it was those from the Coastal zone who reported the least. Approximately, the highest mean fruit and vegetable servings in a week was recorded in the Forest zone (Figs 2 and 3). Other striking results were recorded for fruit and vegetable intake by religion. Both males and females who were traditionalist/spiritualist reported the least servings of fruit and vegetables (females: mean vegetable = 4.5, 95% CI = 3.7–5.4; mean fruit = 6.6, 95% CI = 5.9–7.3; and for males, mean vegetable = 6.9, 95% CI = 6.2–7.8; mean fruit = 3.3, 95%, CI = 2.7–3.9).

Table 2 presents the results obtained from the Poisson regression: Models 1–4 report on female fruit and vegetable intake and Models 5–8 that of males. Models 1, 3, 5 and 7 are bivariate, with the others (Models 2, 4, 6 and 8) being multivariable. For both females and males the results reveal some differences in fruit and vegetable consumption by ecological zone. In the bivariate analysis, females and males in the Forest zone reported a higher frequency of fruit and vegetable consumption than those in the Coastal zone. Males and females in the Savannah zone reported a higher likelihood of vegetable consumption but not of fruit consumption. The differences remained after controlling for all other socioeconomic factors (see Table 2).

Contrary to expectation, increasing household wealth status did not significantly influence fruit and vegetable consumption – there was an inverse relationship with their consumption for both sexes (Table 2). Higher formal education improved fruit

Table 1. Background characteristics of respondents by sex, 2008 GDHS

	Females ($n = 4916$)		Males ($n = 4568$)	
Explanatory variable	%	*n*	%	*n*
Ecological zone				
Coastal	38.6	1897	38.2	1747
Forest	34.5	1697	32.7	1496
Savannah	26.9	1322	29.0	1325
Wealth index				
Poorest	15.93	783	17.71	809
Poorer	18.31	900	17.84	814
Average	19.92	979	17.16	783
Richer	22.76	1118	23.63	1079
Richest	23.08	1134	23.65	1080
Type of place of residence				
Urban	44.0	2162	41.9	1914
Rural	56.0	2754	58.1	2654
Highest educational level attained				
No education	25.4	1247	17.6	803
Primary	20.3	999	15.8	723
Middle/JSS	38.5	1893	40.3	1839
Secondary/SSS	12.1	596	18.2	830
Higher	3.7	181	8.2	373
Age				
15–19	20.84	1025	19.94	910
20–24	17.86	877	15.42	704
25–29	16.93	832	13.66	623
30–34	13.10	644	11.66	532
35–39	12.99	638	11.57	528
40–44	9.56	470	8.62	393
45–49	8.72	428	7.96	363
50–54	—	—	6.51	287
55–59	—	—	4.66	212
Marital status				
Never married	32.41	1593	42.52	1942
Married	58.51	2876	52.63	2404
Formerly married	9.08	446	4.84	221
Occupation				
Not working	22.5	1108	17.4	797
Professional/clerical	4.7	229	15	686
Sales/services	36.6	1798	9.0	410
Agricultural	26.4	1300	39.7	1813
Manual/other	9.8	481	18.9	862

Table 1. *Continued*

Explanatory variable	Females ($n = 4916$) %	Females ($n = 4916$) n	Males ($n = 4568$) %	Males ($n = 4568$) n
Religion				
Catholic	14.9	733	15.1	689
Protestant	14.7	723	15.2	695
Pentecostal	34.5	1696	25.7	1175
Other Christian	9.7	478	11.8	539
Muslim	16.9	832	18.8	861
Traditional/spiritualist	5.4	266	7.6	347
No religion/other	3.8	188	5.7	262
Ethnicity				
Akan	43.4	2136	40.1	1833
Ga/Dangme	6.3	309	5.8	265
Ewe	13.0	637	14.3	653
Mole/Dagbani	21.8	1071	24	1097
Other	15.5	763	15.8	720
Reading newspapers/magazines				
Not at all	78.3	3844	63.6	2899
Less than once a week	7.8	384	12.1	550
At least once a week	11.2	552	16.5	750
Almost every day	2.6	128	7.8	356
Listening to radio				
Not at all	17.3	848	6.9	315
Less than once a week	8.1	396	6.2	284
At least once a week	25.1	1232	16.5	753
Almost every day	49.6	2437	70.4	3210
Watching television				
Not at all	41.6	2041	31.4	1433
Less than once a week	8.7	429	13.6	621
At least once a week	19.1	939	19.9	910
Almost every day	30.6	1501	35.1	1600

and vegetable intake in females and fruit intake (but not vegetable intake) in males. Increased age was associated with more fruit and vegetable consumption among females, and increased fruit intake (but not vegetable intake) among males. Both males and females working in formal and informal agriculture sectors reported higher fruit and vegetable consumption than those in other occupations. The most conspicuous observation for religion is the significantly lower inclination of traditionalist/spiritualist towards fruit and vegetable intake. Vegetable intake was significantly higher among Mole-Dagbani males and females than among Akans, who were used as the reference group (Models 2 and 6). The effect of media exposure was mixed: exposure to print/magazine at least once a week or almost every day highly predicted fruit (but not vegetable) intake among females (Model 4) as well as the consumption of fruit and vegetable among males (Models 6 and 8).

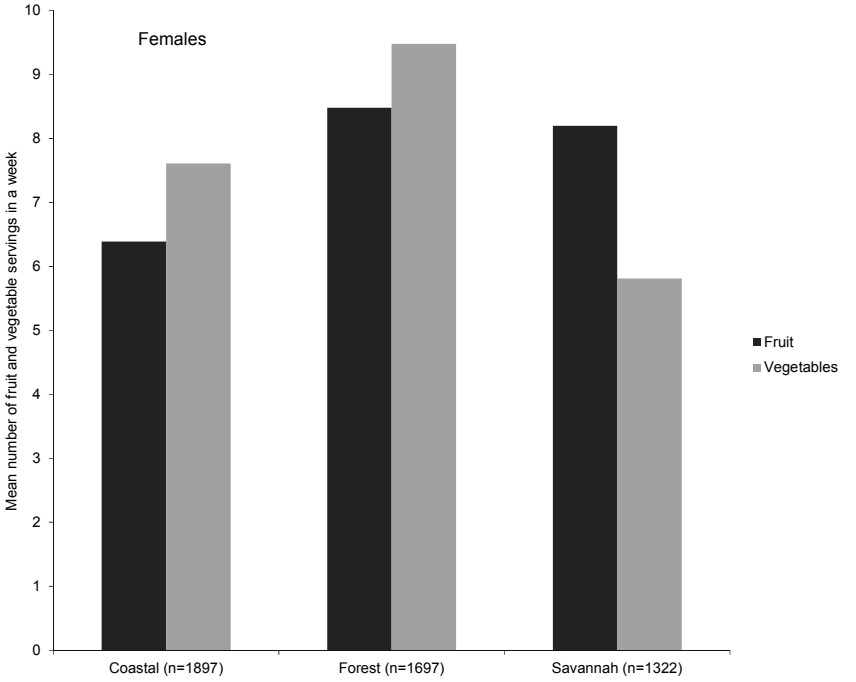

Fig. 1. Fruit and vegetable consumption among females in Ghana by ecological zone, 2008 GDHS.

Discussion

With the changing disease profile of Ghana as part of a natural response to improving welfare, regenerative health, which embraces regular intake of fruit and vegetables, has become an important concern to health policymakers in the country. In this paper, recent data from the Ghana DHS has been used to explore whether fruit and vegetable consumption varies by ecological region as well as other socioeconomic factors. However, the frequencies of fruit and vegetable intake observed in this analysis were far below recommended levels, with respondents reporting about a four times lower intake than the recommended five servings a day.

In general, females reported more fruit and vegetable consumption than males. This is consistent with some earlier studies (Thompson *et al.*, 1999; Ledoux *et al.*, 2010; Azagba & Sharaf, 2011; Nepal *et al.*, 2011). Although the reasons for the differences between females and males are not clear in the literature, some possible explanations are offered: women are more likely to be concerned about losing weight than men and therefore turn to more energy-deficient, high-fibre foods such as fruit and vegetables (Ledoux *et al.*, 2010). More compelling is the fact that men are more likely to be engaged in energy-demanding jobs than females, and therefore more likely to have high-energy content diets. Whitehead *et al.* (2012) suggested that higher levels of fruit and vegetable consumption can cause skin lightening. Fruit and vegetable intake enhances skin

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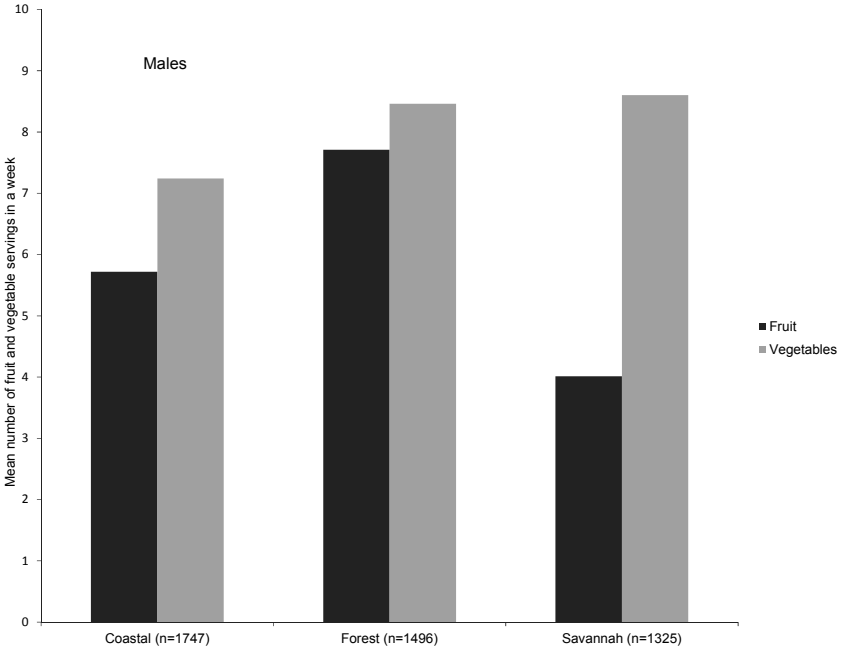

Fig. 2. Fruit and vegetable consumption among males in Ghana by ecological zone, 2008 GDHS.

carotenoid concentration (Darvin *et al*., 2008; Lademann *et al*., 2011) with the potential to change skin colour as well as contribute to overall health (Stephen *et al*., 2011). Undoubtedly, women are very anxious about skin complexion, and may recourse to fruit and vegetables to improve their skin tone. This benefit of fruit and vegetables could provide a persuasive tool for public promotion of their intake.

Significant differences in fruit and vegetable intake were found by ecological zone, thereby rejecting the null hypothesis of this study. Respondents from the Forest zone had a higher frequency of fruit and vegetable intake than those from the Coastal and Savannah zones. While cultural factors may play a role (Azagba & Sharaf, 2011), it is likely that production and distribution issues account for these differences, as the Forest zone is a better physical environment for the production of fruit and vegetables than the Savannah zone. As Dickson & Benneh (1988) showed, the soil quality coupled with climatic conditions of the Savannah zone do not naturally support large-scale production of fruit and vegetables, unless supported by great investments in soil enrichment and irrigation. Not surprisingly therefore, data on fruit and vegetable production from Ghana's Ministry of Food and Agriculture indicate that less than 2% of fruits and about 10% of vegetables are produced in the Savannah zone (Ministry of Food and Agriculture, 2010). Certainly, these physical conditions in concert with other endogenous factors might have contributed to the relatively low intake of fruit and vegetables in the Savannah zone. However, it should be emphasized that there are some important cultural, social, ethnic, economic and geographic idiosyncrasies that could confound

Table 2. Poisson regression results on relationships between socioeconomic factors and fruit and vegetable consumption in Ghanaians

	Females				Males			
	Vegetables (1)	Vegetables (2)	Fruits (3)	Fruits (4)	Vegetables (5)	Vegetables (6)	Fruits (7)	Fruits (8)
Ecological zone								
Coastal	1	1	1	1	1	1	1	1
Forest	1.346***	1.271***	1.217***	1.234***	1.164**	1.112*	1.314***	1.278***
	(1.209, 1.497)	(1.146, 1.409)	(1.098, 1.349)	(1.116, 1.364)	(1.059, 1.280)	(1.020, 1.213)	(1.184, 1.458)	(1.147, 1.423)
Savannah	1.248***	1.053	0.680***	0.694***	1.122	0.848*	0.767**	0.770*
	(1.103, 1.413)	(0.885, 1.252)	(0.585, 0.790)	(0.575, 0.838)	(0.968, 1.301)	(0.723, 0.994)	(0.654, 0.900)	(0.621, 0.955)
Wealth index								
Poorest		1		1		1		1
Poorer		0.938		1.067		1.066		1.166*
		(0.855, 1.030)		(0.939, 1.211)		(0.948, 1.198)		(1.028, 1.323)
Average		0.831**		0.971		0.937		1.066
		(0.738, 0.936)		(0.839, 1.125)		(0.797, 1.100)		(0.922, 1.233)
Richer		0.756***		0.904		0.929		0.923
		(0.662, 0.863)		(0.771, 1.060)		(0.794, 1.086)		(0.790, 1.079)
Richest		0.826*		0.872		0.873		0.890
		(0.713, 0.956)		(0.736, 1.034)		(0.741, 1.028)		(0.750, 1.058)
Type of place of residence								
Urban		1		1		1		1
Rural		1.065		1.116		0.968		1.109*
		(0.948, 1.197)		(0.990, 1.257)		(0.857, 1.093)		(0.986, 1.1248)
Education								
None		1		1		1		1
Primary		1.090		1.069		0.930		1.181*
		(0.996, 1.192)		(0.969, 1.180)		(0.831, 1.041)		(1.036, 1.346)
Middle/Junior Secondary		1.077		1.112*		0.938		1.308***
School		(0.985, 1.178)		(1.007, 1.228)		(0.839, 1.048)		(1.151, 1.485)
Secondary/Senior		1.239***		1.188*		0.913		1.267**
Secondary School		(1.108, 1.385)		(1.038, 1.359)		(0.811, 1.028)		(1.100, 1.459)
Higher		1.122		1.254*		0.907		1.358***
		(0.925, 1.361)		(1.031, 1.524)		(0.790, 1.041)		(1.147, 1.608)

Table 2. *Continued*

	Females				Males			
	Vegetables (1)	Vegetables (2)	Fruits (3)	Fruits (4)	Vegetables (5)	Vegetables (6)	Fruits (7)	Fruits (8)
Age								
15–19		1		1		1		1
20–24		0.985		1.052		1.002		0.972
		(0.896, 1.083)		(0.962, 1.150)		(0.904, 1.109)		(0.877, 1.076)
25–29		1.045		1.029		1.033		0.947
		(0.951, 1.148)		(0.928, 1.141)		(0.929, 1.149)		(0.844, 1.064)
30–34		1.179**		1.034		1.118		0.913
		(1.056, 1.316)		(0.928, 1.151)		(0.998, 1.253)		(0.803, 1.037)
35–39		1.086		1.006		1.078		0.989
		(0.979, 1.204)		(0.900, 1.125)		(0.969, 1.198)		(0.879, 1.113)
40–44		1.116*		0.990		1.140*		0.885*
		(1.006, 1.237)		(0.883, 1.109)		(1.027, 1.265)		(0.784, 1.000)
45–49		1.168**		0.936		1.097		0.990
		(1.053, 1.295)		(0.829, 1.057)		(0.984, 1.223)		(0.868, 1.130)
50–54		—		—		1.101		1.003
						(0.974, 1.244)		(0.860, 1.169)
55–59		—		—		1.138		0.937
						(0.992, 1.307)		(0.804, 1.092)
Marital status								
Never married		1		1		1		1
Married		1.078		0.916		1.034		1.056
		(0.990, 1.173)		(0.830, 1.010)		(0.946, 1.130)		(0.955, 1.167)
Formerly married		0.952		0.934		0.902		0.934
		(0.059)		(0.069)		(0.063)		(0.076)
Occupation								
Non-working		1		1		1		1
Professional/clerical		1.082		1.167*		1.008		1.095
		(0.925, 1.265)		(1.003, 1.358)		(0.905, 1.123)		(0.977, 1.226)
Sales/services		0.974		1.156**		1.072		1.034
		(0.894, 1.062)		(1.058, 1.263)		(0.948, 1.213)		(0.901, 1.188)
Agricultural		1.107*		1.173**		1.172**		1.250***
		(1.003, 1.222)		(1.054, 1.305)		(1.064, 1.292)		(1.114, 1.403)
Manual/other		0.943		1.092		1.025		1.084
		(0.850, 1.046)		(0.977, 1.220)		(0.932, 1.128)		(0.968, 1.215)

Table 2. *Continued*

	Females				Males			
	Vegetables (1)	Vegetables (2)	Fruits (3)	Fruits (4)	Vegetables (5)	Vegetables (6)	Fruits (7)	Fruits (8)
Religious background								
Catholic		1		1		1		1
Protestant		0.999		1.028		0.973		1.041
		(0.894, 1.117)		(0.922, 1.145)		(0.881, 1.076)		(0.928, 1.168)
Pentecostal/Charismatic		0.978		1.071		0.944		0.958
		(0.891, 1.073)		(0.971, 1.182)		(0.869, 1.026)		(0.867, 1.059)
Other Christian		1.203**		1.065		0.913		0.992
		(1.059, 1.366)		(0.941, 1.205)		(0.821, 1.016)		(0.882, 1.116)
Muslim		0.875*		1.146		1.084		1.062
		(0.768, 0.997)		(0.995, 1.320)		(0.926, 1.269)		(0.920, 1.227)
Traditional/spiritualist		0.813		0.705**		0.828**		0.671**
		(0.696, 0.949)		(0.553, 0.899)		(0.719, 0.954)		(0.516, 0.872)
Other		1.025		0.960		0.953		0.967
		(0.873, 1.203)		(0.782, 1.178)		(0.843, 1.076)		(0.830, 1.128)
Ethnicity								
Akan		1		1		1		1
Ga/Dangme		0.982		0.783**		1.101		0.970
		(0.828, 1.164)		(0.674, 0.910)		(0.964, 1.256)		(0.847, 1.111)
Ewe		0.785***		1.038		0.910		1.004
		(0.698, 0.883)		(0.922, 1.168)		(0.817, 1.013)		(0.897, 1.124)
Mole-Dagbani		1.169		1.095		1.294***		1.065
		(0.991, 1.378)		(0.932, 1.287)		(1.139, 1.469)		(0.881, 1.288)
Other		1.091		1.080		0.963		1.189**
		(0.936, 1.271)		(0.946, 1.231)		(0.828, 1.119)		(1.043, 1.356)
Reading newspapers/magazines								
Not at all		1		1		1		1
Less than once a week		1.030		0.963		1.128*		0.980
		(0.925, 1.148)		(0.867, 1.069)		(1.029, 1.236)		(0.894, 1.074)
At least once a week		0.973		1.151**		1.110*		1.036
		(0.884, 1.071)		(1.044, 1.268)		(1.020, 1.208)		(0.943, 1.138)
Almost every day		1.074		1.339***		1.253**		1.191*
		(0.872, 1.323)		(1.159, 1.547)		(1.085, 1.448)		(1.038, 1.366)

Table 2. *Continued*

	Females				Males			
	Vegetables (1)	Vegetables (2)	Fruits (3)	Fruits (4)	Vegetables (5)	Vegetables (6)	Fruits (7)	Fruits (8)
Listening to radio								
Not at all		1		1		1		1
Less than once a week		0.972		1.068		1.026		0.966
		(0.863, 1.094)		(0.921, 1.239)		(0.895, 1.176)		(0.795, 1.174)
At least once a week		0.971		1.198**		0.997		1.045
		(0.891, 1.059)		(1.066, 1.347)		(0.881, 1.127)		(0.880, 1.240)
Almost every day		1.029		1.305***		0.990		1.051
		(0.946, 1.118)		(1.169, 1.457)		(0.875, 1.121)		(0.886, 1.248)
Watching television								
Not at all		1		1		1		1
Less than once a week		1.052		0.974		1.055		1.137*
		(0.936, 1.181)		(0.879, 1.080)		(0.940, 1.184)		(1.007, 1.283)
At least once a week		1.020		1.063		0.981		1.043
		(0.935, 1.113)		(0.981, 1.152)		(0.865, 1.113)		(0.931, 1.168)
Almost every day		1.029		0.981		1.059		1.099
		(0.932, 1.136)		(0.899, 1.070)		(0.946, 1.185)		(0.968, 1.246)
Constant	6.333***	6.046***	7.710***	4.462***	7.255***	7.059***	5.844***	3.822***
	(5.890, 6.808)	(4.861, 7.519)	(7.180, 8.280)	(3.496, 5.694)	(6.760, 7.785)	(5.822, 8.558)	(5.421, 6.300)	(2.982, 4.898)
AIC	−21136.9	−20459.3	−23323.9	−22551.5	−18720.9	−18024.4	−18215.0	−17655.5
Log-likelihood	31.83	215.9	58.27	275.3	10.04	215.4	54.74	234.3
χ^2	4822	4806	4743	4728	4398	4379	4341	4322
N	6.333***	6.046***	7.710***	4.462***	7.255***	7.059***	5.844***	3.822***

Exponentiated coefficients; 95% CI in parentheses.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

the observed variations. For instance, in the Savannah zone, attachment to traditional views on diets is stronger than in the Coastal or Forest areas, partly due to modernization predicated on Western formal education in the latter areas (Shabaya & Konadu-Agyemang, 2004).

With improved fruit and vegetable distribution systems, some of the noted spatial inequalities could be removed. However, there are virtually no storage facilities along the major transport routes between the Forest, Coastal and Savannah zones. Although physical environmental characteristics differ from one country to another, Ali & Tsou (1997) pointed out that fruit and vegetable consumption in most developing countries is negatively affected by poor distribution and storage systems. Issues about distribution of fruit and vegetables appear germane to consumption in Ghana. In Canada for instance, Azagba & Sharaf (2011) observed spatial differences in fruit and vegetable consumption and argued that this may be correlated with regional/state food policies, which may encompass production, distribution and marketing practices. In a related study in South Africa, greater fruit and vegetable intake was found in the Western Cape than the Northern Cape, where socioeconomic conditions are poor and agriculture is underdeveloped (Nude, 2007). The Savannah zone of Ghana is similar to the Northern Cape of South Africa, with less developed agriculture and poor socioeconomic conditions.

The average consumption of vegetables among respondents was slightly higher than that of fruit. Some common eating practices among Ghanaians may account for this trend. Most Ghanaian diets (with dishes such as *fufu, banku* and *Tuo Zaafi*) are soup-based, and prepared using mainly vegetables. Also, export and economic priorities, rather than local consumption, have dominated fruit production in Ghana over the last few years, as is often the case in developing countries (Ayeiko *et al*., 2006). For instance, in 2008, Bomarts Farms Ghana Ltd, a major fruit producer, exported all the 300 tonnes of pineapples it produced to European markets. In addition, a large chunk of funds approved for Ghana under the US Millennium Challenge Account (MCA) was devoted to developing road infrastructure connecting the airport with fruit and vegetable production areas to cut travelling time for export. Besides, a high proportion of the MCA funds given to farmers was to encourage large-scale production of fruit, mainly for export.

From another perspective, this study challenges popular notions about the positive relationship between wealth status and high fruit and vegetable consumption. Azagba & Sharaf (2011), Dave *et al*. (2010) and Doku *et al.* (2013) suggested that fruit and vegetable intake is positively correlated with household wealth. However, in this case, we observed a negative association between household wealth status and fruit and vegetable consumption in both the bivariate descriptive and inferential multivariate analysis, and this cuts across gender. A plausible reason is the fact that fruit and vegetable availability in Ghana is highly seasonal: during the peak season, fruit and vegetables are available and cheap, in and around proximate growing areas as well as areas where distribution systems are better with production areas, particularly in large urban areas such as Accra, Kumasi and Takoradi. This supposition is partly strengthened by the fact that there are rarely differences in fruit and vegetable intake between urban and rural dwellers. High frequency of fruit intake especially is even more likely in rural areas than urban areas, albeit insignificant at the 5% level.

The findings of this study are consistent with those of other studies on the relationship of other socioeconomic factors (for example education) with fruit and vegetable

consumption (Dave *et al.*, 2010). Theoretically, the relationship between education and healthy dietary practices can be attributed to allocative efficiency (Grossman, 2008). Thus, all things being equal, higher education increases the stock of knowledge people have about the benefits of healthy lifestyles, of which fruit and vegetable consumption is instrumental. It is therefore consistent to observe that fruit and vegetable consumption generally correlates with educational attainment. Nevertheless, this relationship may not be straightforward in all cases due to the existence of possible confounders. For example, an inverse relationship has been observed in this analysis between vegetable intake and education among males.

Religious theologies have diverse prescriptions on dietary practices (Hoff *et al.*, 2008). In this study the most disadvantaged group was the traditional/spiritualists. These are a group of people who may hold more conservative views about lifestyles considered 'modern' or 'Western'. As recounted earlier, indigenous Ghanaians somehow view fruit and vegetable consumption as a foreign culture, and prior studies on healthy lifestyles have found this same group to be persistently disadvantaged (see Gyimah, 2007).

The study has some limitations. The use of cross-sectional data means that it is impossible to control for other factors that determine fruit and vegetable intake. For instance, childhood experiences and preferences (Gibson *et al.*, 1998) were not available in the data set. Similarly, the outcome variables (fruit and vegetable consumption) are self-reported and could have been negatively affected by recall, causing under- and over-reporting. Forshee (2004) for instance noted that over-reporting is possible because people can over-report 'good' foods like fruit and vegetables and under-report those considered 'bad'. Besides, the timing (September to November 2008) of the GDHS survey coincided with the minor season of fruit and vegetable availability in the country. Perhaps a different scenario would be noted if a similar study was conducted in a major season of fruit and vegetable availability, such as between June and September. The self-reported nature of the survey also calls for caution on servings of fruit and vegetable *vis-à-vis* quantity. Thus, the study was constrained in its estimation of the fruit and vegetable portion/quantity taken at each servings, and this limited its ability to make claims of adequacy of quantity. However, the approach used in collecting data on fruit and vegetable intake, which is the 24-hour dietary recall, has been found to be valid (WHO, 2002b).

Another limitation is the categorization of the ecological zones, as these are not strictly mutually exclusive. Regions such as Brong-Ahafo and Greater Accra have some sections with characteristics of the savannah areas. Also, some parts of the Western region have features of the forest areas; there are elements of contiguity and one must be circumspect in making attributions. Nonetheless, the fact that the results are consistent with expectations is an indication that the categorization is unbiased.

Policy implications

These findings have important implications for policy in relation to improving fruit and vegetable intake as part of the regenerative health agenda of Ghana. First, the areas with low potential for fruit and vegetable production fared relatively poorly. It therefore seems that addressing short-term fruit and vegetable distribution inequities and longer-term production, coupled with the intensive promotion of local consump-

tion concurrently would be important here. One effective approach could be an application of a sector-wide approach (SWAp), where a number of ministries and departments such as agriculture, finance, trade and industry, transportation and education are fused to engage policy interventions to encourage fruit and vegetable intake. For instance, the Ministry of Finance and Economic Planning could provide financial assistance to producers across the country while the Ministry of Food and Agriculture could provide technical assistance to farmers. Similarly, the Ministry of Trade and Industry is in a position to facilitate storage and distribution. The current orientation of the Ministry of Trade, which is more geared towards export, is counterproductive to the health needs of the local population. Large-scale local production and consumption of fruit and vegetables would not only contribute to a healthy population, but would be an equally positive mechanism for poverty alleviation.

Conclusion

It has been demonstrated in this study that the intake of fruit and vegetables in Ghana overall is low and disparities are noted by ecological zone, as well as by educational attainment, wealth status, marital status, age and exposure to media. The effect of ecological zone remains important even after controlling for other socioeconomic factors, indicating the importance of location on fruit and vegetable intake in the country. Even though the disparities observed are not causal, they point out the need for more inclusive formal and informal education on the benefits of consumption of fruit and vegetables. This will help the country reduce or probably curtail the emerging burden of non-communicable diseases related to lifestyles.

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