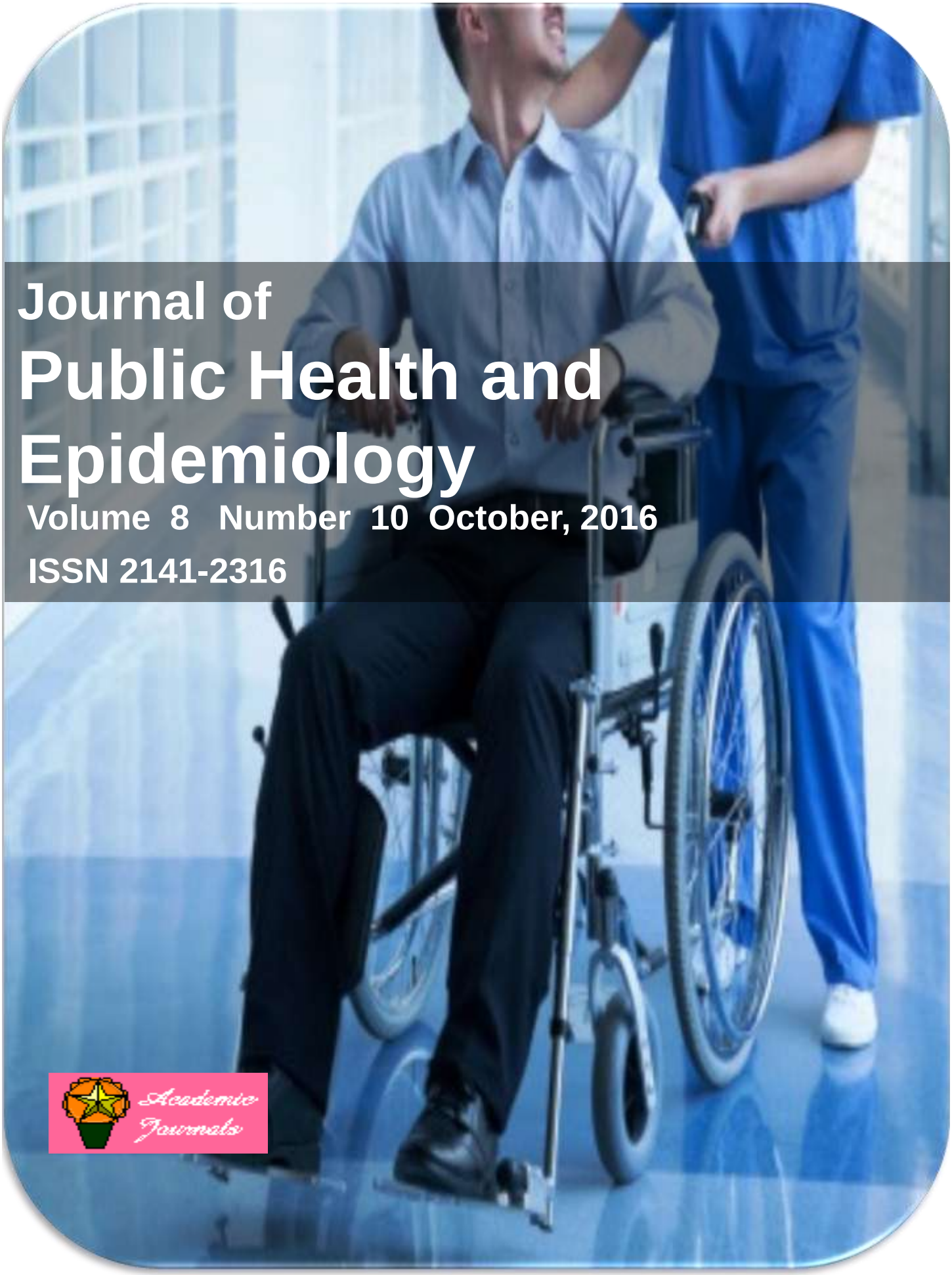

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Full Length Research Paper

The cost-effectiveness of an updated theory-based online health behavior intervention for new university students: U@Uni2

Chloe Thomas[1]*, Penny Breeze[1], Mark Strong[1], Alan Brennan [1], Paul Norman[2], David Cameron[2] and Tracy Epton[3]

[1]School of Health and Related Research, University of Sheffield, Regent Court, 30 Regent Street, Sheffield S1 4DA, United Kingdom.
[2]Department of Psychology, University of Sheffield, Western Bank, Sheffield S10 2TP, United Kingdom.
[3]Manchester Centre for Health Psychology, School of Psychological Sciences, University of Manchester, Coupland Street, Oxford Road, Manchester M13 9PL, United Kingdom.

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The transition to university marks a point where young people may be open to changing health behaviours such as smoking, exercise, diet and alcohol intake. This study aimed to estimate the cost-effectiveness of an updated online health behaviour intervention for new university students in the UK – "U@Uni2", compared with both a control (measurement only) scenario and with the original intervention ("U@Uni1"). The economic analysis, based on a randomized controlled trial, comprised a detailed costing analysis, a within-trial cost-effectiveness analysis and long-term economic modelling. Cost-effectiveness of the U@Uni2 trial was estimated using 6-month data on costs and health-related quality of life. An individual patient simulation model was adapted for long-term economic analysis of U@Uni2. Probabilistic sensitivity analysis and value of information analysis accounted for uncertainty in model inputs and identified key parameters. The U@Uni2 intervention costs £45.97 per person for full implementation, £10.43 per person for roll-out in a different institution and £3.03 per person for roll-out over five years. The U@Uni2 trial was not cost-effective because marginally fewer quality-adjusted life years (QALYs) were obtained in the intervention arm than the control. However, modelled over a lifetime, U@Uni2 is estimated to produce more QALYs than control but fewer than U@Uni1, primarily due to the effect of the interventions on smoking. Roll-out of U@Uni2 is highly likely to be more cost-effective than doing nothing (ICER = £536 per QALY, 86% probability cost-effective). Decision uncertainty occurs primarily around the effectiveness of the U@Uni2 intervention and is worth up to £3.24 m. The U@Uni2 intervention is highly likely to be cost-effective to roll-out when compared with doing nothing. The results suggest that preventing uptake of smoking is the key driver of QALY gain and should be the primary target of such interventions.

Key words: Alcohol, diet, exercise, smoking, health behavior, cost-effectiveness, economic evaluation, students, university.

INTRODUCTION

The National Health Service (NHS) spends billions of pounds per year treating the burden of disease caused by unhealthy lifestyle choices such as smoking, excessive drinking, lack of exercise and poor diet (The King's Fund,

2014). Many of these behaviours are adopted early in adulthood, and ultimately result in an increased risk of disease and mortality, and a reduction in health-related quality-of-life. The transition between school and university is a point when individuals are likely to change existing health behaviours and establish new habits (Friedman et al., 2008; Plotnikoff et al., 2015). U@Uni is an online intervention based upon the psychological theories of self-affirmation, planned behaviour and implementation intentions (Ajzen, 2005; Gollwitzer and Sheeran, 2006; Harris and Epton, 2009), which targets four health behaviours: smoking, drinking alcohol, eating fruit and vegetables, and physical activity in new university students. A 2012 randomized clinical trial (RCT) of a first variant U@Uni1 and a full economic analysis of U@Uni1 versus 'measurement only' control concluded that although the effect of the intervention on health behaviours was small, rolling out the intervention to other universities would be cost-effective (Epton et al., 2014; Kruger et al., 2014).

The U@Uni1 trial suffered from low levels of recruitment and technological problems, resulting in poor engagement with the intervention. An updated version of the intervention (U@Uni2) was designed using the LifeGuide intervention software developed by Southampton University (Yang et al., 2009), which helped to minimize technical problems. The pre-intervention baseline questionnaire was also shortened. The U@Uni2 intervention was compared with the control in an RCT of 2,623 undergraduates beginning their studies in 2013 at the University of Sheffield, United Kingdom. Results from the trial are available elsewhere (Cameron et al., 2015).

This economic evaluation aims to estimate the short-term (6-month) and long-term (lifetime) cost-effectiveness of U@Uni2, when compared with both the 'measurement only' control condition and also with the U@Uni1 intervention. The perspective of the study is that of the UK Department of Health.

METHODS

The economic evaluation took the same format as U@Uni1 (Kruger et al., 2014), with three components: a costing analysis; a within-trial analysis; and an economic modelling analysis to estimate long-term cost-effectiveness of the U@Uni2 intervention, when compared with either the control condition or with the U@Uni1 intervention. The methods are summarized here; detailed methods are available in the online supplementary appendix.

Costing analysis

The costs of U@Uni2 were estimated using a modified version of theU@Uni1 staff costs questionnaire (Kruger et al., 2014 and Additional file 1). Staff from the Department of Psychology were asked to estimate the number of hours they had spent developing, updating and implementing the U@Uni2 intervention in addition to any non-staff costs incurred. The full economic cost of all staff time including overheads, national insurance and pension costs was estimated using the University of Sheffield's University Research Management System. Costs were calculated at 2013 values. Three different scenarios were costed for long-term modelling. The cost of full implementation of a U@Uni2 style intervention including development costs, the cost for roll-out of the existing U@Uni2 intervention to another university, and the cost of rolling out the intervention assuming it could be used for five years with minimal updating (five-year costs). Roll-out costs were estimated in a similar manner by including the cost of developing local elements from U@Uni1 in addition to a subset of costs from U@Uni2. Five-year costs were based upon roll-out costs but were divided into an annuitized set-up cost and an annual maintenance cost. The long-term economic modelling allows three-way comparison of control, U@Uni1 and U@Uni2 interventions. To allow direct comparison, all costs from U@Uni1 were inflated to 2013 values using the consumer price index from the Office of National Statistics (ONS) (Office for National Statistics, 2014).

Within-trial cost-effectiveness analysis (short-term 6-month time horizon)

A within-trial analysis was performed by balancing the gain in QALYs accrued during the trial against the cost of healthcare and the costs of full implementation of the U@Uni2 intervention. Healthcare costs were calculated from questionnaire data that asked about healthcare utilisation during the trial period (Cameron et al., 2015). NHS Reference Costs 2012-13 (Department of Health, 2013) and the Unit Costs of Health and Social Care 2013 (Personal Social Service Research Unit, 2013) were used to assign unit costs to each healthcare source used. Data on health-related quality of life was collected at baseline, one month and six month time-points, and weighted using preference based EQ-5D values (Dolan et al., 1995). Missing data for costs and health-related quality of life was imputed using multiple imputation by chained equations (White et al., 2011). Baseline characteristics of the individuals who took part in the trial are presented in Appendix Table 1. Ordinary least squares (OLS) regression models were generated to estimate total costs and QALYs using personal characteristics as covariates.

Long-term economic modelling (lifetime time horizon)

Long-term cost-effectiveness of the U@Uni2 intervention was assessed using an adaptation of the U@Uni1 economic model (Kruger et al., 2014). The model is a population based individual patient-level simulation that models individuals selected from baseline data collected in the U@Uni2 trial. Their age, gender, portions of fruit/vegetables consumed daily, units of alcohol consumed weekly, minutes of physical activity undertaken weekly and smoking status influence their probability of dying and their estimated utility during each year of their life. The same individuals were simulated in control conditions and with the U@Uni1 and U@Uni2 interventions. Life years, QALYs and costs were discounted annually at 1.5% as recommended by NICE for public health economic evaluations (National Institute for Health and Clinical Excellence, 2012). Incremental analysis was carried out to

*Corresponding author. E-mail: c.thomas@sheffield.ac.uk.

compare each of the interventions with the control condition and with each other.

Uncertainty

Probabilistic sensitivity analysis (PSA) was carried out to estimate the probability of the interventions being cost-effective at different willingness to pay thresholds. 30,000 model runs were performed, each simulating 1000 random individuals. Expected value of perfect information (EVPI) and partial expected value of perfect information (EVPPI) were carried out, using the Sheffield Accelerated Value of Information (SAVI) online tool (Strong et al., 2014), to determine the value of further research into parameter estimation.

A series of structural sensitivity analyses were carried out to test certain model assumptions. The sensitivity of the results of the duration of intervention effect was tested by fixing the mean at values of 1, 2, 5 and 10 years. The model was also tested for the sensitivity of results to the structural updates to the model. Finally, the contribution of each of the four individual behaviors to costs and QALYs was assessed.

RESULTS

Costing analysis results

Costs for full implementation of the U@Uni2 intervention were estimated at £61,828 (£50,544 to £73,158, 95% confidence interval [CI]), of which £47,179 was due to previous spending on U@Uni1 and £14,649 was specific to U@Uni2. Staff cost was £27,444 in total, whilst non-staff costs comprised £34,384. This is considerably cheaper than the cost estimated for full implementation of U@Uni1 (Kruger et al., 2014), which when inflated to 2013 values came to £213,921. The reason for the large difference is due predominantly to the use of the LifeGuide software for U@Uni2 (Yang et al., 2009), which eliminated the need for costly development of a website from scratch. Given that there were 1,345 individuals in the intervention arm of the RCT, this works out as £45.97 per person (£37.58 to £54.39, 95% CI).

Roll-out costs for U@Uni2 were estimated at £15,701 (£13,555 to £17,864, 95% CI), of which £9,792 was due to previous spending on U@Uni1 and £5,909 was specific to U@Uni2. The comparable inflated costs for U@Uni1 were £30,768. The U@Uni1 costs were larger due to website maintenance that the U@Uni1 site required. The mean number of UCAS acceptances per UK institution in 2013 was 1,506 (Universities and Colleges Admissions Service, 2013). Dividing U@Uni2 roll-out costs by this figure results in a cost of £10.43 per person (£9.00 to £11.86, 95% CI).

The costs of rolling out U@Uni2 over a five year period were estimated as £4,563 per year (£3,842-£5,292, 95% CI), of which £2,946 was due to annuitized setting up costs and £1,617 was yearly maintenance costs. This was equivalent to £3.03 per student (£2.55 to £3.51, 95% CI). Comparable inflated costs for U@Uni1 were £9,434 (£8,530-£11,234, 95% CI), of which £6,069 was due to annuitized setting up costs and £3,365 was yearly maintenance costs. This worked out as £6.26 (£5.66 to £7.46, 95% CI) per person.

Within-trial cost-effectiveness analysis results

The within-trial analysis found that the U@Uni2 intervention cost an extra £35.30 (£30 to £40.51, 95% CI, based on 5000 bootstrap runs) per individual when compared with the control arm, considerably lower than the incremental costs generated in the intervention arm of the U@Uni1 trial (£326.37). The incremental cost was entirely due to the cost of the intervention, as healthcare utilization was reduced in the intervention arm of the trial, resulting in lower healthcare costs when compared with the control arm (-£10.67). Although, the intervention group used fewer healthcare resources during the 6-month trial period, they also gained fewer QALYs than the control group (-0.0025 incremental QALYs), although this was not statistically significant (0.0001 to -0.0051, 95% CI, based on 5000 bootstrap runs).

The incremental cost-effectiveness ratio (ICER) was calculated at -£14,314 per QALY gained (at a threshold of £20,000 per QALY). INB was found to be -£84.63, indicating that the intervention is not cost-effective in the short-term, due to the negative estimated QALY gain. Uncertainty analysis determined that the probability the intervention would be cost-effective at this threshold is only 0.0004 (Figure 1).

Long-term economic modelling results

The long-term lifetime economic modelling results are presented in detail in **Error! Reference source not found.** and Figure 2. Both U@Uni1 and U@Uni2 produce small increases in life years and QALYs gained as compared to the control. However, U@Uni2 is slightly less effective than U@Uni1, producing only 0.00533 incremental QALYs when compared with the 0.00767 incremental QALYs produced by U@Uni1.

Incremental costs for full implementation of U@Uni2 when compared with control are £37.90, resulting in an ICER of £7,106, an INB of £69 and a probability cost-effective of 76% (Tables 1 and Figure 2). In contrast, incremental costs for full implementation of U@Uni1 are £152.94. The intervention is marginally cost-effective with an ICER of £19,947, but there is a high level of uncertainty around this result as the probability cost-effective is only 49%. Direct comparison indicates that the updated U@Uni2 intervention is more likely to be cost-effective than the original U@Uni1 intervention, with a probability of 75% and INB of £68 (Table 1).

Roll-out of U@Uni2 costs only £2.86 per person, when compared with £9.26 for roll-out of U@Uni1. Both interventions are likely to be cost-effective in the roll-out scenario when compared with control to a similar extent (ICER = £1,207 for U@Uni1, probability cost-effective =93%; ICER = £536 for U@Uni2, probability cost-effective = 86%) (Table 1 and Figure 2). Despite higher costs, the

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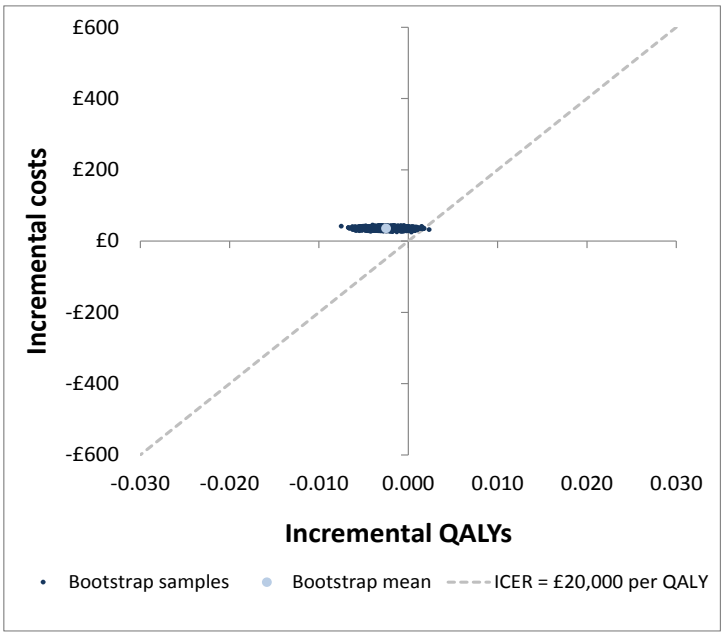

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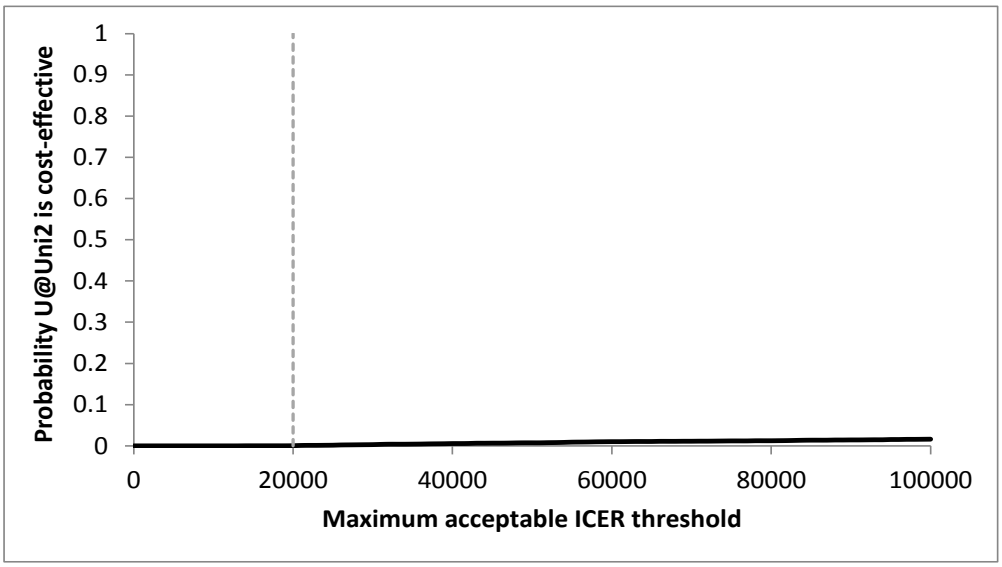

Figure 1. Within-trial cost-effectiveness planes and cost-effectiveness acceptability curves for U@Uni2 as compared to do nothing control. The individual-level cost-effectiveness plane and cost-effectiveness acceptability curve resulting from 5,000 bootstrap replicates in the within-trial cost-effectiveness analysis. **A)** Cost-effectiveness plane showing the incremental costs and QALYs accumulated over the 6 month trial period for full development and implementation of U@Uni2 compared to control. **B)** Cost-effectiveness acceptability curve showing the probability (out of 5,000 bootstrap replicates) that full development and implementation of U@Uni2 is cost-effective compared to control for a range of willingness-to-pay thresholds.

net benefit gained by U@Uni1 (£144) is slightly higher than for U@Uni2 (£104), due to its larger incremental QALY gain. However, there is a high level of uncertainty around the relative cost-effectiveness of the two interventions and they occupy similar distributions on the cost-effectiveness plane (Figure 2B).

Rolling out either intervention over a five year period is estimated to be cost saving as compared to control, as

Table 1. The incremental long-term cost-effectiveness of U@Uni (per person).

	U@Uni1 vs Control	U@Uni2 vs Control	U@Uni1 vs U@Uni2
Scenario 1: Full development and implementation of U@Uni1/U@Uni2			
Discounted life years	0.00070	0.00062	0.00008
Discounted QALYs	0.00767	0.00533	0.00233
Discounted costs	£152.94	£37.90	£115.04
ICER	£19.947	£7.106	£49.278
INB** at threshold of £20,000 per QALY	£0.41	£69	-£68
Probability cost-effective at willingness-to-pay threshold of £20,000 per QALY	48.7%	76.1%	24.1%
Scenario 2: Roll-out of U@Uni1/U@Uni2			
Discounted life years	0.00070	0.00062	0.00008
Discounted QALYs	0.00767	0.00533	0.00233
Discounted costs	£9.26	£2.86	£6.40
ICER	£1,207	£536	£2,741
INB** at threshold of £20,000 per QALY	£145	£104	£40
Probability cost-effective at willingness-to-pay threshold of £20,000 per QALY	92.7%	86.4%	65.9%
Scenario 3: Roll-out of U@Uni2 over five years			
Discounted life years	0.00070	0.00062	0.00008
Discounted QALYs	0.00767	0.00533	0.00233
Discounted costs	-£5.30	-£4.50	-£0.80
ICER	-£692	-£844	-£344
INB** at threshold of £20,000 per QALY	£159	£111	£47
Probability cost-effective at willingness-to-pay threshold of £20,000 per QALY	95.1%	88.2%	68.4%
Probability cost-saving at willingness-to-pay threshold of £20,000 per QALY	67.7%	66.7%	53.5%

*Any apparent discrepancies are due to rounding; **Incremental net monetary benefit = incremental QALYs x willingness-to-pay threshold – incremental costs.

the reduction in healthcare cost outweighs the cost of the interventions. £5.30 is saved per person for U@Uni1 and £4.50 is saved per person for U@Uni2. Again, both interventions are highly likely to be cost-effective when compared with control (INB of U@Uni1 = £159, probability cost-effective = 95%; INB of U@Uni2 = £111, probability cost-effective = 88%), and are cost-effective as compared to the standard roll-out from a cost-minimization perspective.

Structural sensitivity analyses

Sensitivity analyses suggest that the results are not sensitive to the removal of model updates, but they are sensitive to the method of imputation for missing data (Appendix Table 2).

The cost-effectiveness of all scenarios is correlated with the duration of intervention effect (Table 2). For roll-out, both interventions have almost 70% probability of being cost-effective even if the mean duration of intervention effect is only 1 year, and by 10 years, both interventions are cost saving. Rollout of both interventions over 5 years is highly likely to be cost-effective in all situations, but only becomes cost-saving if duration of intervention effect lasts for about 2-3 years.

The model allows assessment of the individual contribution of each health behaviour change to quality of life and mortality. Results show that the reduction in smoking accounts for almost 75% of the incremental life years gained with U@Uni1 and over 60% of the incremental life years gained with U@Uni2. An increase in physical activity accounts for a further 20% of incremental life years gained whilst the other two behaviours contribute only very slightly to mortality reductions. The utility effects of smoking are even more dramatic than the mortality effects, such that the entire QALY gain seen in both interventions is purely due to the effect of the interventions on smoking.

Value of information

Value of information analysis was performed for roll-out of the U@Uni2 intervention versus the control only. The overall value of information from EVPI analysis was found to be £6.54 per person for the roll-out of U@Uni2. The population potentially affected by the decision was the

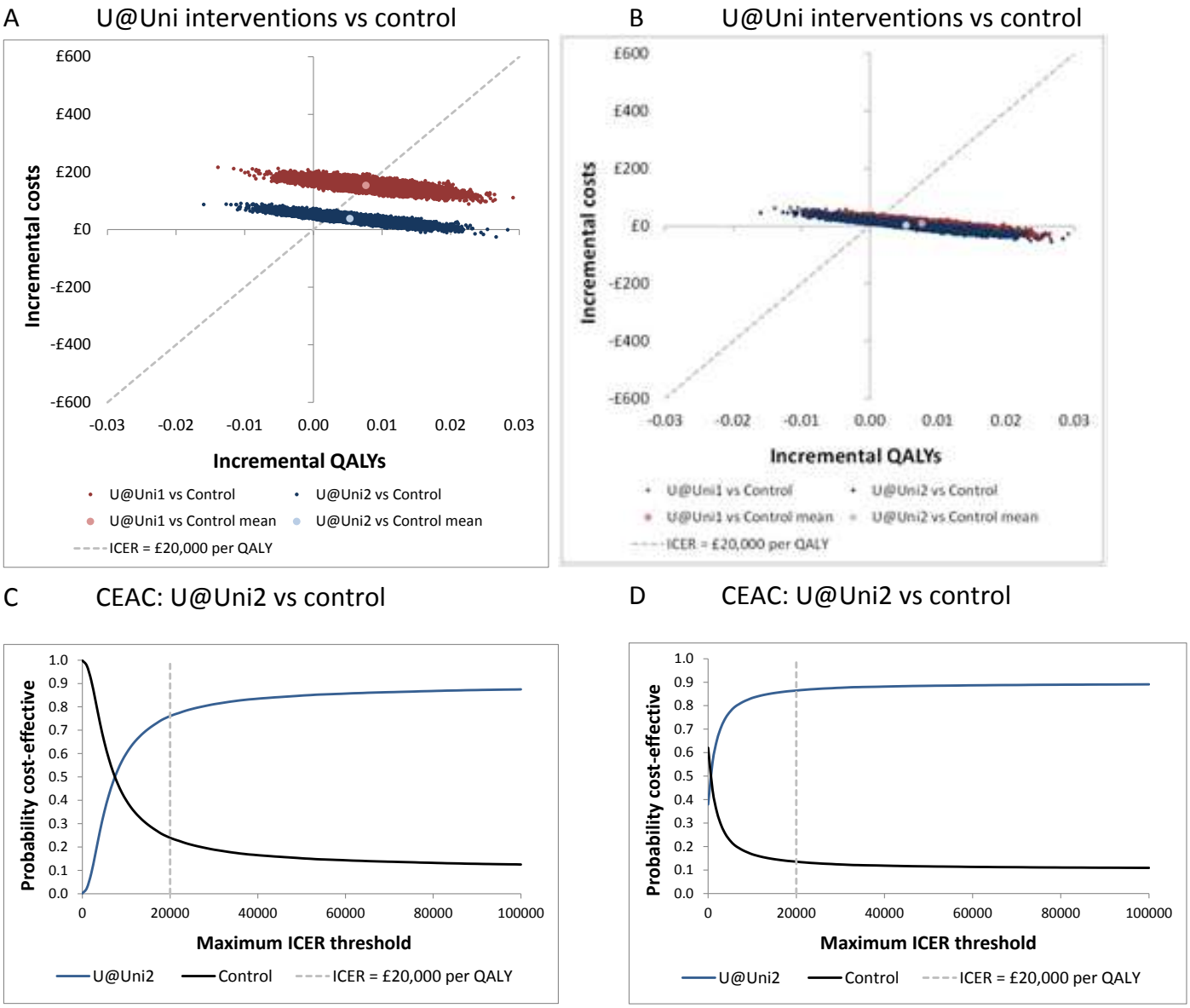

Figure 2. Cost-effectiveness planes and cost-effectiveness acceptability curves for long-term modelling of full implementation and roll-out of U@Uni1 and U@Uni2 interventions, compared to a do nothing control. **A)** Cost-effectiveness plane showing the per-person incremental discounted lifetime costs and incremental discounted lifetime QALYs for full implementation of U@Uni1 and U@Uni2 compared to a do nothing control. **B)** Cost-effectiveness plane showing the per-person incremental discounted lifetime costs and incremental discounted lifetime QALYs for roll-out of U@Uni1 and U@Uni2 compared to a do nothing control. **C)** Cost-effectiveness acceptability curve (CEAC) showing the probability (out of 30,000 PSA runs) that full development of U@Uni2 compared with control is cost-effective at different willingness-to-pay thresholds. **D)** Cost-effectiveness acceptability curve (CEAC) showing the probability (out of 30,000 PSA runs) that roll-out of U@Uni2 compared with control is cost-effective at different willingness-to-pay thresholds.

individuals starting university each year. In 2013, there were 495,560 UCAS acceptances in the UK (Universities and Colleges Admissions Service, 2013), meaning that it could be worth spending up to £3.24 million on further research that would enable an accurate decision to be made within a year. EVPPI analysis indicates that decision uncertainty is driven primarily by the parameters relating to the effects of the intervention on health behaviours, worth up to £3.79 per person or £1.9 million in total (Table 3). The individual parameters that have by far the most influence are the rates of non-smokers taking up smoking in the U@Uni2 and control conditions, which are worth 31p and 21p per person, respectively.

DISCUSSION

The U@Uni2 intervention is an updated version of the

Table 2. Comparison of incremental cost-effectiveness results over different durations of intervention effect.

DURATION OF EFFECT	U@Uni1 vs Control				U@Uni2 vs Control			
	QALYs	Costs	INB	Prob. CE	QALYs	Costs	INB	Prob. CE
Scenario 1: Full development and implementation of U@Uni1/U@Uni2								
1 yr	0.00185	£162.19	-£125.27	0.1%	0.00138	£43.76	-£16.22	34%
2 yrs	0.00367	£159.09	-£85.72	6.6%	0.00266	£41.69	£11.58	57.8%
5 yrs	0.00923	£150.16	£34.44	62.5%	0.00645	£36.29	£92.67	79.9%
10 yrs	0.01871	£135.72	£238.54	87.6%	0.01266	£28.68	£224.45	87.5%
Scenario 2: Roll-out of U@Uni1/U@Uni2								
1 yr	0.00185	£18.69	£18.23	68.7%	0.00138	£8.69	£18.85	69.6%
2 yrs	0.00367	£15.59	£57.78	83.7%	0.00266	£6.62	£46.65	80.5%
5 yrs	0.00923	£6.67	£177.94	94.4%	0.00645	£1.22	£127.74	87.7%
10 yrs	0.01871	-£7.78	£382.04	97.3%	0.01266	-£6.39	£259.52	90.7%
Scenario 3: Roll-out of U@Uni2 over 5 years								
1 yr	0.00185	£4.18	£32.74	80.9%	0.00138	£1.31	£26.23	76.0%
2 yrs	0.00367	£1.07	£72.29	91.0%	0.00266	-£0.75	£54.03	83.7%
5 yrs	0.00923	-£7.85	£192.45	96.2%	0.00645	-£6.15	£135.11	89.1%
10 yrs	0.01871	-£22.12	£396.38	97.8%	0.01266	-£13.76	£266.90	91.5%

QALY, Quality Adjusted Life Year; INB, Incremental Net Monetary Benefit; Prob. CE Probability Cost-Effective.

Table 3. EVPPI values for key single parameters and parameter combinations implicated in decision uncertainty when comparing U@Uni2 roll-out with a do nothing control.

Parameters	Roll-out of U@Uni2 vs Control		
	Per Person		UCAS population mean
	Mean	St. error	
Probability non-smokers start smoking (do nothing)	£0.21	£0.02	£105,100
Probability non-smokers start smoking (U@Uni2)	£0.31	£0.02	£153,800
Physical activity: U@Uni2 intervention coefficient	£0.00	£0.00	£2,392
All intervention effects total	£3.79	£0.15	£1,878,200
Intervention effects – all smoking parameters	£2.03	£0.15	£1,006,000
Intervention effects – all fruit/veg parameters	£0.00	£0.00	£0
Intervention effects – all physical activity parameters	£0.01	£0.01	£4,956
Intervention effects – all alcohol parameters	£0.00	£0.00	£0
Utility coefficients (all)	£0.44	£0.28	£218,000

U@Uni theory-based online health behaviour intervention for students as they start university (Cameron et al., 2015; Epton et al., 2014). This analysis shows that the U@Uni2 intervention is considerably cheaper to implement than U@Uni1. However, lifetime modelling indicates that U@Uni2 is likely to be less effective than U@Uni1, producing both fewer life years and fewer QALYs. Roll-out of U@Uni2 is highly likely to be more cost-effective than doing nothing, but is not likely to be more cost-effective than roll-out of U@Uni1.

The LifeGuide software was more user-friendly than the U@Uni1 website, and this together with some changes to trial design resulted in increased levels of recruitment and engagement with the intervention (Cameron et al., 2015). Despite these changes, the U@Uni2 intervention did not show a significant improvement in any of the four behaviours and the U@Uni2 trial itself was not found to be cost-effective due to a small reduction in health-related quality-of-life. QALY loss during the trial is likely to be due to stochastic sample variability and low sensitivity of the EQ-5D to measuring subtle changes in quality of life at the top of the scale (Brazier et al., 2007).

Improvements in smoking behaviour appear to account for the vast majority of life-years and QALYs gained for

both interventions. This is driven by the large effects smoking has on both quality of life and mortality compared with the other behaviours (Kruger et al., 2014; Kvaavik et al., 2010). A recent review of the economic impacts of smoking suggests that the direct costs of smoking may use 5% of the annual NHS budget, and far outweigh any economic benefits such as increased tax intake (Ekpu and Brown 2015). This suggests that specifically targeting smoking may not only be the best way to improve the health of young people, but will have positive economic consequences in the long term. In line with this, smoking cessation programmes aimed at young people have been found to be highly cost-effective in other economic analyses (Dino et al., 2008; Hollingworth et al., 2012).

A series of sensitivity analyses were carried out to test assumptions of model structure and methodology. Sensitivity analyses around the duration of intervention effect produced the largest changes in cost-effectiveness. Very little work has been done to investigate the likely duration of effect of online health interventions; this would be a useful area for further research. EVPPI analysis indicates that the highest level of decision uncertainty is around the effect of the intervention on health behaviours, particularly smoking. As intervention effectiveness is key to deciding whether to fund U@Uni2, decision makers may wish to invest in gathering more information to inform these parameters.

Taken together, the results of the two U@Uni trials suggest that online interventions can have a positive effect on health behaviours in new university students. These effects may be very small, but over a lifetime can result in significant health gains that are extremely cost-effective to implement. Similar small but positive effects have been found recently in other trials of online interventions aiming to reduce unhealthy behaviours in students (Kattelmann et al., 2014; Kypri et al., 2014). However, the U@Uni interventions remain unique amongst similar online health behaviour interventions in their demonstration of cost-effectiveness in addition to efficacy.

This study was performed from the perspective of the UK Department of Health; however, it is unclear whether they would be willing to fund such an intervention. Public health funding is concerned both with maximizing efficiency and reducing inequity (National Institute for Health and Clinical Excellence, 2012). University students are disproportionately from more privileged backgrounds (Universities and Colleges Admissions Service, 2014), and individuals with a degree have better health outcomes (Higher Education Funding Council for England, 2001) meaning that funding the U@Uni2 intervention could act to increase health inequalities. However, given the commitment of universities in England to the “Healthy Universities Scheme” to improve student health and well-being (UK National Healthy Universities Network, 2015), and the relatively low costs involved, larger universities may themselves wish to consider funding a U@Uni2 type intervention as part of their student health and well-being programme.

Conclusions and recommendations

This study estimates the costs and cost-effectiveness of U@Uni2, an updated version of the U@Uni trial of an online intervention targeting multiple health behaviours in new university students. The study shows that U@Uni type interventions are cost-effective to roll-out and suggests that universities committed to student health consider such an intervention given the low costs involved. Most of the decision uncertainty is associated with the effect of the intervention on health behaviour change, suggesting that further research should focus on this area. Given that intervention efficacy is almost entirely dependent on the smoking effect, targeting smoking is a priority for improving healthy behaviours in young people.

Conflict of interests

The authors have not declared any conflict of interests.

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Appendix

A full list of all the parameters used in the model and their values and distributions.

Table 1. Model input parameters.

Parameter	Distribution	Parameters*	Source
Individual baseline characteristics			
Age (years)	Individual-level data	Mean = 18.81 SD = 2.36	U@Uni2 RCT
Gender	Individual-level data	44.8% Male 55.2% Female	
Fruit and vegetables (portions per day)	Individual-level data	Mean = 4.49 SD = 2.27	
Alcohol (units per week)	Individual-level data	Mean = 6.87 SD = 9.51	
Physical activity (minutes per week)	Individual-level data	Mean = 814.16 SD = 765.95	
Smoking status	Individual-level data	2.9% Smoker 97.1% Non-smoker	
Costs			
U@Uni1 cost (full development)	Lognormal	Mean ln(cost) = 12.30663 SD ln(cost) = 0.05185	Costing analysis
U@Uni1 cost (roll-out)	Lognormal	Mean ln(cost) = 10.36116 SD ln(cost) = 0.06628	Costing analysis
U@Uni2 cost (full development)	Lognormal	Mean ln(cost) = 11.01548 SD ln(cost) = 0.09433	Costing analysis
U@Uni2 cost (roll-out)	Lognormal	Mean ln(cost) = 9.65251 SD ln(cost) = 0.07043	Costing analysis
U@Uni2 cost (roll-out over 5 years)	Lognormal	Mean ln(cost) = 8.41381 SD ln(cost) = 0.08173	Costing analysis
Intervention effect regression coefficients			
β_0 Fruit and vegetables: constant	Multivariate normal (see Additional file 1 for covariance matrix)	Mean = 0.7696	U@Uni1 & U@Uni2 RCTs
β_1 Fruit and vegetables: baseline behaviour coefficient		Mean = 0.4583	
β_2 Fruit and vegetables: age coefficient		Mean = 0.0722	
β_3 Fruit and vegetables: gender coefficient (1 = male; 0 = female)		Mean = -0.4053	
β_4 Fruit and vegetables: U@Uni1 intervention coefficient (i.e. mean effect of U@Uni1 on portions of fruit and vegetables per day compared to control)		Mean = -0.05387	
B_5 Fruit and vegetables: U@Uni2 intervention coefficient (i.e. mean effect of U@Uni2 on portions of fruit and vegetables per day compared to control)		Mean = 0.1714	
β_0 Alcohol: constant	Multivariate normal (see Additional file 1 for covariance matrix)	Mean = 14.720	U@Uni1 & U@Uni2 RCTs
β_1 Alcohol: baseline behaviour coefficient		Mean = 0.6408	
β_2 Alcohol: age coefficient		Mean = -0.5077	
β_3 Alcohol: gender coefficient (1 = male; 0 = female)		Mean = 2.8588	

Table 1. Contd.

β_4 Alcohol: U@Uni1 intervention coefficient (i.e. mean effect of U@Uni1 on units of alcohol per week compared to control)		Mean = -0.20932	
B_5 Alcohol: U@Uni2 intervention coefficient (i.e. mean effect of U@Uni2 on units of alcohol per week compared to control)		Mean = -0.5032	
β_0 Physical activity: constant	Multivariate normal (see Additional file 1 for covariance matrix)	Mean = 563.26	U@Uni1 & U@Uni2 RCTs
β_1Physical activity: baseline behaviour coefficient		Mean = 0.2068	
β_2 Physical activity: age coefficient		Mean = 2.1423	
β_3 Physical activity: gender coefficient (1 = male)		Mean = 77.835	
β_4 Physical activity: U@Uni1 intervention coefficient (i.e. mean effect of U@Uni1 on minutes of physical activity per week compared to control)		Mean = 25.93877	
B_5 Physical activity: U@Uni2 intervention coefficient (i.e. mean effect of U@Uni2 on minutes of physical activity per week compared to control)		Mean = 17.759	
Probability smokers quit smoking (U@Uni1)	Beta	α = 5.4 β = 13.6	U@Uni1 RCT
Probability non-smokers start smoking (U@Uni1)		α = 22.83 β = 547.17	
Probability smokers quit smoking (U@Uni2)	Beta	α = 3.72 β = 15.28	U@Uni2 RCT
Probability non-smokers start smoking (U@Uni2)		α = 27.47 β = 542.53	
Probability smokers quit smoking (do nothing)	Beta	α = 3.81 β = 17.19	
Probability non-smokers start smoking (do nothing)		α = 50.29 β = 602.71	
Lag effects (years until full effect of behaviour change on mortality risk)			
Fruit and vegetables lag	Lognormal	Mean = 2.7438 SD = 0.1247	Expert elicitation
Alcohol lag	Gamma	α = 1.3541 β = 0.6537	
Physical activity lag	Normal	Mean = 5.5000 SD = 1.4642	
Smoking lag	Normal	Mean = 5.5000 SD = 1.1110	
Distribution of individual-level duration of U@Uni behavioural effect (years)**			
Mean duration	Beta	α = 1.8179 β = 0.1304 Scale = 4.5000	Expert elicitation
Standard deviation of duration		α = 2.9109 β = 0.2691 Scale = 3.3800	
Hazard ratios for effect of health behaviours on mortality risk			
Fruit and vegetable consumption	Lognormal	Mean = 0.0953 SD = 0.0673	Kvaavik et al. (2010) (16)
Alcohol consumption		Mean = 0.1655 SD = 0.0840	

Table 1. Contd.

Physical activity		Mean = 0.3577 SD = 0.0641	
Smoking status		Mean = 0.3577 SD = 0.0873	
Utility ordinary least squares regression model coefficients			
β_0 Constant	Multivariate normal (see Additional file 1 for covariance matrix)	Mean = 0.9490	Analysis of Health Survey for England 2008 (17)
β_1 Age coefficient		Mean = -0.0038	
β_2 Gender (1 = male; 0 = female) coefficient		Mean = 0.0142	
β_3 Fruit and vegetables (portions per day) coefficient		Mean = 0.0207	
β_4 Alcohol (units per week) coefficient		Mean = 0.0016	
β_5 Smoke (smoker = 1; non-smoker = 2) coefficient		Mean = -0.0541	
β_6 Physical activity (minutes per week) coefficient		Mean = 0.0002	
β_7 Age^2		Mean = -4.31×10^{-06}	
β_8 Fruit and vegetables^2		Mean = -0.0033	
β_9 Fruit and vegetables^3		Mean = 0.0001	
β_{10} Alcohol^2		Mean = -2.77×10^{-05}	
β_{11} Alcohol^3		Mean = 6.45×10^{-08}	
β_{12} Physical activity^2		Mean = -2.59×10^{-07}	
β_{13} Physical activity^3		Mean = 4.88×10^{-11}	
β_{14} Age*Fruit and vegetables interaction		Mean = 4.94×10^{-05}	
β_{15} Age*Alcohol interaction		Mean = 1.61×10^{-05}	
β_{16} Age*Physical activity		Mean = 2.47×10^{-06}	
Age and sex dependent smoking quit rates			
Men aged 16-19	Multivariate normal (see Additional file 1 for covariance matrix)	Mean = 0.0469	Kemm et al. (2003) (11)
Men aged 20-24		Mean = 0.0219	
Men aged 25-34		Mean = 0.0193	
Men aged 35-44		Mean = 0.0186	
Men aged 45-54		Mean = 0.0354	
Men aged 55-64		Mean = 0.044	
Men aged 65-74		Mean = 0.0618	
Men aged 75+		Mean = 0.0484	
Women aged 16-19		Mean = 0.0551	
Women aged 20-24		Mean = 0.0178	
Women aged 25-34		Mean = 0.0288	
Women aged 35-44		Mean = 0.0255	
Women aged 45-54		Mean = 0.0239	
Women aged 55-64		Mean = 0.0563	
Women aged 65-74		Mean = 0.0581	
Women aged 75+		Mean = 0.0966	
Healthcare utilisation probit model regression coefficients			
β_0 Constant	Multivariate normal (see Additional file 1 for covariance matrix)	Mean = 2.519442	Analysis of Yorkshire Health Study (12)
β_1 Age coefficient		Mean = -0.03155	
β_2 EQ-5D coefficient		Mean = -0.81372	
β_3 Age^2		Mean = 0.000221	
β_4 EQ-5D^2		Mean = -1.27013	
β_5 Oldage (>=65 = 1; <65 = 0)		Mean = 0.174598	
β_6 Age*EQ-5D interaction		Mean = 0.01363	

Table 1. Contd.

β_7 Uni education (uni = 1, no uni = 0) coefficient		Mean = 0.089921	
β_8 Gender (1 = male; 0 = female) coefficient		Mean = -0.17944	
β_9 Smoke (smoker = 1; non-smoker = 2) coefficient		Mean = -0.09011	
Healthcare utilisation generalised linear model regression coefficients			
β_0 Constant	Multivariate normal	Mean = -1.78686	Analysis of Yorkshire Health Study (12)
B_1 EQ-5D coefficient		Mean = 7.478248	

*SD = standard deviation. **The sampled mean and standard deviation from the beta distributions are then converted to log (mean) and log (standard deviation) and used as parameters for the lognormal distribution for individual-level durations of response.

Table 2. Comparison of incremental cost-effectiveness results using different imputation methods.

IMPUTATION METHOD	U@Uni1 vs Control				U@Uni2 vs Control			
	QALYs	Costs	INB	Prob. CE	QALYs	Costs	INB	Prob. CE
Scenario 1: Full development and implementation of U@Uni1/U@Uni2								
MICE (default)	0.00767	£152.94	£0.41	48.7%	0.00533	£37.90	£68.76	76.1%
LOCF	0.00334	£165.11	-£98.41	17.9%	0.00418	£36.52	£47.07	68.1%
Complete Case	0.00625	£154.93	-£29.91	37.5%	0.00523	£37.37	£67.19	73.3%
Scenario 2: Roll-out of U@Uni1/U@Uni2								
MICE (default)	0.00767	£9.26	£144.09	92.7%	0.00533	£2.86	£103.80	86.4%
LOCF	0.00334	£21.40	£45.31	67.1%	0.00418	£1.54	£82.06	81.0%
Complete Case	0.00625	£11.37	£113.66	86.7%	0.00523	£2.31	£102.25	84.4%
Scenario 3: Roll-out of U@Uni2 over 5 years								
MICE (default)	0.00767	-£5.30	£158.65	95.1%	0.00533	-£4.50	£111.16	88.2%
LOCF	0.00334	£6.79	£59.91	72.2%	0.00418	-£5.84	£89.43	83.7%
Complete Case	0.00625	-£3.23	£128.26	89.7%	0.00523	-£5.06	£109.63	86.4%

MICE Multiple Imputation using Chained Equations; LOCF Last Observation Carried Forward; QALY Quality Adjusted Life Year; INB Incremental Net Monetary Benefit; Prob. CE Probability Cost-Effective.

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Full Length Research Paper

The prevalence and predisposing factors of norovirus and astrovirus infection among diarrheic children in north east, Nigeria

Oyinloye, S. O.[1]*, Aminu, M.[2], Ella, E. E.[2] and Jatau, E. D.[2]

[1]Department of Microbiology, Faculty of Science, University of Maiduguri, Borno State, Nigeria.
[2]Department of Microbiology, Faculty of Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.

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This is a case-control study design that aims to determine the prevalence of norovirus and astrovirus infections in diarrheic children in Northeast region of Nigeria. Six hundred diarrheic stools (which were neither mucoid nor blood tinged) of children of 5 years or below were collected between May 2013 – April 2014. They were screened according to the manufacturer's instruction, using a 3rd generation Ridascreen ELISA kit (R-Biopharm AG, Germany). The control group comprised thirty five non-diarrheic stools. Demographic data were collected via questionnaire administered to parents/guardians of the subjects and analysis was done using online Easy-Chi-square ($p<0.05$) statistical package. An overall norovirus and astrovirus prevalence of 6.7% (40/600) and 5.0% (30/600) respectively across the Northeast region was obtained. The prevalence of norovirus in Taraba, Bauchi and Borno states was 7 (14/200), 5 (10/200) and 8% (16/200), while that of astrovirus was 5.5 (11/200) 4.5 (9/200) and 5% (10/200), respectively. The sex distribution of number of male relative to female children sampled reveals a preponderance of male (336/600) over female (264/600). Prevalence of norovirus and astrovirus antigen was high in children aged 1 to 2 years across the region. Source of drinking water, nearness of toilet to source of drinking water, hand washing after toilet use, playing with toys, attendance of day care center and educational status of parents were statistically ($p<0.05$) and significantly contributory factors to infection. The prevalence of norovirus (6.7%) and astrovirus (5.0%) in diarrhea in Northeast Nigeria has shown that both viruses contribute to childhood diarrhea, with most of the children infected below age 2.

Key words: Prevalence, predisposing factors, norovirus, astrovirus, diarrhea, north-east, Nigeria.

INTRODUCTION

Acute gastroenteritis (AGE) is a major cause of morbidity and mortality in pediatric populations world-wide. Globally, an estimated 800 000 infants and young children die from diarrhea each year (Liu et al., 2012). Viruses are the

*Corresponding author. E-mail: faisam26@gmail.com.

major etiological agents of AGE in children of less than 5 years of age. Group A rotavirus, norovirus, enteric adenovirus, human astrovirus, and sapovirus are established etiological agents of AGE (Benschop et al., 2008; Cheng et al., 2008; Arthur et al., 2009; Zhang et al., 2011; Verma et al., 2011).

Norovirus gastroenteritis was reported to be responsible for the mortality of 200,000 children in developing countries (Koopmans, 2008). Norovirus (NoV) is a genus in the family, Caliciviridae and are approximately 38 nm icosahedral viruses with an approximately 7.5 kb single stranded, positive-sense RNA genome that encodes three large open reading frames (ORF2 and ORFs). ORF1 encodes the replicase polyprotein, while ORF2 and ORF3 encode the major and minor capsid proteins, respectively (Lindesmith et al., 2011). NoV exhibits high genetic diversity and can be divided into six genogroups (genogroup I [GI], GII, GIII, GIV, GV and GVI) (Kroneman et al., 2011), while human astroviruses are non-enveloped and positive-sense single-stranded RNA viruses. They belong to the genus Mamastrovirus; family *Astroviridae* (Rivera, 2009; Zhou et al., 2014). The astrovirus taxonomy is mainly based on the species of origin and the serotypes within each species are defined on the basis of twenty-fold or greater cross-neutralization titers (De-Benedictis et al., 2011). The first astrovirus that infected humans was described in 1975 (Madeley and Cosgrove, 1975). Since then, a total of 8 serotypes closely related to this original astrovirus ("classic human astroviruses" (HAstVs)) have been identified, all of which are believed to cause diarrhea.

NoV and HAstV transmission occurs via food, water, and airborne routes, hand contact with contaminated surfaces or fomites and through person-to-person contact. It is primarily fecal-oral contamination that drives the spread of both viruses; they cause a severe, sporadic or more than 85% of epidemic diarrhea and vomiting in all age groups especially during the winter (Farkas and Jiang, 2007; Zheng et al., 2010).

A hospital based study in Lagos reported a prevalence of 37.3% norovirus diarrhea (Ayolabi et al., 2010), and Japhet et al., (2012) reported a prevalence of 25.5% in a community based study in Osun State, Nigeria. In Owo, Ondo State, Nigeria, norovirus was found in 4/50 (8%) of the diarrheic children examined (Babalola et al., 2015). Previous studies in Nigeria show different prevalence of astrovirus. In a study in Northwest Nigeria, 5% astrovirus positivity was reported (Aminu et al., 2008), while Ayolabi et al. (2010) and Kuta et al. (2014) reported 16% prevalence in Lagos and Nasarawa states, respectively.

The aim of this study is to determine the prevalence and predisposing factors of norovirus and astrovirus infection among diarrheic children in north east Nigeria. This work was done due to the increasing epidemiological significance of viral gastroenteritis in North eastern region of Nigeria in addition to paucity of literature on the aetiology of norovirus and astrovirus diarrhea in the study area.

MATERIALS AND METHODS

Study area

The North-east region of Nigeria comprises six states: Adamawa, Taraba, Gombe, Yobe and Borno. However, three representative states of Taraba, Bauchi and Borno were selected because they do not have contact with one another. This region is in the Sahel Savannah, with high temperature for almost seven months of the year and with little rainfall. Taraba, Bauchi and Borno states have coordinates 8°00′N 10°30; 10° 18' 57"N, 09° 50' 39"E. and 11° 30'N, 13° 00'E, respectively. Ethical approval was obtained from the respective institutional ethics and research committee.

Study population

Children of less than 1 to 60 months old attending selected primary health centers within the metropolis of the representative states were considered to be the target population. Diarrheic children of both sexes whose parent consented were included in the study. Non-diarrheic and diarrheic children above 5 years old or below and whose parents/guardians declined consent were excluded.

Laboratory method and analysis

Sample preparation

Each stool sample was prepared for analysis according to the manufacturer's instruction without modification. One milliliter (1 ml) RIDASCREEN® sample was placed in dilution buffer in a labeled test tube. Liquid stool was sucked up into a disposable pipette until it rose to just above the second mark (approximately 100 µl). It was suspended in the buffer which was placed in the tube beforehand. The stool suspension was homogenized either by suction and ejection from a disposable pipette or, alternatively, by mixing in a vortex mixer. The specimen was centrifuged at 5000 rpm (approximately 2300 to 2500 G) for 5 min and the resulting supernatant of the stool suspension was used.

Procedure

RIDASCREEN Enzyme linked Immunosorbent assay kit has been used in previous studies (Hugo et al., 2014; Robilotti et al., 2015; Gupta et al., 2015) to assay norovirus and astrovirus. In this study, the analysis was done as described by the manufacturer's (RIDASCREEN, R-biopharm AG, Darmstadt, Germany) instruction without modification: One hundred microliter (100 µl) of positive control, the negative control (specimen-dilution buffer diluent) and the stool supernatant were dispensed in the wells. One hundred microliter (100 µl) of the biotin-conjugated antibody was added to the wells and incubated at room temperature (20 to 25°C) for 60 min after mixing thoroughly (by lightly tapping on the edge of the plate). After this, the plates were washed 5 times in 300µl wash buffer with the aid of an automated machine (the wells were emptied completely by knocking them out after each wash on a part of the absorbent paper which is dry and unused). One hundred microliter (100 µl) of the streptavidin-peroxidase conjugate was added to the wells, incubated at room temperature (20 to 25°C) for 30 min and washed as described above. One hundred microliter (100µl) of substrate was added to each well. Then the plate was incubated at room temperature (20 to 25°C) for 15 min in the dark.

Table 1. Prevalence of norovirus and astrovirus in stool of diarrheic children 0-5 years old in north east Nigeria.

State	Total sample	Norovirus positive (%)	Astrovirus positive (%)
Bauchi	200	10 (5.0)	9(4.5)
Borno	200	16 (8.0)	10(5.0)
Taraba	200	14 (7.0)	11(5.5)
Total	600	40 (6.7)	30 (5.0)**

p=0.68728*; p=0.93611**.

Table 2. Sex distribution of norovirus and astrovirus detected in stool of diarrheic children 0-5 years old in north east Nigeria.

State	Male			Female		
	Total	No rovirus*	Astrovirus***	Total	No rovirus*	Astrovirus***
Bauchi	120	8	7	80	2	2
Borno	180	6	5	70	10	5
Taraba	86	7	7	114	7	4

p=0.0005*; Odd Ratio=0.86*; p=0.0005**; Odd Ratio=1.38**.

The reaction was stopped by adding 50 µl of stop reagent to each well. After mixing carefully (by lightly tapping the side of the plate) the extinction was measured at 450 nm using a reference wavelength ≥ 600 nm (optional).

Evaluation and interpretation criteria

Calculating the cut-off

In order to establish the cut-off, 0.15 extinction units are added to the measured extinction for the negative control.

Cut-off = Extinction for the negative control + 0.15

Test result

Samples are considered positive if their extinction is more than 10% above the calculated cutoff. Samples are considered equivocal and must be repeated if their extinction is within ± 10% of the cut-off. If repeating the test with a fresh stool sample again yields a value in the grey range, the sample must be considered as negative. Samples with extinctions of more than 10% below the calculated cut-off must be considered as negative.

RESULTS

Out of the six hundred samples from across the three representative states, an overall prevalence of 6.7 (40/600) and 5% (30/600) for norovirus and astrovirus, respectively was obtained (Table 1). The number of male positive for norovirus (21/40) was higher than that of female (19/40), while 19/30 and 11/30 astrovirus positive was for male and female, respectively (Table 2). Odd ratio for norovirus and astrovirus positive was 0.86 and 1.38, respectively (Table 2). Children ≤ 2years were found to be more infected with norovirus (24/40) than those >2 years (16/40) (Table 3), while astrovirus infection was even (15/30; 15/30) for the two aforementioned age categories (Table 4). Table 5 shows that source of drinking water, nearness of toilet to source of drinking water, hand-washing after toilet use, playing with toys, attendance of day care center and educational status of parents were statistically ($p<0.05$) associated with infection (Table 5).

DISCUSSION

The norovirus prevalence of 6.7% (Table 1) is lower than the prevalence (21%) found for children in the United States of America and that reported in a pooled analysis of studies conducted in seven developing countries (12.1%), spanning from Malawi to Thailand and Peru (Dove et al., 2005). Also, the figure in the present study was lower than 37.5% found for children in Lagos, South-west, Nigeria (Ayolabi et al., 2010). The prevalence of astrovirus in the North-east region of Nigeria in this study was 5% (Table 1). It is within the prevalence range of 2 to 16% of human astrovirus (HAstV) infection reported among children hospitalized with diarrhea and 5 to 17% in community studies that used either EIA or RT-PCR analysis (Blanton et al., 2006; Pang and Vesikari, 1999; Kirkwood and Bishop, 2001). This prevalence is also similar to those obtained in previous studies in other regions in Nigeria. The prevalence of astrovirus in this study was observed to be similar to 5% prevalence in Northwest Nigeria (Aminu et al., 2008); and 4.9%

Table 3. Age based prevalence of norovirus in diarrheic children 0-5 years old in north east Nigeria.

Age group (months)	Taraba		Bauchi		Borno	
	Total	Positive (%)*	Total	Positive (%)*	Total	Positive (%)*
0-6	18	1(5.6)	23	3(13)	13	0(0)
7-12	58	3(5.2)	25	2(8)	44	3(6.8)
13-24	41	5(12.2)	22	1(4.5)	49	6(12.2)
25-36	15	1(6.7)	57	2(3.5)	35	4(11.4)
37-48	35	3(5.6)	43	2(4.7)	36	2(5.6)
49-60	33	1(3)	40	0(0)	23	1(4.3)

p=0.015985*.

Table 4. Age based seroprevalence of astrovirus in diarrheic children 0-5 years in north east Nigeria.

Age group (months)	Taraba		Bauchi		Borno	
	Total	Positive (%)*	Total	Positive (%)*	Total	Positive (%)*
0-6	18	0(0)	23	0(0)	13	1(7.69)
7-12	58	3(5.2)	25	1(4.0)	44	1(2.27)
13-24	41	2(4.9)	22	2(9.1)	5	5(10.20)
25-36	15	2(13.3)	57	1(1.8)	35	2(5.71)
37-48	35	1(2.9)	43	1(2.3)	36	1(2.78)
49-60	33	3(9.1)	40	4(10)	23	0(0)

p=0.003574*.

prevalence reported in Mexico; it was lower than 10.8% reported in the United States, and 16% prevalence in Nasarawa State, North Central, Nigeria (Kuta et al., 2014).

Different prevalence for both viruses was observed across the study area. This may have been due to the period the samples were collected from each patient relative to the duration of the diarrhea. Norovirus shedding generally peak within the first week of illness but can last for nearly two months (Aoki et al., 2010). This reflects how the duration of the illness can affect the outcome of the study because samples collected after the peak period of viral shedding will, as expected, present a possible outright negative or false negative result thereby impacting on the prevalence to be reported. In this study, the age of illness of patients was not recorded implying that some samples might have been collected perhaps after the peak period of the infection. This limitation is similar to the reports which neglected to list limits in the duration of illness (Mattison et al., 2010; Ayukekbong et al., 2011; Nordgren et al., 2013).

The sex distribution of number of male relative to female children sampled reveals a preponderance of male (336/600) over female (264/600). This was found to be significant (p=0.005) at p<0.05. Also, the number of males positive for norovirus (21/336) (Table 2) and astrovirus (19/336) (Table 2) was higher than female for both viruses (19/264; 9/264 respectively). These figures were marginally significant (p=0.104) at p=0.10. While Odd ratio of norovirus male positivity rate was found to be 0.86 (O.R=0.86) (Table 2), implying that males were 0.86 more likely to be infected than female, for astrovirus. Odd ratio was 1.38 (Table 3), implying males were 1.38 more likely to be infected with astrovirus than female. Males' greater susceptibility to rotavirus infection has been attributed to genetic and immunological factors (Fischer et al., 2007). By extension, this may also be applicable to norovirus and Astrovirus, hence the result obtained in this study.

In the present study, the age-based prevalence of norovirus across the three states was found to be significant (p=0.015985) affecting a greater proportion (24/40) of children less than age 2 (Table 3). This finding is similar to that of other studies (Bucardo et al., 2008; Payne et al., 2013). Interestingly, 4/24 (1 in Taraba; 3 in Bauchi) of these children were of 1 to 6 months old (Table 3). Possible reason for this observation is that children begin to learn to crawl at age 3 to 4 months; hence the tendency to pick and transfer items on the ground into their mouth is rife. Since the virus transmission is through fecal-oral route, such contaminated items picked on the ground would then serve as potential mechanical vector. For astrovirus, age-based prevalence in all three states was also significant (p=0.003574). However, equal proportion of children between those ≤2 years and older was infected (Table 4).

Table 5. Predisposing factors of norovirus and astrovirus infection among diarrheic children in north east Nigeria.

Risk factors	Norovirus and astrovirus antigen in stool						p-value
	Norovirus +ve			Astrovirus +ve			
	TR	BA	BO	TR	BA	BO	
Source of drinking water							0.00001
Tap	4	1	5	1	3	3	
Borehole	1	0	2	4	1	2	
Well	7	6	7	5	3	4	
Stream	2	3	0	0	2	0	
Sachet	0	0	2	1	0	1	
Type of toilet used							0.483932
Water closet	1	2	3	2	0	3	
Pit	4	3	4	3	3	2	
Bucket	3	2	4	2	5	2	
Bush	3	5	4	4	1	3	
Nearness of toilet to source of water							0.001271
Near	10	5	12	8	4	7	
Far	4	5	4	3	5	3	
Hand wash after toilet use							0.000209
Yes	2	1	4	2	2	1	
No	12	9	12	9	7	9	
Exclusive breast Feeding							0.093113
Yes	3	2	7	5	2	2	
No	11	8	9	6	7	8	
Play with Toys							0.037559
Yes	10	7	10	4	7	5	
No	4	3	6	7	2	5	
Attendance of day-care centre							0.00001
Yes	5	6	11	8	4	7	
No	9	4	5	3	5	3	
Educational status of parents							0.00001
Non-formal	6	2	8	5	1	4	
Primary	4	2	1	3	1	2	
Secondary	1	1	3	2	2	2	
Tertiary	3	5	4	1	5	2	

TR: Taraba; BA: Bauchi; BO: Borno.

All but two (type of toilet used and exclusive breast feeding) of the predisposing factors examined were found to have significant impact on the occurrence of infection with norovirus and astrovirus (Table 5). The source of drinking water (tap, borehole, well, stream or sachet) was significantly associated with infection with norovirus and astrovirus infection (p=0.00001). Table 5 reveals that well water was largely implicated as 20/40 norovirus positive and 12/30 of the astrovirus positive patients had well as their source of drinking water. One significant (p=0.001271) factor attributable to this is the nearness of toilet to source of drinking water of the sampled population because 470/600 respondents (Table 5) had their toilets less than 30 meters away from the wells which served as the source of drinking water. This is contrary to the World Health Organization recommended distance of 30 meters between toilets and any source of drinking water (WHO, 1996). Such nearness makes

seepage of contaminants into such wells possible, leading to contamination of the water body. Coupled with the nearness of toilet to source of drinking water is the observed poor toilet habit of the respondents manifesting as lack of hand-washing after use of toilet. A total of 364/600 parents or wards did not wash hand after using the toilet. Out of these, 87.5% (35/40) of norovirus positive and 83.3% (25/30) of astrovirus positive (Table 5) patients did not wash hand after toilet use. This serves as a significant (p=0.000209) contributory factor to infection with both viruses due to possible transfer of the viruses through oral route. With respect to attendance of Day-Care Centre, 22/40 of norovirus and 16/30 of astrovirus positive patients were among the 173/600 (Table 5) who attended day-care centre. Their attendance was associated (p=0.00001) with positivity rate. Understandably, such children might have been victims of either unhygienic behavior of nannies attending to them or lack of adequate attention given to the children. There is likelihood of children transferring soiled items into their mouths. Items such as toys are often played with either at homes or schools. Such are prone to contamination as they often fall to the ground, are picked with bare hand, rubbed on clothing (which sometimes are put into mouth) or even put such toys in their mouth directly; these lead to infection through oral route. Interestingly in the present study, playing with toys was found to be a significant factor of infection (p=0.037559) (Table 5). The educational status of parents/guardians was significant factor of infection with both viruses (p=0.00001). However, amazingly in this study, the prevalence of norovirus and astrovirus positive children/wards of parents with non-formal education (15.6%; 26/167) was less than for parents who had tertiary education (19.8%; 20/101) (Table 5). This is contrary to expectation. This observation may be due to chance or may have been caused by the care-free attitude of supposedly educated parents/guardian to common practice of personal hygiene such as washing of hand after toilet use before handling or attending to their children.

This study is however not without some limitations, not least the number of controls relative to sample size. Also, the predisposing factors advanced in this study were not tested for in the controls. In addition, the choice of enzyme linked Immunosorbent assay technique rather than a more sensitive polymerase chain reaction technique might have influenced low prevalence reported in this study. Also, research grant was not secured for this study.

Conclusion

The prevalence of norovirus (6.7%) and astrovirus (5.0%) in children presenting with diarrhea in Northeast Nigeria presented in this study, based on available published literature, is the latest report if not the first. In addition, this study has shown that both viruses contribute to disease burden of childhood diarrhea in north-east, Nigeria with most of the children infected below age 2. Source of drinking water, nearness of toilet to source of drinking water, hand washing after use of toilet, playing with toys, attendance of daycare center and educational status of parents/guardians of children were found to be statistically ($p<0.05$) and significant contributory factors to infection. Therefore, a more comprehensive research to establish a broader representative prevalence and confirm norovirus and/or astrovirus as primary aetiology of pediatric diarrhea using polymerase chain reaction technique is advocated.

Conflict of Interests

The authors have not declared any conflict of interests.

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Effect of an educational program on awareness of cervical cancer and uptake of Pap smear among market women in Niger State, North Central Nigeria

Gana, G. J.[1]*, Oche, M. O.[1,2], Ango, J. T.[1], Raji, M. O.[1,2] and Okafoagu, N. C.[1]

[1]Usmanu Danfodiyo University Teaching Hospital, Sokoto, Sokoto State, Nigeria.
[2]Usmanu Danfodiyo University, Sokoto, Sokoto State, Nigeria.

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Cervical cancer is an important but preventable public health problem among women worldwide. Studies have shown low awareness about cervical cancer and its screening test. The aim of this research was to determine the effectiveness of an educational intervention programme on awareness of cervical cancer and uptake of Pap smear by women in selected markets in Niger State, Nigeria. This was a quasi-experimental study conducted in 2014. Sample size was determined based on a previous study on Pap smear test in Nigeria. Multi stage sampling technique was used for recruiting the study participants. SPSS statistical software was used for data entry, editing and analysis. The socio-demographic profile of the respondents was comparable between both groups. Respondents' awareness about cervical cancer and uptake of Pap smear were comparable between both groups at pre-intervention. Post-intervention, there was a statistically significant difference in awareness about cervical cancer (χ^2 = 59.127, p<0.001) with a marginal increase in uptake of Pap smear test (Fisher's exact, p=0.621) in the intervention group as compared to the control group. This finding underscores the need for awareness creation strategies and the need for more interventional programs.

Key words: Pap smear test, human papilloma virus, cervical cancer.

INTRODUCTION

Cervical cancer is the commonest genital tract malignancy in females and second overall to breast cancer in the developing world (Budukh et al., 2001; Mutyaba et al., 2006; Ezem, 2007). Cervical cancer is an important but preventable public health problem among women worldwide (Budukh et al., 2001; Parkin et al., 2005; Arulogun and Maxwell, 2012). It poses a serious public health threat to women in many low and medium resource countries in South and Central America, sub-Saharan Africa, South and Southeast Asia where it is still the leading type of cancer among women (Budukh et al., 2001; Arulogun and Maxwell, 2012).

Worldwide, about 500,000 new cases are diagnosed every year, and more than 80% of these occur in developing countries (WHO, 2004; Hoque et al., 2008; Hoque and Hoque, 2009; Wright et al., 2011). In Nigeria,

*Corresponding author. E-mail: gojigan2001@gmail.com. Tel: +234 8035927162.

9900 cases occur annually (WHO/ICO Information Centre on HPV and Cervical Cancer (HPV Information Centre), 2010). Incidence rates are 16.7/100,000 women worldwide, 17.8/100,000 in West Africa and 16.7/100,000 in Nigeria (WHO/ICO Information Centre on HPV and Cervical Cancer (HPV Information Centre), 2010). Worldwide mortality figure is estimated at about 300,000 deaths annually, 85% are said to occur in developing countries (WHO, 2004; Hoque et al., 2008; Hoque and Hoque, 2009). Nigerian annual mortality is estimated at about 8020 deaths (WHO/ICO Information Centre on HPV and Cervical Cancer (HPV Information Centre), 2010). Mortality rates are reportedly 8.9/100,000 worldwide; and 13.5/100,000 in Nigeria (WHO/ICO Information Centre on HPV and Cervical Cancer (HPV Information Centre), 2010).

Many factors have been implicated in the development of cervical cancer. They include infection with high risk human papilloma virus (HPV type 16 and 18), early sexual debut, high parity, multiple sexual partners, co-infection with human immunodeficiency virus type-2, immunosuppresants and certain dietary deficiencies are all known to be associated risk factors for cervical cancer (World Health Organization, 2002). Studies have shown that human papilloma virus infection is responsible for more than 90% of the cases of invasive cervical cancer worldwide, and it is related to 80% of pre-cancerous changes in the cervix (Terefe and Gaym, 2008; Wong et al., 2009).

A study by Bosch and de Sanjose in 2007 showed that more than 99% of cases of cervical cancer worldwide are estimated to contain HPV DNA (Nasiell et al., 1986). HPV infects the cells of the cervix and slowly causes precancerous cellular changes (dysplasia) that can progress to cancer. Though primary prevention strategies such as HPV vaccination are beginning to show a lot of promise in developed countries, secondary prevention which involves using relatively cheap cervical cancer cytological screening (Pap smear) test has been found to be the most cost effective screening test (Chirenje et al., 2001).

Systematically organized population based programmes have been found useful in preventing cervical cancer (Serraino et al., 2002). The use of Pap smear to screen for cervical cancer led to the fall in incidence of cancer of the cervix by 70-90% in highly screened populations in some industrialized countries (Wong et al., 2009). In the United States of America for instance, the introduction of the Pap smear has been responsible for a 90% decrease in deaths from cervical cancer (Eddy, 1990). Likewise in Australia, deaths from cervical cancer have steadily decreased, at about 2.8% a year, since the introduction of the National Cervical Cancer Screening Program in 1991 (Wong et al., 2009).

In Nigeria, though there is a national guideline for cervical cancer screening program in the country, there is no effective cervical cancer screening program in place. Hitherto, about 75% of patients in Nigeria present at an advanced stage (stage 3 or 4) with bad survival prognosis, which is the inverse of presentations in developed countries where 75% present early and prognosis of survival is better (Aboyeji et al., 2005). Studies have shown poor knowledge about cervical cancer (Audu et al., 1999; Feyi-Waboso et al., 2005; Ayinde et al., 2006), and poor acceptance and underutilization of the screening test (Ayinde et al., 2004; Ezem, 2007; Wright et al., 2011; Hyacinth et al., 2012). A study done by Wright et al. (2011) in Lagos showed that only 14.9% of a group of market women had heard of cervical cancer while another study among female health workers in Ilorin showed that only 0.3% of the respondents had ever been screened (Aboyeji et al., 2005; Wright et al., 2011). This raises questions on the situation of things in northern Nigeria if the south-western part of the country which usually has better health indices have these findings.

It has been shown that the more the number of screening a woman has had in her lifetime, the higher the degree of protection she derives from the process (Wright et al., 2011). Thus, 1-2 yearly screening has been shown to reduce the incidence of cervical cancer by 93%; this figure reduces to 83% where screening is done every 5 years (Miller, 1992; Wright et al., 2011). Even a single Pap smear in a woman's lifetime between the ages of 40 -50 years can reduce her risk of an invasive disease by 25% (Gamarra et al., 2005).

It is believed that the knowledge, attitude and practice among market women who belong to different faiths, diverse tribal and socio-cultural backgrounds will be largely representative of most of the women groups found in the state hence their selection as a target for health education. It is therefore hoped that health educating these market women would have a positive impact on their attitude to cervical cancer screening with subsequent improvement in utilization of available screening services and therefore improve the quality of life of women.

Furthermore, considering their diverse backgrounds they would serve as positive agents of change as they would have appropriate knowledge to create awareness on cervical cancer risk factors, Pap smear screening benefits and place to access the screening service to their peers. As such, two important outcomes would have been achieved. The aim of this study was to provide information on the effectiveness of an educational intervention programme on awareness of cervical cancer and uptake of Pap smear by market women to aid the institution of an effective cervical cancer screening program in Nigeria.

MATERIALS AND METHODS

Background information on study area

Niger state occupies about 8% of Nigeria's landmass. It had a

population of 3,950,249 people (2006 census) and an estimated projected population of over 5 million people for 2016. By reason of its location, climate and soil type, the state is one of the largest and most fertile agriculture lands in the country and has the capacity to produce most of Nigeria's stable crops. It also has ample opportunities for grazing, fishing and forestry. The state has a rich network of markets in all the LGAs because of the bountiful agricultural produce yearly.

Study design

This was a quasi-experimental study design comparing market women in health zone A (intervention group) with market women in health zone B (control group) (with pre and post intervention data collection) in Niger state. The state is divided into three health zones, two health zones were selected by simple random sampling and randomly assigned as intervention and control groups by balloting. This meant that individual subjects did not have the privilege of being randomly assigned into either study group (individual randomization) rather block randomization was done. Market women who were registered with the selected market associations and had market stalls/space were those considered eligible to be enrolled into the study.

Sample size determination

Sample size was determined based on a previous study on Pap smear test in Nigeria (Kabir et al., 2005). A minimum sample size of 84 was obtained for each group (intervention and control), a correction for non-response was done and 93 participants were enrolled per group. The level of significance was set at 5% (α = 0.05) and the power of the study was set at 80% = 0.8.

Sampling method

Multi stage sampling technique was used for recruiting the study participants into the study groups. Stage 1: Two health zones were selected from the three in the state using simple random sampling and randomly assigned as the intervention and control groups. Stage 2: One local government area (LGA), each was selected from each of the selected health zones using simple random sampling. Stage 3: Three wards with markets were eventually selected from each selected LGA. Stage 4: Participants were recruited using systematic random sampling into the intervention and control group using the sampling interval (number of eligible market women in each market divided by the proportional allocation of market women to be selected from each market).

Data collection method

The study was carried out in three phases. The pre-intervention phase, baseline information on awareness of cervical cancer and uptake of screening test was collected from participants (intervention and control groups) by trained interviewers using an interviewer administered questionnaire. During the intervention phase, health education was provided on cervical cancer, Pap smear test with emphasis on its benefit and procedure and on proximate health institutions that provide such services to the intervention group. In addition, IEC materials were designed to stimulate increased awareness on cervical cancer and Pap smear test in English and local languages (Nupe and Hausa) for the intervention group. A total of three such meetings were held at the market, in groups to capture the different sections of the market usually between 10 am and 12 noon before activities peak at the respective markets. A post-intervention survey was conducted three months post-intervention on both groups, using the same instrument, and research assistants who administered the pre-intervention questionnaires to reduce interviewer bias. After post-intervention data collection, the control group was also given a series of health education intervention to enable them benefit from the essence of the study.

Data analysis

The questionnaires were manually checked for completeness. Data were then entered directly into SPSS version 20.0. Data editing and cleaning was performed before data analysis began. This was done to correct errors that may have occurred during data collection and entry. The data editing was performed by running frequencies and descriptive statistics for all variables.

Dependent variables include: pre intervention knowledge of risk factors and symptoms of cervical cancer, pre intervention attitude of respondents to cervical cancer, uptake rate of Pap smear test. Independent variables include: age, marital status, tribe and level of education.

The proportion of the respondents who knew about the risk factors, symptoms, prevention and diagnosis of cervical cancer and knew about indication for Pap smear were used as indices for the measurement of knowledge of cervical cancer among the respondents. Descriptive analysis of data using mean and standard deviation for continuous numerical variables (respondents' age, number of children, knowledge score of cervical cancer, attitude score), counts and frequencies for qualitative variables (marital status, tribe, and educational status) was done. Bivariate analysis was done to compare variables between both groups at pre-intervention and between pre and post-test findings in both groups at the end of the study. The findings at post intervention in both groups were also compared. Chi square test was used to compare the similarity of the socio-demographic variables (age group, marital status, educational status, tribal distribution) in both groups pre-intervention. Chi square was also used to determine the association between respondents' knowledge, attitude, socio-demographic characteristics and uptake of Pap smear test in both groups pre and post intervention. Chi square was also used to compare the proportion of uptake of Pap smear, factors affecting uptake of Pap smear in both intervention and control group pre and post intervention. All the results were presented in form of tables and charts. All statistical tests were carried out as 2 tailed test with level of significance (α) set at 0.05.

Limitations of the study

Inability to provide free Pap smear test screening however the test was provided at a subsidized rate.

Ethical clearance

The Research and Ethics Committee of the Usmanu Danfodiyo University Teaching Hospital approved the study protocol. Permission was sought from the Niger State Ministry of Health and the necessary market authorities and informed consent was obtained from the participants while confidentiality was assured.

RESULTS

Most of the respondents were within the age groups 35 to 54 years with a mean age of 38.54 ± 11.06 years and

Table 1. Socio-demographic characteristics of the respondents.

Variables	Intervention group n=93; no. (%)	Control Group n=93; no. (%)	Test statistics & P-value
Age (years)			
18-24	8 (8.6)	4 (4.3)	
25-34	27 (29)	18 (19.4)	
35-44	26 (28)	29 (31.2)	$\chi^2 = 4.7$
45-54	20 (21.5)	27 (29)	p = 0.323
≥ 55	12 (12.9)	15 (16.1)	
Mean age ± SD	38.54 ± 11.06	41.94 ± 10.94	
		41.95	
Marital Status			
Single	4 (4.3)	6 (6.5)	
Married	86 (92.5)	81 (87.1)	$\chi^2 = 1.55$
Widowed/ Divorced	3 (3.2)	6 (6.5)	p = 0.461
Educational status			
No formal education	71 (76.3)	46 (49.5)	
Primary level	15 (16.1)	23 (24.7)	
Secondary level	6 (6.5)	18 (19.4)	$\chi^{2*} = 16.6$
			p = 0.001
Tertiary level	1 (1.1)	6 (6.5)	
Respondents' living children			
Mean ± SD	4.73 ± 2.94	5.33 ± 2.97	t = 1.387, df=184,p = 0.167, CI= -0.254 to 1.459

χ^2 = Pearson chi square test; χ^{2*}= Likelihood ratio Chi square test.

Table 2. Awareness on cervical cancer.

Ever heard of cervical cancer	Pre-intervention		Post-intervention	
	Intervention (n=93); No. (%)	Control (n=93); No. (%)	Intervention (n=88); No. (%)	Control (n=87); No. (%)
Yes	14 (15.10)	20 (21.5)	63 (71.6)	19 (21.80)
No	79 (84.90)	73 (78.50)	25 (28.4)	68 (78.20)

Fisher's exact, p=0.343; $\chi^2 = 59.127$, p<0.001.

41.94 ± 10.94 years for the intervention and control groups, respectively. There was no statistically significant difference in the age group distribution of the two groups (χ^2 = 4.7, p=0.323). The proportion of married respondents was similar in both groups (92.5% in intervention and 87.1% in control groups, respectively). The proportion of those without any formal education was statistically significantly higher in the intervention group (χ^2 = 16.6, p<0.001); however, the mean respondents' children was similar in both groups (t= 1.387, CI= -0.254 to 1.459, p=0.167) (Table 1).

Pre-intervention, the awareness about cervical cancer was 15.10 and 21.50% in the intervention and control groups, respectively and the difference was not statistically significant (Fisher's exact, p=0.343), while at post-intervention, it was 71.60 and 21.80% in the intervention and control groups, respectively and was statistically significant (χ^2 = 59.127, p<0.001) (Table 2). Respondents' friends were the single most important source of information about cervical cancer at the beginning of the study in both study groups (Figure 1). The mass media was the only source of information about Pap smear test in the intervention group while health workers (42.9%) and relatives (28.6%) were the main sources of information in the control group (Figure 2). Less than 10% of respondents had heard of Pap smear at the beginning of the study in both groups and the difference was not statistically significant while in post-intervention, 34.1% of respondents in the intervention group and 5.7% in the control group had heard of Pap smear test (χ^2 = 21.966, p<0.0001) (Table 3). Only 9.7% of the respondents in the intervention group and 8.6% of the respondents in the control group knew that early onset of sexual intercourse is a risk factor for cervical cancer (p = 0.474, (Fisher's exact). 11.8% of respondents in both groups knew that having multiple sexual partners is a risk factor of cervical cancer (χ^2 = 3.237, p = 1.000). 7.5% of respondents in the intervention

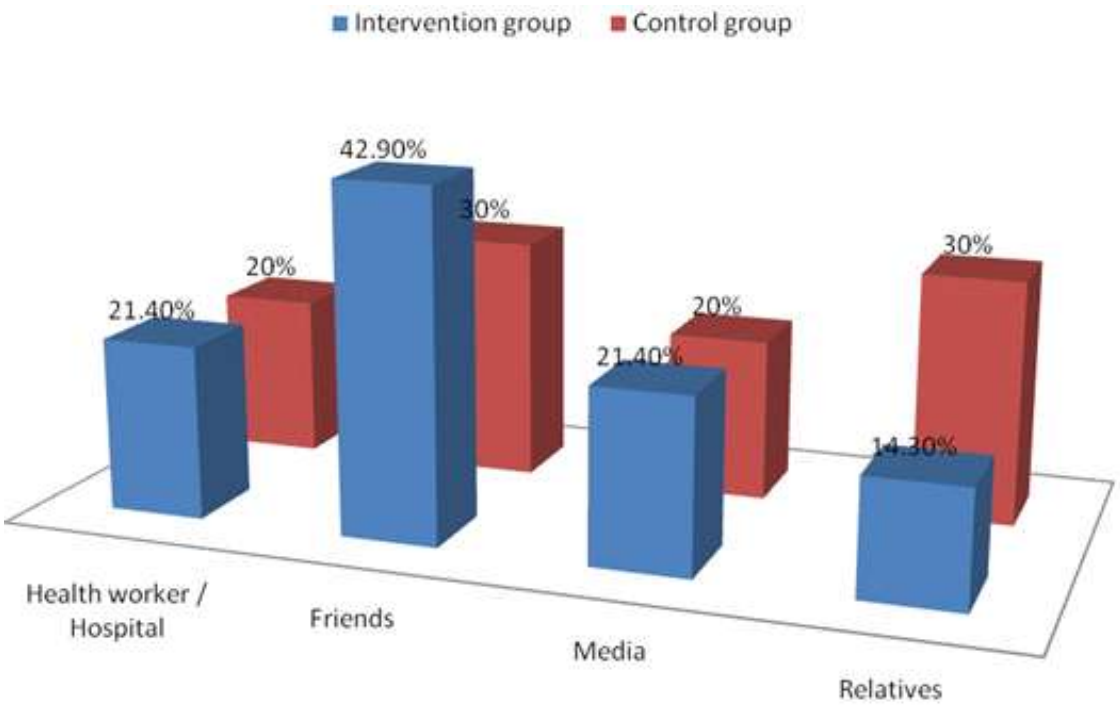

Figure 1. Respondents' sources of information on cervical cancer.

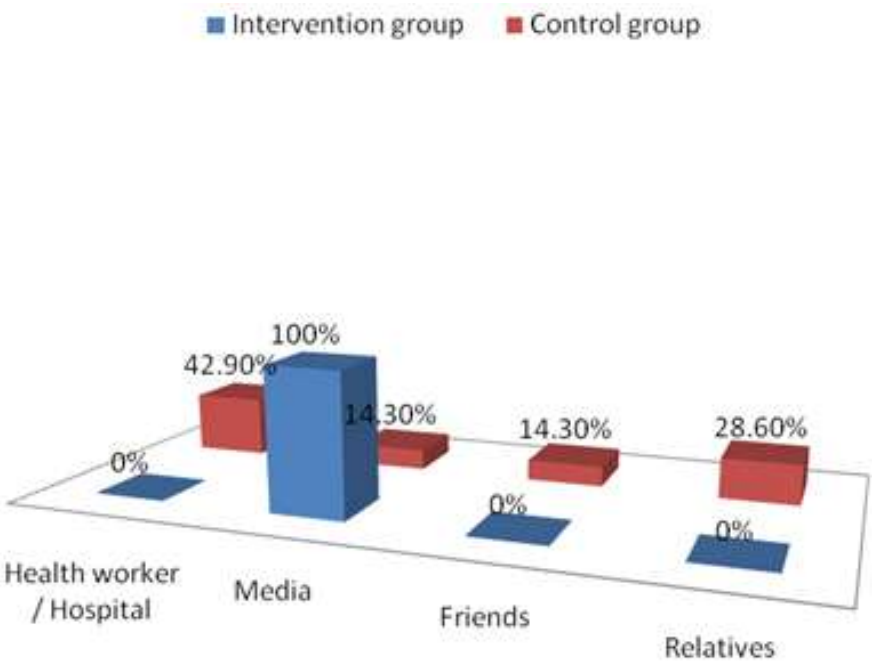

Figure 2. Sources of information about Pap smear test.

group and 5.4% of respondents in the control group knew that history of human papilloma virus infection was associated with cervical cancer (χ^2 = 5.116, p = 0.164) (Table 4).

In post intervention, 55.7% of respondents in the intervention group and 9.2% of those in control group

Table 3. Respondents' awareness about Pap smear test.

Variable		Group			
		Pre-intervention		Post-intervention	
		Intervention n=93; No. (%)	Control n=93; No. (%)	Intervention n=88; No. (%)	Control n=87; No. (%)
Have you ever heard of Pap smear test	Yes	1 (1.1)	7 (7.5)	30 (34.1)	5 (5.7)
	No	92 (98.9)	86 (92.5)	58 (69)	82 (94.3)

p=0.064, Fisher's exact; χ^2 = 21.966, p<0.0001.

Table 4. Comparative knowledge of risk factors among respondents in both groups pre and post intervention.

Variable	Study group		Control group	
	Pre-intervention n=93; No. (%)	Post-intervention n=88; No. (%)	Pre-intervention n=93; No. (%)	Post-intervention n=87; No. (%)
Early onset of sexual intercourse	7 (7.5)	49 (55.7)	8 (8.6)	8 (9.2)
Test statistics and p-value	χ^2 = 58 , p< 0.0001		χ^2 = 9, p=0.253	
Multiple sexual partners	11 (11.8)	60 (68.2)	11 (11.8)	14 (16.1)
Test statistics and p-value	χ^2 =57, p<0.0001		χ^2 = 11, p=0.027	
Family history of cervical cancer	8 (8.6)	48 (54.5)	12 (12.9)	8 (9.2)
Test statistics and p-value	χ^2 =57, p<0.0001		χ^2 =12, p=0.101	
Human papilloma virus infection	7 (7.5)	25 (28.4)	5 (5.4)	8 (9.2)
Test statistics and p-value	χ^2 =56, p<0.0001		χ^2 =10, p=0.125	
High parity	6 (6.5)	42 (47.7)	6 (6.5)	6 (6.9)
Test statistics and p-value	χ^2 =58, p<0.0001		χ^2 =11, p=0.276	
Vaginal bleeding after menopause	6 (6.5)	48 (54.5)	11 (11.8)	12 (13.8)
Test statistics and p-value	χ^2 =58, p<0.0001		χ^2 =9, p=0.109	
Weight loss	8 (8.6)	48 (54.5)	11 (11.8)	12 (13.8)
Test statistics and p-value	χ^2 =57, p<0.0001		χ^2 =10, p=0.075	

χ^2 = McNemar Bowker test.

knew that early onset of sexual intercourse is a risk factor for cervical cancer (χ^2 = 250.655, p<0.0001), 68.2% of those in intervention group and 16.1% of those in control group knew that having multiple sexual partners is a risk factor of cervical cancer (χ^2 =249.912, p<0.0001), 54.5% of those in intervention group and 13.8% of those in control group knew that vaginal bleeding after intercourse and weight loss were symptoms of cervical cancer (χ^2 =257.63, p<0.0001) (Table 5).

Only one respondent in both groups (1.1%) had ever done Pap smear test before the study, while in post-intervention, it was 3.4% of respondents in intervention group and 1.1% in the control group (Fisher's exact, p=0.621) (Table 6). The main reason for non-uptake of Pap smear test pre-intervention in both groups was "not being aware of the test" and finding was similar in both groups while in post-intervention, other significant contributing factors were: do not have time to do the test (15.9%), not having symptoms (13.6%), not feeling at risk of the disease (11.5%) (p<0.0001, Fisher's exact) (Table 7). A comparable proportion of respondents in both groups: 79.5% in intervention group and 79.3% in the control group expressed willingness to do a screening test for cervical cancer if it is beneficial and it is available (Table 8) and a comparable proportion were also willing to go for diagnostic tests if it is indicated (Table 9).

DISCUSSION

This study showed that only a fifth of respondents in both groups had ever heard of cervical cancer. This is quite similar to findings in a study on community education on cervical cancer among market women in Lagos where only 14.9% of respondents in the intervention group and 21.7% of those in the control group had ever heard of cervical cancer (Wright et al., 2010) but lower than findings in a study among market women in Ibadan where about 40.8% had heard about cervical cancer (Ayinde et al., 2006). This was because there was an on-

Table 5. Post intervention knowledge of cervical cancer among study and control groups

Variable	Study group	Control group
	Post-intervention n=88; No. (%)	**Post-intervention n=87; No. (%)**
Early onset of sexual intercourse	49 (55.7)	8 (9.2)
Test statistics and p-value	χ^2 = 250.655,	p<0.0001
Multiple sexual partners	60 (68.2)	14 (16.1)
Test statistics and p-value	χ^2 =249.912,	p<0.0001
Family history of cervical cancer	48 (54.5)	8 (9.2)
Test statistics and p-value	χ^2 =259.742,	p<0.0001
Human papilloma virus infection	25 (28.4)	8 (9.2)
Test statistics and p-value	χ^2 =261.873,	p<0.0001
High parity	42 (47.7)	6 (6.9)
Test statistics and p-value	χ^2 =256.429,	p<0.0001
Vaginal bleeding after menopause	48 (54.5)	12 (13.8)
Test statistics and p-value	χ^2 =264.7,	p<0.0001
Weight loss	48 (54.5)	12 (13.8)
Test statistics and p-value	χ^2 =257.63,	p<0.0001

χ^2 = Likelihood ratio Chi square test.

Table 6. Comparative Pap smear uptake pre and post-intervention.

Variable	Before intervention	Intervention group n = 93; No (%)	Control group n = 93; No (%)	Test statistics and P-value
Have you ever done Pap smear test	Yes	1 (1.1)	1 (1.1)	p=1.000 (Fisher's exact)
	No	92 (98.9)	92 (98.9)	
	After intervention	**Study group n = 88**	**Control group n = 87**	**Test statistics and P-value**
	Yes	3 (3.4)	1 (1.1)	p=0.621 (Fisher's exact)
	No	85 (96.6)	86 (98.9)	
Test statistics and P-value		p=0.357 (Fisher's exact)	p=1.000 (Fisher's exact)	

going awareness campaign about cervical cancer with free Pap smear screening at the time of the study (Ayinde et al., 2006). This means that awareness about cervical cancer is very low among the study subjects and is corroborated by studies done across various parts of the country.

Respondents' friends were the most important source of information on cervical cancer. Their friends and relatives were responsible for more than half of the respondents in both groups becoming aware of cervical cancer. This was corroborated by another study in Lagos which had similar findings (Wright et al., 2011). This finding highlights the gap in content of health education messages given by health workers when women go to health facilities for various reasons namely; antenatal care services, family planning services, immunization services for their under five children, consultations, bearing in mind that 92.5% of those in intervention group and 87.1% in control group were married. Health education and counselling sessions in hospitals need to incorporate messages on cervical cancer, its screening services and benefits of screening to improve awareness about the disease.

The awareness about Pap smear test was very poor, less than 10% of respondents in both groups had heard about it. This may have been because of the very low awareness about cervical cancer in the first place. Another study in Lagos had similar findings with 6.9% of respondents in intervention group and 12.0% of those in control group having heard of Pap smear test (Wright et al., 2011). This shows the extent of ignorance about preventive measures of common non-communicable

Table 7. Reasons for lack of uptake of Pap smear test.

Why have you not done Pap smear test	Intervention group		Control group	
	Pre-intervention n=92 (%)	Post-intervention n=85 (%)	Pre-intervention n=92 (%)	Post-intervention n=86 (%)
Not feeling at risk of the disease	3 (3.3)	11 (12.5)	4 (4.3)	4 (4.6)
Cultural or religious reasons	1 (1.1)	1 (1.1)	1(1.1)	0 (0)
Do not have symptoms	3 (3.3)	12 (13.6)	2 (2.2)	2 (2.3)
Not aware of the test	84 (91.3)	42 (47.7)	80 (87)	75 (86.2)
Do not have time to do the test	1 (1.1)	14 (15.9)	5 (5.4)	5 (5.7)
Test is expensive	0 (0)	3 (3.4)	0 (0)	0 (0)
Fear of outcome of result	0 (0)	2 (2.3)	0 (0)	0 (0)

p=0.539, Fisher's exact; p<0.0001, Fisher's exact.

Table 8. Willingness to have a Pap smear test in future.

Variable	Before intervention	Intervention group n = 93; No (%)	Control group n = 93; No (%)	Test statistics and P-value
Would you like to do the screening test in the future	Yes	67 (72)	72 (77.4)	P=0.745 (Fisher's exact)
	No	26 (28)	21 (22.6)	
	After intervention	**Study group n = 88**	**Control group n = 87**	**Test statistics and P-value**
	Yes	70 (79.5)	69 (79.3)	P=0.668 (Fisher's exact)
	No	18 (20.5)	18 (20.7)	
Test statistic		P=0.213 (Fisher's exact)	P=0.927 (Fisher's exact)	

Table 9. Willingness to go for further diagnostic tests if required.

Variable	Before intervention	Intervention group n=93; No. (%)	Control group n=93; No. (%)	Test statistics & P-value
Would you go for further tests if Pap smear shows cancerous changes	Yes	56 (60.2)	45 (48.4)	χ^2=2.719
	No	37 (39.8)	48 (51.6)	p=0.254
	After intervention	**Study group n=88**	**Control group n=87**	
	Yes	68 (77.3)	41 (47.1)	p=0.000 (Fisher's exact)
	No	20 (22.7)	46 (52.9)	
Test statistics		p=0.011 (Fisher's exact)	p=1.000 (Fisher's exact)	

ailments that the women folk have. Consequently, the uptake rate of Pap smear test was just 1.1% in both study groups. This is better than that found in a study among female health workers in Ilorin where only 0.3% had ever done a Pap smear test (Aboyeji et al., 2005) though lower than what was seen in a female population group in Ibadan where about 5.6% of women had been screened previously (Ayinde et al., 2006). Among studies conducted in Nigeria, cervical cancer screening rates were highest among female health workers with uptake rates between 10 and 20% (Anya et al., 2005; Kabir et al., 2005; Ojule et al., 2012; Hyacinth et al., 2012; Oche et al., 2013).

The main reason for non-uptake in this study and across other studies in the sub-region is lack of awareness on the test (Ayinde et al., 2006; Ezem, 2007; Wright et al., 2011). It is worth noting that more than three-quarters of respondents in both groups were willing to do a screening test for cervical cancer if they were told it exists and were informed of its benefits. This finding is

similar to findings in another study in Lagos (Wright et al., 2011). These findings stress the need for awareness creation strategies and the need for more interventional programs.

This study was able to establish the benefits of an organized intervention program on awareness levels of market women about cervical cancer. On the whole, significant increase in awareness level of cervical cancer and Pap smear test attest to a favourable outcome following the intervention done in the experimental group.

Conclusion

This study showed an increased awareness about cervical cancer and Pap smear test; however, the uptake of Pap smear test remained low even after intervention. This may not be unconnected to the time bound nature of the study (6 months) and the limited contact time with the respondents (4 visits). There is a need to do larger scale interventions to improve awareness about cervical cancer and uptake of its screening test across the country.

Conflict of interests

The authors have not declared any conflict of interest.

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Full Length Research Paper

Creatinine height index as a predictor of nutritional status among patients with liver cirrhosis

Medhat, A. Saleh[1]*, Ahmed, A. Obeidalla[2], Ahmed F. Thabet[2] and Amal, M. Abdel Aal[3]

[1]Public Health and Community Medicine, Faculty of Medicine, Assiut University, Egypt.
[2]Internal Medicine Department, Faculty of Medicine, Assiut University, Egypt.
[3]Department of Clinical Pathology, Faculty of Medicine, Assiut University, Egypt.

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Assessment of nutritional status in cirrhotic patients is very difficult, and there is no gold-standard method used for nutritional evaluation of these patients. The study aims to assess the role of creatinine height index in evaluation of nutritional status of patients with liver cirrhosis, and to compare its results with different ordinary methods used for nutritional assessment. The study was cross sectional observational study, carried out at El-Rajhi Liver Hospital and internal medicine department in Assiut University on 103 patients with liver cirrhosis after obtaining their informed consent form May to September 2015. 24 h urine collection was obtained from all patients, then measurement of their urine creatinine was done, after that, creatinine height index (CHI) was calculated for every patient, furthermore, All patients did the followings investigations: Serum albumin, Anthropometric measurements, Subjective Global Assessment. Then its results were compared with their CHI. According to CHI, malnutrition was present in 89.2% of patients: 11 patients (11.8%) were mildly malnourished, 38 (40.8%) were moderately malnourished and 35 (36.6%) were severely malnourished, Subjective Global Assessment detects malnutrition in 92.2% of patients. Furthermore, 87.4% of the patients were malnourished according to Mid Arm Muscle Circumference while 86.4% of them were malnourished according to Triceps Skin Fold Thickness. Mean value of CHI was decreased markedly from 86.1, 64.5 to 39.1% in Child score A, B and C respectively (P value= 0.000). CHI is a good predictor of muscle mass in patients with liver cirrhosis.

Key words: CHI, nutritional status, liver, cirrhosis, assessment.

INTRODUCTION

Liver cirrhosis results from different mechanisms of liver injury among which nutritional factors may be claimed (Schuppan and Afdhal 2008), and clinically, cirrhosis has been regarded as an end-stage disease that invariably leads to death, unless liver transplantation is done (D'Amico et al., 2006). It is well documented that liver performs essential functions in food digestion and in absorption, metabolism, storage, transport, activation and utilization of nutrients (Bémeur et al., 2010. Compromising these functions in patients with liver cirrhosis can result in the development of protein calorie malnutrition (PCM) (Moriwaki, 2002). Although PCM is

*Corresponding author. Email : medhatelaraby75@yahoo.com

not always diagnosed, it is a frequent complication in patients with liver cirrhosis, and its onset and/or severity increases with the progression of liver dysfunction mainly in situations of metabolic stress associated with the presence of infection and/or hospitalization (Roongpisuthipong et al., 2001; Caregaro et al., 2001; Sobhonslidsuk et al., 2001).

Previous studies in western patients have documented malnutrition rates from 20% in compensated liver cirrhosis up to 100% in decompensated liver cirrhosis (Caly et al., 2003). Causes for malnutrition in liver cirrhosis are known to include a reduction in oral intake (for various causes), increased protein catabolism and insufficient synthesis, malabsorption and maldigestion associated with portal hypertension (Merli et al., 2011). Although a consequence of the disease, malnutrition alone can lead to further morbidity in patients with liver cirrhosis. Increased rates of septic complications, poorer quality of life, and a reduced life span have all been observed in cirrhotic with poorer nutritional status compared to those with good nutritional status (Dan et al., 2008).

Furthermore, assessment of nutritional status is difficult in cirrhotic patients as fluid retention hinders the interpretation of simple criteria such as body weight and Body Mass Index (BMI) as the fluid excess causes weight to height parameters to underestimate the prevalence of chronic liver disease which itself causes alteration in visceral protein synthesis, cellular immunity, and total lymphocyte count independent of PCM (Hasse, 2008).

Subjective global assessment has been shown to be effective at identifying malnutrition in a variety of hepatic patients either suffering from cirrhosis or not (Fiaccadori et al.,1999). Malnutrition may unfavorably affect the natural history of cirrhotic patients. The rate of complications has been shown to be lower in those patients receiving nutritional intervention that is able to increase nutrient intake than in untreated patients. Further, malnutrition is associated with a higher incidence of refractory ascites and in patients with esophageal varices, it may be a predictor of the first bleeding episode. Malnutrition is strongly associated with deterioration in liver function, Merli et al. (2002) reported that a reduction in muscle mass was associated with a lower cumulative survival in cirrhotic patients.

Serum albumin concentration is the most frequently used laboratory measure of nutritional status. Although nonspecific, it has been used to assess change in nutritional status. The normal range of serum albumin is 3.5-5.5 g/dl (Lim et al., 2000). The ESPEN guidelines recommend the use of simple anthropometric parameters in evaluating malnutrition which are also not affected by the presence of ascites and peripheral edema. These parameters consist of mid-Arm Circumference (MAC), Triceps Skin Fold Thickness (TSFT) and Mid-Arm Muscle Circumference (MAMC) (Ferguson et al., 1999).

The amount of creatinine excreted in the urine over a 24 h can be used in estimating body muscle mass. Creatinine is the only metabolite of creatine, a nitrogenous compound formed from amino acids in the liver and taken up by many tissues, but mainly by muscle. Ninety eight percent of the body creatine is found in muscle. Creatine spontaneously dehydrated to form creatinine, which is then excreted in the urine; therefore measurement of creatinine in 24 h urine collection should reflect total body creatinine and consequently total muscle mass (Stephenson et al., 2001).

CHI is a ratio of patient measured 24 h urinary creatinine excretion and the expected excretion of normal individual of same sex and height. The index is calculated from the following formula: CHI = 24h-urine creatinine excretion (mg) / expected 24h-urine creatinine excretion (mg) x100 its result is as follows: If CHI ≥ 80%, there is normal protein status. If CHI 60-<80%, there is mild protein depletion. If CHI 40-<60%, there is moderate protein depletion. If CHI < 40 %, there is severe protein depletion. The expected 24 h urinary creatinine excretion values for height for adult male and female. Creatinine height index is a good method for assessing protein status in cirrhotic patients where sarcopenia is a common complication in liver cirrhosis, however, several factors affect the reliability of CHI, and advanced age results in decreased creatinine excretion and renal impairment reduce the amount of creatinine filtered through the kidney. Trauma, infection, fever, physical activity and catabolic states increase short term creatinine excretion; and incomplete 24 h urine collection will invalidate creatinine excretion results (Huisman et al., 2011).

In Egypt, the high prevalence of virus C infection, has resulted in large numbers of people developing liver cirrhosis with its' associated complications. Most of the data on malnutrition in patients with cirrhosis have been derived from western patients in whom chronic alcohol ingestion has been the commonest etiology. Patients with cirrhosis should have a full assessment of nutritional status at presentation because malnutrition increases complications. Due to the high prevalence of malnutrition and its relationship with morbidity and mortality in patients with liver cirrhosis as well as the absence of a gold-standard method for nutritional evaluation of these patients, we conducted the present study.

METHODOLOGY

This study is an observational cross sectional hospital based study carried out on 103 cirrhotic patients admitted to El-Rajhi Liver Hospital and internal medicine department in Assiut University, Egypt, started in May 2015 and ended in February 2016. All eligible patients who fulfilled the predetermined inclusion criteria are invited to participate in the study after getting their consent, inclusion criteria was Adult patients (18 years and more) with liver cirrhosis, diagnosed of liver cirrhosis was based on a combination of clinical features, blood profile and radiological imaging. Clinical features included those of portal hypertension, that is, ascites and/or gastrointestinal varices. Blood profile included evidence of thrombocytopenia and/or coagulopathy.

Radiological features, either with trans-abdominal ultrasound or computerized tomography, had to demonstrate a small shrunken liver and ascites with or without splenomegaly (Jones, 2004). Exclusion criteria were: Patients with any renal diseases as patients with renal diseases have low creatinine excretion in urine, which may decrease creatinine height index values and act as a confounding variable. Younger patients less than 18 years, patients with hepatocellular carcinoma as carcinoma is considered an additional factor for causing malnutrition beside cirrhosis, and patients with severe hepatic encephalopathy were also excluded, that is, Grade 3 or 4 due to difficult body compositions measurement.

Data of the study were collected by structured questionnaire which was filled by the researcher herself who explained aims of the study to each patient before participation in the study. The questionnaire asked about demographic variables as age, sex, occupation, marital status, residence and educational level, the questionnaire also asked about medical history of the disease as etiology of the liver cirrhosis and Child-Pugh score which used in classification of severity in liver cirrhosis, data about presence of complications as hepatic encephalopathy, oesophageal varices and spontaneous bacterial peritonitis, the data were obtained from patient sheet in health information system of the hospital, then the patients were asked for presence of co-morbidities as hypertension and diabetes. Measurement of creatinine was done by modified Jaffe method using pentra 400 auto-analyzer. The index is calculated from the following formula:

CHI= 24-hour urine creatinine excretion (mg)/ expected 24-hour urine creatinine excretion (mg) × 100.

Interpretation of the obtained results is as follows, If CHI ≥ 80%, there is normal protein status, if CHI 60-<80%, there is mild protein depletion, if CHI 40- < 60%, there is moderate protein depletion and if CHI < 40 %, there is severe protein depletion (Huisman et al., 2011). Measurement of serum albumin was done by colorimetric determination using Pentra 400 auto-analyzer. All measurements were taken by the same investigator, to avoid any inter-observer variation. The following anthropometric measures were used: Mid-Arm Circumference (MAC): Triceps Skin-Fold Thickness (TSFT), Mid-Arm Muscle Circumference (MAMC), and Body Mass Index (BMI).

Statistical analysis

Data were analyzed using statistical package for social sciences (SPSS) software package version 16. Descriptive statistics were done in the form of frequencies, mean and SD then analytic statistics were done as Chi square, Independent sample T-test and one way ANOVA. Values were considered significant when P values equal or less than 0.05.

Ethical consideration

Informed consent was obtained from all participants; it was explained to all participants that the collected data will be confidential and for the purpose of the scientific research only. All investigations were free without any financial burden on the participants. Furthermore, any faulty dietary habits were advised though health education.

Obstacles and limitations of the study

The main obstacle of the study was collection of 24 h urine to calculate creatinine height index, creatinine height index was calculated for ninety three patients instead of 103 with a drop out less than 10% which is accepted in medical research.

RESULTS

Mean age of patients was 52.14±10 years and was ranged from 19 to 83 years. 57.3% of patients were males while 42.7% were females, regarding etiology of liver cirrhosis, 60.2% of patients were postviral C aetiology, 9.7% of postviral B aetiology, while the aetiology was not known in 27.2% of pateints, moreover, 2.9% of pateints had other aetiology (like autoimmune cirrhosis and bilharzial cirrhosis). According to Child score, 1.9% of the cases were classified as Child A, 34% classified as Child B score and 64.1% classified as Child C. Complications of liver cirrhosis as tense ascities and spontaneous bacterial peritonitis were present in 34% of cases, oesophageal varices in 24.3%, hepatic encephalopathy in 27.1%. On the other hand, 51.5% of cases were hypertensive and 35% were diabetic, both co-morbidities were present in 5.8% of cases and absent in 7.7% of them.

Figure 1 shows that according to creatinine height index, malnutrition was present in 89.2% of patients, 11.8% of them were mildly malnourished, 40.8% were moderately malnourished and 36.6% were severely malnourished. Table 1 and Figure 2 show that creatinine height index differed significantly between the Child A, B and C patients (P value= 0.000) where the mean value of CHI was 86.1, 64.5 and 39.1% in Child score A, B and C respectively.

Table 2 shows that the value of creatinine height index in all patients was ranged from 4.4 to 91.1% with mean value of 49.4±20.5%. It also shows that the mean value of CHI was 46.7±21.4% and 52.8±18.9% in both males and females respectively with no statistical significant difference between them (P value=0.154), it also shows that there is statistical significant difference between mean values of TSFT between males and females (P value= 0.001), where the mean value in males was 8.9±1.4 mm and in females was 10.4±2.8 mm. Furthermore, there is no statistical significant difference between mean values of MAC between males and females (P value= 0.278). Lastly, mean value of MAMC in males was 20.6±2.5cm and in females was 20.7±3.6 cm with no statistical significant difference (P value= 0.987).

According to Table 3, no cases were classified as underweight by using BMI classification, while 23.3% of cases were classified as normal weight, 32% of cases were overweight, 34% classified as grade I obesity, 7.8% of cases were classified as grade II obesity, and 2.9% of cases were classified as grade III obesity. The mean value of BMI was 29.3kg/m^2, and was ranged from 19.1 to 47.3 kg/m^2., meanwhile according to subjective global assessment (SGA) grading, malnutrition was present in 92.2% of patients, 43 patients (41.7%) had mild to moderately malnourished, 52 patients (50.5%) had

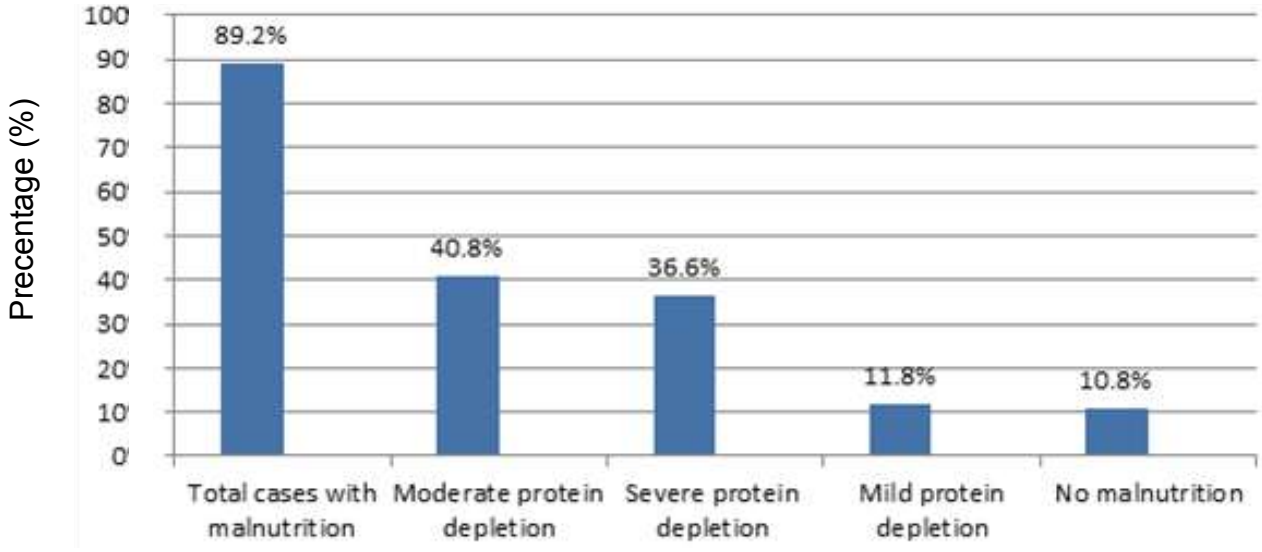

Figure 1. Percentage of malnutrition by creatinine height index in the studied patients, El-Rajhi Hospital, Assiut University 2015.

Table 1. Distribution of creatinine height index values in different child-pugh scores in the studied patients.

Variable	Child pugh score			F-value	*P-value
	A (n=2)	B (n=35)	C (n=66)		
	Mean ± SD	Mean ± SD	Mean ± SD		
CHI (%)	86.1±7.1	64.5±17.4	39.1±14.6	33.7	0

*One way ANOVA test

severe malnutrition and 7.8% of them had no malnutrition.

Figure 3 shows that according to Subjective Global Assessment, malnutrition was present in 92.2% of patients while, according to creatinine height index; it was present in 89.2% of them. It also shows that 87.4% of patients were malnourished according to both MAC and MAMC, meanwhile 86.4% of patients were malnourished according to TSFT. Table 4 shows that there is statistical significant difference between means of serum albumin and Child class A, B and C. As mean values of serum albumin showed significant deterioration in these parameters with disease progression from Child-Pugh class A to C (P value =0.000), mean values of serum albumin was 3.9±0.07, 2.8±0.28 and 2±0.32g/dl in Child class A, B and C respectively. There is also statistical significant difference between serum albumin and nutritional status assessed by SGA, As, mean serum albumin in SGA score A is 3±0.62 g/dl versus 2.5±0.44 g/dl and 2±0.39 g/dl in SGA score B and C, respectively (P value= 0.000).

Table 5 and Figure 4 shows relationship between Child- Pugh classes and mean values of MAC, TSFT and MAMC. It reveals that mean values of these anthropometric measures showed significant deterioration with disease progression from Child-Pugh class A to class C. with statistical significant difference between means of MAC, TSFT and MAMC and Child score A, B and C (P value=0.000).

DISCUSSION

For many years, malnutrition has been related to worse clinical outcomes and higher incidence of complications such as ascites, hepatic encephalopathy, infections and hepato-renal syndrome. Furthermore, protein calorie malnutrition (PCM) itself may accelerate deterioration of liver functions and adversely affects its clinical outcome (Plauth et al., 2000). PCM considered a major risk factor for morbidity and mortality before and after transplantation as well as in abdominal surgery (Vulcano et al., 2013).

This study try to assess nutritional status of cirrhotic

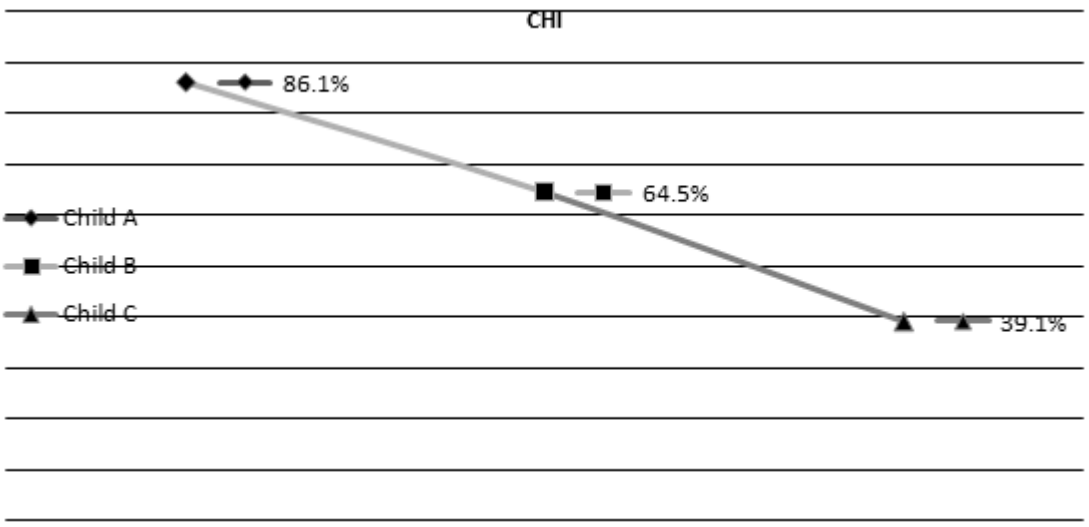

Figure 2. Distribution of creatinine Height Index values in different child-pugh scores in the studied patients.

Table 2. Distribution of anthropometric measurements according to sex, El-Rajhi Hospital, Assiut University, 2015.

Anthropometric measurements	All cases mean± SD	Male mean± SD	Female mean± SD	*P value
CHI (%)	49.4±20.5	46.7±21.4	52.8±18.9	0.154
MAC(cm)	22.8±2.9	22.9±2.7	22.4±3	0.278
TSFT(mm)	9.6±2.3	8.9±1.4	10.4±2.8	0.001
MAMC(cm)	20.6±3	20.6±2.5	20.7±3.6	0.987

*Independent sample T-test. MAC= mid-arm circumference. MAMC=mid-arm muscle circumference. TSFT=triceps skin-fold thickness.

patients using a combination of more than one tool of assessment as, subjective global assessment (SGA), creatinine height index (CHI), serum albumin and different anthropometric measurements as mentioned before, in order to compare the results obtained from these tools and find out the most appropriate method that can be used in these set of patients.

Generally, role of sex in malnutrition development is not well established, as female patients usually suffer from higher BMI than male with more fat contents, on the other hand, male patients usually have more lean body mass than females, these two factors usually mask the role of sex in malnutrition development, In our study, no statistical significant difference was observed between sex and occurrence of malnutrition by using SGA and CHI tools (P value = 0.224 and P value=0.154 respectively), which is agreement with Alberino et al. (2001), who found that sex has no role in development of malnutrition in hepatic patients.

Liver cirrhosis is caused by a variety of interacting factors; in this study main etiology of liver cirrhosis was post viral C infection (60.2%), which is mismatched with Roongpisuthipong et al. (2001), who studied 60 patients with liver cirrhosis in Thailand, where the main etiology of cirrhosis was alcoholic in 51.7% of patients and non-alcoholic in 48.3% of patients. Also this finding disagree with Morgan et al. (2006), who studied 26 patients with cirrhosis at University College London where the main etiology also was alcoholic cirrhosis in 61% of cases, post viral cirrhosis in 23% of cases, biliary cirrhosis in 8% of cases and other etiologies in 8% of cases (Morgan et al., 2006). This mismatching in main etiology of cirrhosis may be related to customs and traditions that allow alcohol intake in these countries while in our eastern societies, traditions and religious restriction that prohibit alcohol intake, decrease the rate of alcoholic liver cirrhosis. Also high prevalence of virus C infection in Egypt plays the major role in occurrence of liver cirrhosis in Egyptian patients. On the other hand our finding is in agreement with Monsef et al. (2014), who studied 60 patients with liver cirrhosis treated in hepatology Department in Ain Shams University hospitals and wady

Table 3. Body mass index and subjective global assessment in the studied patients.

Grads of body mass index	No	Percentage (%)	Grads of SGA	No	Percentage (%)
Underweight(kg/m^2)	0	0	No malnutrition (score A)	8	7.8
Normal weight	24	23.3			
Overweight	33	32	Mild/Moderately malnourished (score B)	43	41.7
Obese grade I	35	34			
Obese grade II	8	7.8	Severely malnourished (score C)	52	50.5
Obese grade III	3	2.9			
Total cases	29.3±4.9	(19.1-47.3)	Total cases	103	92.2

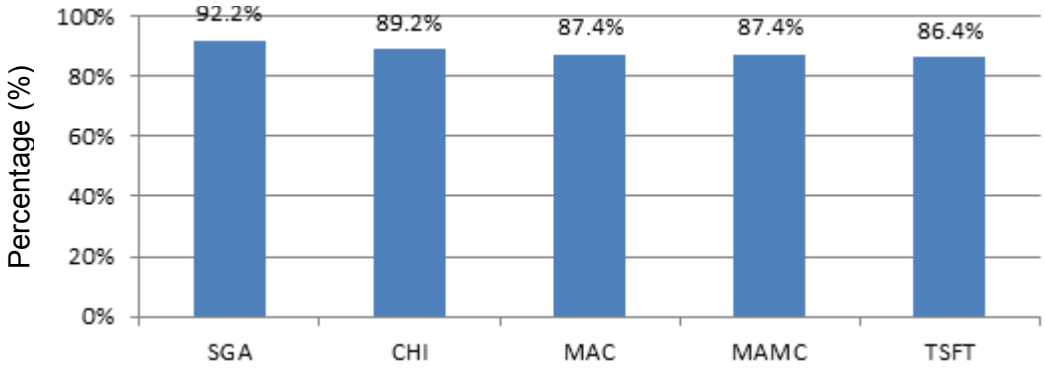

Figure 3. Percentage of malnutrition by different methods in the studied patients, El-Rajhi Hospital, Assiut University, 2015.

El-Nile hospital during the period from June, 2012 to June, 2013 where, the main etiology of cirrhosis was post viral C cirrhosis in 65% of cases (Monsef et al., 2014).

Malnutrition in cirrhosis consists mostly of loss of skeletal muscle mass or sarcopenia, which is associated with higher mortality and worse quality of life. Therefore, Assessment of nutritional status of those cirrhotic patients must depends on estimation of muscle mass and protein contents of such patients instead of other ordinary anthropometric measures that usually used for nutritional assessment like BMI, these highlight the importance of using CHI as a nutritional tool that can estimates muscle mass and protein contents of cirrhotic patients.

In this study according to CHI, malnutrition was observed in 89.2% of cirrhotic patients, which is very high figure that reflects the bad nutritional status of such patients, and the drain of their muscle and protein contents, that leads to development of sacropenia, which increased with deterioration of liver condition from child A to C, as there was a statistical significant difference between mean value of creatinine height index and Child score A, B and C, (P= 0.000). The mechanisms that contribute to sarcopenia include inadequate dietary intake, metabolic disturbances, and malabsorption. Because cirrhotic liver tissue exhibits impaired synthesis and storage of glycogen, relatively short periods of fasting in patients with cirrhosis result in the breakdown of fat and muscle and promote gluconeogenesis from non-carbohydrate sources. Unless dietary protein intake is sufficient, this can lead to muscle wasting. About 15%-30% of cirrhotic patients are hypermetabolic and increased energy expenditure in cirrhotic patients accelerates the degradation of protein, which may aggravates muscle loss (Ferguson et al., 1999).

The study results is in agreement with Caregaro et al. (2001), who studied one hundred and twenty patients with liver cirrhosis in Italy, where the mean values of creatinine height index differ significantly between Child A, B and C scores (Caregaro et al., 2001). Meanwhile, mean value of creatinine height index in the study patients was 49.4±20.5 %. This value is lower according to the study of Caregaro et al. (1996), where the mean value of creatinine height index in his studied patients was 74.19±28.75% [25]. Also our value is lower than that of Roongpisuthipong et al. (2001), where mean value of creatinine height index was 57.1±24.4% (Roongpisuthipong et al., 2001). The difference in the mean values of creatinine height index between our study

Table 4. Distribution of serum albumin level in different child-pugh scores and SGA scores in the studied patients.

Variable	Serum albumin(g/dl) Mean ±	F-value	*P-value
Child -pugh score			
A (n=2)	3.9±0.07	102.2	0.000
B (n=35)	2.8±0.28		
C (n=66)	2±0.32		
SGA score			
A (n=8)	3±0.62	27.3	0.000
B (n=43)	2.5±0.44		
C (n=52)	2±0.39		

* One way ANOVA test

Table 5. Distribution of anthropometric measurements in different Child-Pugh scores in the studied patients.

Anthropometric measures	Child Pugh score			F-value	*P-value
	A (n=2)	B (n=35)	C (n=66)		
	Mean ± SD	Mean ± SD	Mean ± SD		
MAC	29±0.0	24±2.8	21.68±2.5	13.5	0.000
TSFT	13.5±2.1	10.9±2.5	8.69±1.6	16.8	0.000
MAMC	25.9±0.85	22.3±3.5	19.5±2	17.2	0.000

* One way ANOVA test.

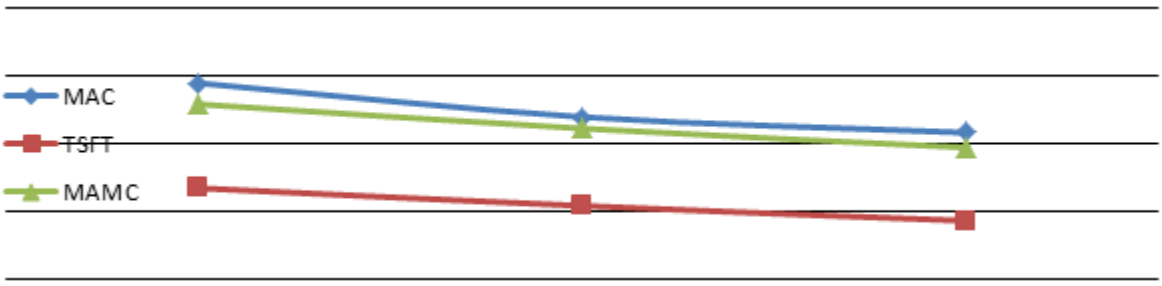

Figure 4. Distribution of anthropometric measurements in different Child- Pugh scores, El-Rajhi Hospital, Assiut University, 2015.

and theses two studies is related to the difference in the percentage of Child score A, B and C patients in these studies, where in Roongpisuthipong and Caregaro study, the majority of patients were Child A and Child B with better prognosis and good nutritional status, while in our study the majority of patients were Child C with bad prognosis, low muscle and protein contents and subsequent lower creatinine height index values.

The use of biochemical tests for nutritional assessment in patients with liver disease is questioned, because it may represent liver dysfunction and does not necessarily represent changes in nutritional status. Some authors use albumin as a nutritional index, the decrease in albumin in patients with cirrhosis is related to liver dysfunction and not due to nutritional indices. Albumin is a protein made specifically by the liver, and can be measured cheaply

and easily, furthermore, albumin level usually decreased in chronic liver diseases such as cirrhosis (Caly et al., 2003). This study estimated the nutritional status in different stages of liver cirrhosis by serum albumin and we found that mean values of serum albumin showed significant deterioration with disease progression from Child-Pugh class A to class C (P-value =0.000). This finding is in agreement with Tai et al. (2010), who studied sixty cirrhotic patients where mean values of serum albumin demonstrated significant differences in patients with SGA grades B and C, with a higher SGA grade correlating well with lower serum albumin and also serum albumin levels demonstrated to be significantly lower in patients with Child-Pugh C score compared to those with Child-Pugh B score (p-value= 0.001) (Tai et al., 2010). The study finding is also in agreement with Patricia et al. (2013) and Butt et al. (2009) where mean values of serum albumin showed significant deterioration in with disease progression from Child-Pugh class A to class C (Patricia et al., 2013; Butt et al., 2009).

Assessment of nutritional status by body weight can be misleading in patients with ascites and peripheral edema, because the presence of ascites and edema increase the measured weight, Furthermore, body mass index (BMI) usually gives underestimated results when used in cirrhotic patients for nutritional evaluation (Campillo et al., 2006). In our study mean value of BMI was 29.3 kg/m^2 and was ranged from 19.1 to 47.3 kg/m^2, this mean that no patients were classified as underweight as all patients had BMI above 18.5 kg/m^2. This finding is not matched with other methods used for nutritional evaluation which reported malnutrition in the majority of the studied patients (Campillo et al., 2006). Therefore; body weight and BMI as tools of nutritional assessment in cirrhotic patients should be used very rarely as tense ascites and edema increase the measured weight and underestimate malnutrition. When we correlate grads of BMI with SGA classes, we found that mean values of BMI did not differ significantly in the three classes (28.9±5.9, 29.4±4.2 and 29.3±5.5kg/m^2 respectively, p-value = 0.969).

Regarding other anthropometric measures used in the study for nutritional assessment, mean values of MAC, MAMC and TSFT showed significant deterioration with disease progression from Child-Pugh class A to class C (P-value =0.000). This finding is in agreement with Bémeur et al. (2010), who stated that mean values of MAC, MAMC and TST differ significantly between grades B and C of cirrhotic patients, with a higher. Subjective global assessment (SGA) is a practical method for nutritional diagnosis. Its applicability to cirrhotic patients and to liver transplant candidates is valid, since liver disease changes the majority of objective indicators. SGA is recommended by ESPEN as a practical bedside method in assessing undernourished patients (Wakahara et al., 2007).

In this study, adopting SGA as a tool to diagnose malnutrition revealed that 92.2% of patients were malnourished, 50.5% of them were severely malnourished, and 41.7% of them were moderately malnourished, this percentage is higher than that found by Vulcano et al. (2013), where they found that 46.5% of the cirrhotic patients suffering from different degree of malnutrition according to SGA (Vulcano et al., 2013). Also this study results were higher than that of Teiusanue et al. (2012), where 76% of the patients were well nourished, 15% of the patients were mild to moderately malnourished and 9% only were severely malnourished (Teiusanue et al., 2012). This difference may be related to the high percent of Child class B and C in the study patients, while in Teiusanue (2012) study, the majority of patients were Child A and B with small percentage of Child C (4% only) in addition to the low socioeconomic and educational levels among our patients compared to patients of the mentioned two studies which may affect food availability and also affect selection of food with high nutritional values.

Finally, the study can conclude that, CHI is a valid and very simple tool for assessment of protein status in liver cirrhotic patients. However, it is dependent on complete 24 h urine collections, urinary losses and renal function. So, to overcome its two main limitations, we exclude patients with renal impairment and patients with incomplete urine collection. The percentage of malnutrition according to creatinine height index was lower than that detected by subjective global assessment. this difference was attributed to the fact that creatinine height index assess only protein and muscular status of the patients while subjective global assessment is a comprehensive method of nutritional assessment that includes assessment of patient history regarding weight changes, gastrointestinal symptoms, dietary intake, functional disability and patients clinical examination regarding subcutaneous loss and muscle wasting, so subjective global assessment is a broad method for nutritional assessment. But the value of CHI appears in assessment of protein and muscle status of liver cirrhotic patients.

CONCLUSION

Protein-calorie malnutrition is a common complication of liver cirrhosis in Egyptian patients. Nutritional disorders appeared to be related to the degree of liver injury and nutritional status is good in early stages of liver cirrhosis, and deteriorates in end stage liver disease. CHI is a very good predictor of muscle mass and protein contents of the hepatic patients

RECOMMENDATIONS

Creatinine height index is a good predictor of muscle mass in patients with liver cirrhosis, provided that there is

no renal impairment. Nutrient requirements of individuals with liver cirrhosis are specific and individualized depending on degree of liver failure, presence and degree of malnutrition. This study provides useful nutritional data which is currently lacking among Egyptian patients with liver cirrhosis.

Conflict of interests

The authors have none to declare.

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Full Length Research Paper

Analysis of hospital account of malaria cases in a Malawian hospital

Richard E. Kang[1], David S. Chung[2], Seung Hyun Han[3], Brian Lee[4], Jeffrey Y. Lee[5], Allen Ho[6], Woohyung Lee[7], Sung-Jae Chung[8,9] and Jerome Z. Nkambule[10]*

[1]The School of Public Health, UC Berkeley, Berkeley, CA 94704, United States.
[2]Division of Biology and Medicine, Brown University, Providence, RI 02912, United States.
[3]Johns Hopkins University, Baltimore, MD 21218, United States.
[4]University of Colorado, Boulder, CO 80309, United States.
[5]Wayzata High School, Plymouth, MN 55446, United States.
[6]Andover High School, Andover MA 01810, Andover High School.
[7]Hong Kong University of Science and Technology, Hong Kong.
[8]School of Arts and Sciences, Marymount University, Arlington, VA 22203, United States.
[9]STEM Research Institute, Fairfax, VA 22031, United States.
[10]Kasungu District Hospital, Kasungu District, Malawi.

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The current study has been undertaken by studying the data from the hospital registers at the Kasugu District Hospital, Malawi. The malaria cases of 2014 were chosen for the study. They typically represent disease distribution based on the ages and genders of the patients. The data suggest that the cure rates among patients under age 5 and above do not have any significant difference, contrary to the commonly anticipated outcome that the older children should have better developed immune systems and should have higher cure rates. A notable point is there are huge dichotomies between genders in terms of the reported registered cases, the cure and mortality rates. The gender differentiation in the reporting and management of malaria is understood under the contemporary socio-cultural beliefs and economic realities of the Malawian society. This analysis has been carried out from a qualitative perspective, but with an attempt to identify a pattern from a year's length of statistical data.

Key words: Malaria epidemiology, malaria cases, mortality, case fatality rates.

INTRODUCTION

There have been a number of epidemiological studies on the prevalence of tropical diseases in sub-Saharan Africa (Carneiro et al., 2010; Fenwick et al., 2009; Cairns et al., 2015; Ceesay et al., 2015; Hotez and , Kamath 2009; et

*Corresponding author. E-mail: paulschung08@gmail.com.

Table 1. Registered malaria cases in Kasungu District Hospital every month in 2014.

Confirmed Cases (Inpatient)	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
< 5	325	259	275	465	54	41	38	75	104	121	222	34
5 +	301	142	191	238	428	280	302	92	75	92	96	72
Total	626	401	466	703	482	321	340	167	179	213	318	106

Talisuna al., 2015). There seems to be a universal agreement that much of medical maladies can be attributed to socio economic realities and the inevitable domino effects. Among all, malaria as a disease that poses a pre-eminent danger to the world population with mortality rate at 42% globally since 2000 and 49% in the African region (World Malaria Report 2013). Malawi has been consistently regarded as one of the most prone to the wide scale prevalence of malaria perhaps only after Congo, Nigeria and Uganda. While it is obviously possible to attribute this to the poor economic state of the country because insufficient funding can stifle the preventive measure programs, geographical factors such as climate and topography cannot be discounted or overlooked.

The current study has been undertaken by a group of students from various US universities and high schools who joined together under the auspices of the Science, Technology, Engineering, Mathematics Research Institute (STEMRI) Fairfax, Virginia, USA and worked in collaboration with the authorities at Kasungu District Hospital (KDH), Malawi. By this, the hospital data were made available for analysis in order to understand and recognize any patterns in the incidence of diseases in this district as a geographical sample of the country.

Malawi is a land locked country bounded by Mozambique, Zambia, and Tanzania. Lake Malawi, formerly known as Lake Nyasa, is a part of the country's eastern border and is a major water body. Kasungu District Hospital (KDH), where this study was conducted, is a public hospital in Kasungu, a town in the central region of Malawi.

A number of studies of malaria under the patronage of World Health Organization (WHO) have been undertaken e.g. in the aspects of the current world burden, control and epidemiology (Bell et al., 2005; Socrates, 2015; Olliaro et al., 2011). There are enormous literature resources to understand the clinical, socio-economic and political aspects of this disease. These studies, though valuable, in informing the scholars and general public and even in influencing global policies towards the management of diseases, are still far from being controversial. There are reports claiming tendencies by various agencies, mostly government, to artificially inflate or underplay the statistical figures for other vested motives (Rothmyer, 2011).

This is unfortunate and therefore can, in some cases, cast suspicious statistical data that cannot be taken on their face value, though a perception on the general trend can still be accomplished. In order to have a hands-on approach to handle the most authentic figures right from the hospital registers, this study has been undertaken so that an analysis can be presented.

Thus, this study was focused on the registered cases of malaria in a representative year (2014) in KDH, Malawi. The year of focus- 2014 for this study has been selected because it is the most recent during the “study period” for which data are available. It should be borne in mind that the year is not special in respect of any event-climatic or geopolitical.

Therefore, it can be safely regarded as an average representative year for the report of diseases and treatments in the hospital.

The objective is to make cognizance of any pattern that can be detected in the data so that there can be related to various factors- socioeconomics, gender mindsets, local belief systems.

MATERIALS AND METHODS

The hospital patients' records were made available for this study. Thus, the patients’ distribution for malaria in respect of genders, age groups, treatment outcomes and times of the year were collected and arranged. The data collection and analysis focused on the most recent available in complete form, that is the year 2014.

RESULTS

In 2014, a total number of 4322 malaria cases were registered as hospital in-patients comprising 2013 patients under the age of 5 and 2309 patients above 5. These cases have been registered on a monthly basis as presented in Table 1.

It is clear that there is a spike in registered cases during the months of March, April and May (Figure 1). This trend is noticed in the other years too (not shown here as it is outside the scope of this paper). Out of these cases, the reported mortality was 117 for under age 5 and 158 for over 5, accounting for 94.2 and 93.2% cure rates, as shown in Table 2.

Table 2. Cure rates among the patients under and above the age of 5, showing practically no difference.

Age	Malaria Cases	Malaria Deaths	Cure Rate among in-patients
< 5	2013	117	94.2 %
5 +	2309 (39 Deaths are 14 +)	158	93.2 %
All Ages	4322	275	93.6 %

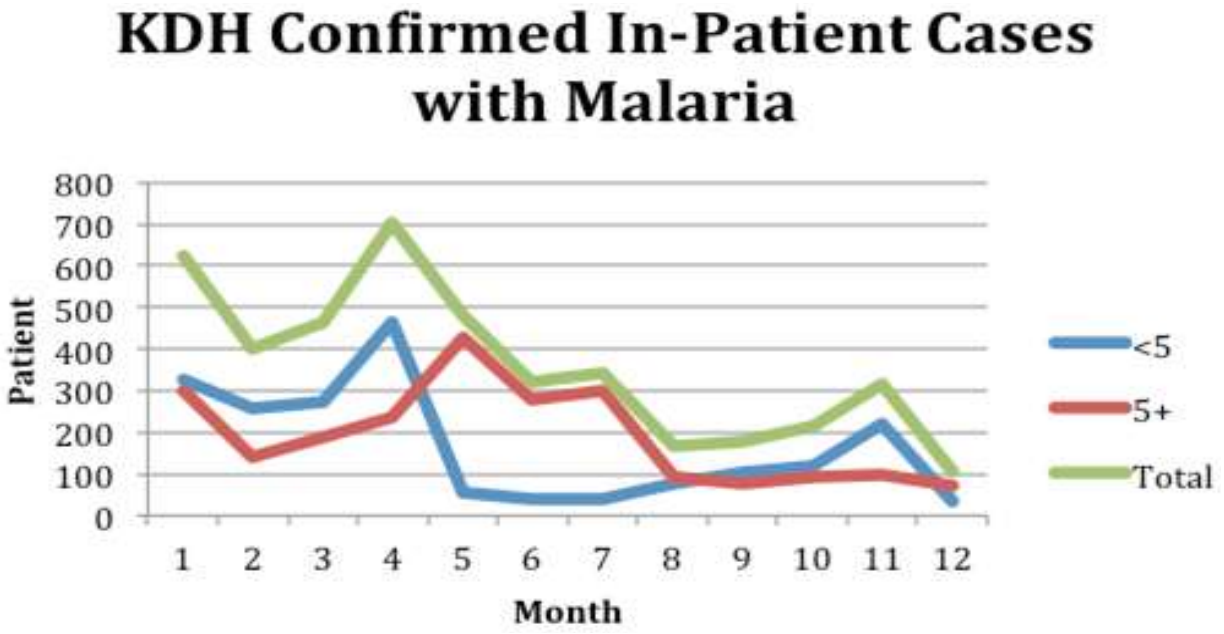

Figure 1. Plot of registered malaria cases in Kasungu District Hospital every month in 2014. The spike in the months 3, 4 and 5 and the fall off during 10, 11, 12 are noteworthy.

Table 3. Malaria cases distribution between genders.

Malaria cases	Male	Female
Total malaria cases	569	936
Non-severe malaria cases	389	747
Severe malaria cases	180	189
Secondary diagnosis cases	171	252

DISCUSSION

It appears that the difference in the cure rates between both the under 5 and above 5 age groups is miniscule, indicating that lower immunity under the age 5 has very little bearing on the overall curability figures. This data is different from many findings in the literature where more than 75% mortality share is on the under 5 age group.

However, in the age group above 14, there are some perceptible differences between the genders (Table 3). In 2014, there were 569 males and 936 females. Among the males, 389 were afflicted with non-severe malaria and the rest 171 were severe cases. Among the females, 747 accounted for the non-severe and 189 as severe cases. It is clear from Figure 2 that in spite of a significantly smaller number of registered cases for the males, the numbers of severe cases for both genders are roughly the same. One obvious inference is that there is a tendency by the male patients to register as in-patients when the affliction has degenerated to an advanced stage. It was also noted that both male and female patients were affected with secondary complications, as noted in Figure 3. As expected, anemia as secondary complication had a more visible presence in females than in males, diarrhea, peptic ulcer, meningitis and pneumonia being other associated complications. As for the mortality rates among the males and females, a significant difference exists. Whereas death occurred in 65% of the severe malaria male cases among males, it was 48% in female (Figure 4). This signifies that the severe cases in

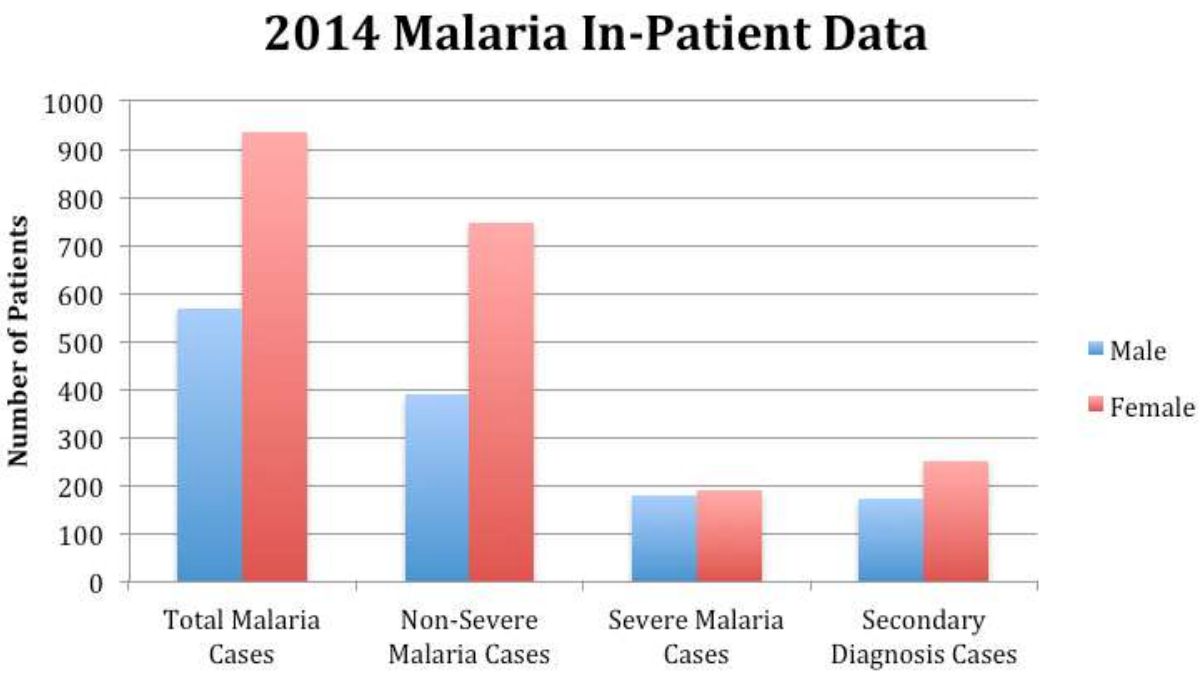

Figure 2. Distribution of malaria cases by genders.

males were more acute than in case of females. There was also a noteworthy difference between the in-patient residence times for male and female patients as shown in Figure 5. 17% of the male patients and 31% females registered as in-patients were discharged on the same day of admission. Also, 25% of the females spent an average of one day whereas only 19% males did so. The residence time beyond 1 day did not show much difference between males and females. It appears that the tendency of the male to need a hospital care requiring an average of one day is low either due to psychological or economic factors or both.

In general, men report to the hospital when the case assumes a severity when it may *prima facie* require more than a day's care.

DISCUSSION

The hospital record of KDH for malaria patients for 2014 as a representative year presents a very interesting case in the general perspective of disease occurrence and management. There are interesting features in respect of the number of malaria cases occurring in terms of age and gender distribution.

At the outset, the general rise in registered cases in the months of March, April and May (Figure 1) is consistent with the climatic conditions in the southern hemisphere where high heat and rain fall rate would aid the mosquito breeding resulting in malaria proneness. Transmission of the disease depends on climatic conditions that affect the number and survival of mosquitoes- rainfall, temperature and humidity. Therefore, it is conceivable that there is a considerable decrease in the dry months of October, November and a part of December.

Among the reported cases in terms of age, as shown in Table 2, the cure rates of patients under 5 and above 5 are almost identical at 94.2 and 93.2% respectively. This is an unusual exception from the general trend where the mortalities among the under 5 children is overwhelmingly large according to many reports (Ladeia-Andrade et al., 2009; Artavanis-Tsakonas et al., 2003; Nyirenda et al., 2015). Worldwide, usually the children under five are one of most vulnerable groups. This is also inconsistent with a focused study on Malawian children done by Dembo (2012). There were an estimated 584 000 malaria deaths around the world in 2013, of which approximately 78% were in children under five years of age.

In high transmission areas, only partial immunity to the disease is acquired during childhood. In such settings, the majority of malarial disease, and particularly severe disease with rapid progression to death, occurs in young children without acquired immunity. Severe anemia, hypoglycemia and cerebral malaria are features of severe malaria more commonly seen in children than in adults. In the hospital data, this observation, however, is not supported. Though this may require a more comprehensive multi-year data analysis, this may also have some

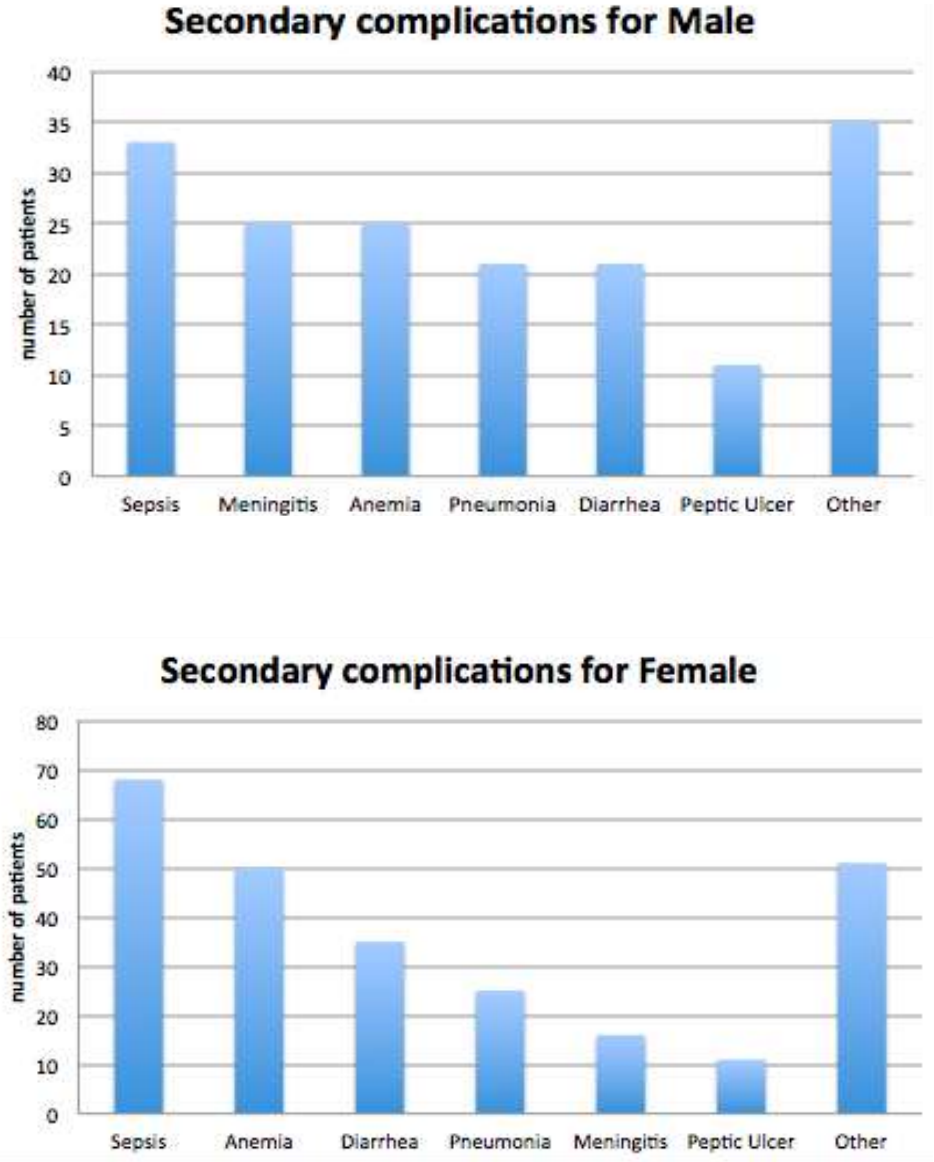

Figure 3. Secondary cases developed in both male and female malaria patients 171 out of 569 total and 256 out of 936 total respectively, roughly 30% for both.

connotation with the child's welfare and malaria prevention program that Malawi and the Kasungu District administration have implemented. Programs such as universal distribution of insecticide treated mosquito nets, community case management of childhood illnesses including malaria as well as improvements in case management and improvements in early diagnosis have borne out results. Also, most current strategies for interventions often target children under five years of age, making the efficacy of the programs more visible and perhaps shifting the vulnerabilities to an older age group in a statistical sense. This has been supported by a simulation study done by a research group in Swiss Tropical and Public Health Institute (Pemberton-Ross et al., 2015).

The most noteworthy of the statistics is in the gender gap that exists in the reporting and management of the disease. As seen in Figure 2 and Table 2, the female patients far outnumber the male-936 against 569. However, the number of severe malaria cases among the male and female are essentially same at 180 and 189 for male and female respectively. This implies that the percentage of male patients afflicted with a severity of the disease is much higher which may also imply that the

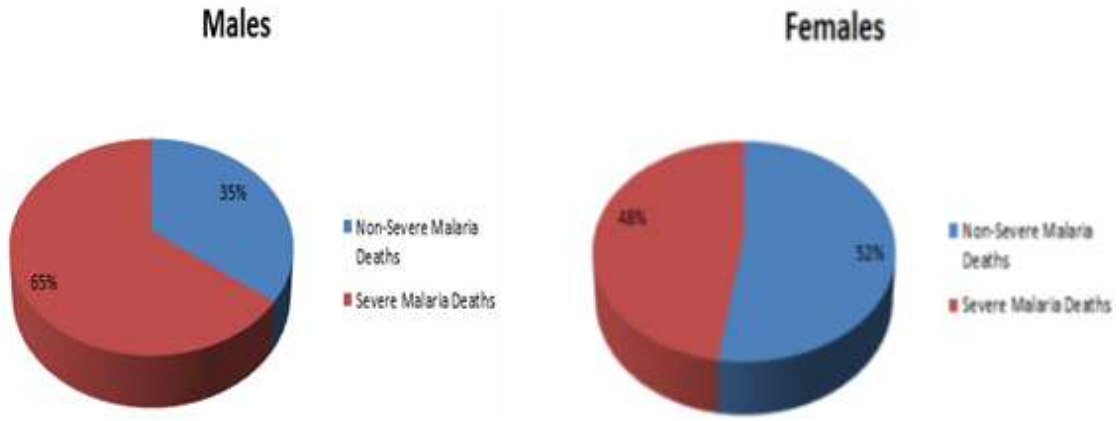

Figure 4. Deaths among the male and female malaria patients according to the severity of the disease.

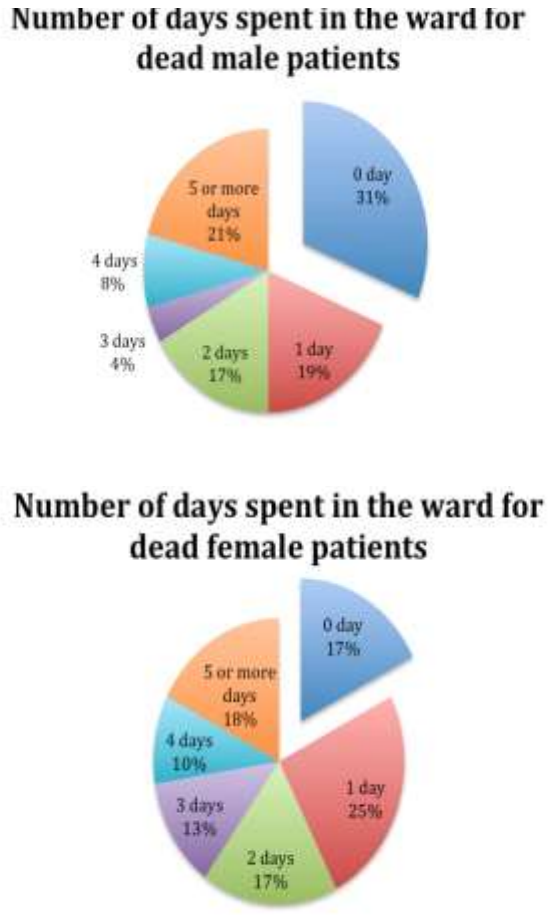

Figure 5. Side by side comparison of number of days spent as in-patients between males and females.

males have a tendency to report as registered in-patients only at a later stage of severity. This is a social trend that is in keeping with the general ethos where males are regarded as the fenders for the families who would be procrastinate being registered as in-patients since it would keep them away from homes, as it potentially would jeopardize the family's economic structure. This is an interesting finding and it would be curious to explore a trend in the general socio-economic divide across African nations and even globally. Whereas the reluctance in male patients to register as in-patients arises from genuine economic concerns, there are also reports of cultural stubbornness routed in a certain degree of superstition. One such practice is that even if there is a provision of distributing mosquito nets, the male members in many cases desist from using them because of a conjectured fear that this practice reduces male virility. This fear may not necessarily arise from superstition, but rather deep distrust that exists in certain pockets on the Government preventive programs where the public fear that the Government has other motivations in stealth mode.

The case study for malaria at KDH for the year 2014 is being treated as a typical representative study with no extraneous factors in terms of climatic or political event prejudicing the results. Moreover, this analysis has been made by resorting to the data straight from the hospital register. It is conceivable that the general rise in education and economic level in this largely agrarian and rural population will also amend many social and cultural habits that will contribute towards the total eradication of this serious disease. However, it will be hard to extra-polate a prediction by analyzing some trends in few years' data. Yet, this study is an important addition to the literature of data and figures that establish a trend as to how the disease is being managed at present.

CONCLUSION AND RECOMMENDATION

The data analyzed under this study is a snap shot in time

albeit of a year's length. Thus, it is sufficient data to notice a general trend in respect of gender and age distribution. The little difference in the cure and mortality rates between age groups under and above 5 is particularly noteworthy. The differences in the registrations and treatment outcome between genders are also highly noticeable which are attributed to the reasons of socioeconomics and traditions.

However, it is recommended that a larger multi-year data analysis needs to be undertaken to validate or nullify the aforementioned conclusions, because such a study will bear greater statistical significance.

Conflict of interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

Road fatalities in Trinidad: A geographic information system approach

Chavin D. Gopaul*, Aruna Singh-Gopaul, Edison Haqq and Dave D. Chadee

The University of the West Indies Trinidad and Tobago, Trinidad and Tobago.

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This paper aims to examine road fatalities using a GIS approach in Trinidad in an effort to provide recommendations on how road collisions and the number of casualties can be mitigated. In order to achieve this, the paper has examined a number of maps of Trinidad. The study examined data generated from maps of Trinidad using the Arc GIS Maps 10 software. Different variables were used to manipulate the data and these were road incidents by administrative area, municipalities, population density and socio economic status in Trinidad. The data generated represented the period 2005 to 2011 from 355 locations across Trinidad. From the data analyzed, it is clear that there is a positive correlation between the number of fatalities and the economic status of an area as well as the population of the area. From the data represented in the maps, it is clear that in regions with high population and numerous intersections such as City of San Fernando, Tunapuna, Port of Spain, San Juan, Laventille, and Diego Martin the number of road fatalities was high. The findings established in the study can allow for change in: (i) Road Traffic legislation and control measures and (ii) infrastructural redesign and implements.

Key words: Geographic information system, Trinidad, road traffic fatalities.

INTRODUCTION

Road fatalities claim a significant number of lives in Trinidad and Tobago. Collisions can be attributed to human error or natural factors (Elvik, 2009). The road network is the most widely used form of transport since it is the cheapest form of transport for both goods and passengers over short distances (E.C.D, 2001). Thus road fatalities continue to remain one of the leading causes of death worldwide as it claims millions of lives across the world (Albrecht, 2011). Road transport is estimated to cause more than 1.2 million deaths annually (WHO, 2012). The fundamental aim of the analysis is to depict the usefulness of reducing road fatalities by undertaking a GIS approach to doing so. The paper will use Trinidad as the geographic location and represent key data useful for making recommendations geared toward reducing road fatalities. The findings from the maps generated from the GIS approach will be discussed with relevant inferences and recommendations.

*Corresponding author. E-mail: chavin.gopaul@gmail.com.

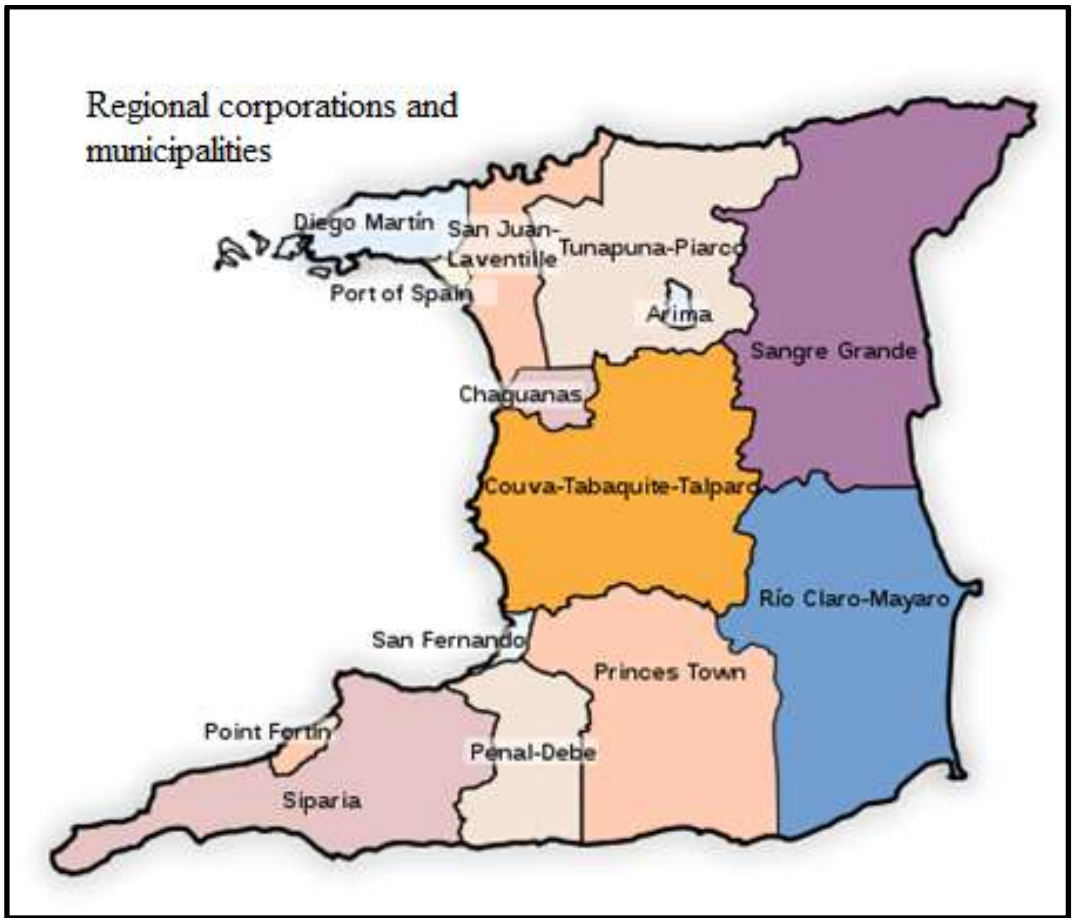

Figure 1. Map showing the 14 regional corporations and municipalities.

METHODOLOGY

A Geographic Information System (GIS) is an information system that deals with a variety of geographical data. It is able to capture, store, analyze and manipulate this geographical data so that easier conclusions can be made. This is mainly because geographical data for specific regions is available and this data can be manipulated using GIS software in order to study a specific geographical area. GIS can be made to the researchers' specifications and is therefore very important in analysis of data of a geographic area. Therefore GIS is an important tool in analyzing road fatalities in a given geographical area. Trinidad is made up of 14 regional corporations and municipalities. These are shown on the map in Figure 1. The map shown above demonstrates the 14 regional corporations and municipalities of Trinidad. Of the 14 regional corporations and municipalities, nine are regions while five are municipalities. These form the main administrative regions of Trinidad and will guide the basis of the research. Data for these municipalities and corporations were retrieved in order to help determine variables such as fatality by administrative area, municipality, population density and socio-economic status.

In order to determine the collision prone areas of the island, information on the locations of RTCs for the period 2000-2011 were obtained from the Central Statistical Office of Trinidad and Tobago and cross-referenced with accident reports from the Traffic and Highway Patrol Unit (Table 1). The researcher and two assistants visited each site, utilizing a handheld GIS monitor, Trimble Juno SB Outdoor Handheld GPS GIS Mapping data collector. The data were collected from 335 locations within the different Municipalities in Trinidad. The co-ordinates for each location were obtained and documented. Maps were developed using Arc GIS Maps 10. The data analyzed were collected as described above and contained information on the incidence of road fatalities. This information includes total number of road incidents and fatalities by administrative area, Municipal Corporation, population distribution and socio-economic status of the community. These factors will be used to determine the trend of collisions using Geographic Information Systems (GIS).

RESULTS

The results from the research is divided into different subsections as it relates to the administrative areas, municipalities and population distribution using the GIS approach in Trinidad.

Total number of fatalities by administrative area

The map shown demonstrates the areas prone to collisions in different administrative regions (Figure 2).

Table 1. Table showing the size, population, and population density of the 14 regional corporations and municipalities of Trinidad in 2011

Regional Corporation	Size in km^2	Population	Population density / km^2
Port of Spain City Corporation	13.45	49,031	3,650
San Fernando City Corporation	18.64	55,419	2,970
Chaguanas Borough Corporation	59.65	67,433	1,130
Arima Borough Corporation	11.15	32,278	2,890
Point Fortin Borough Corporation	23.88	19,056	800
Couva-Tabaquite-Talparo Regional Corporation	719.64	162,779	230
Diego Martin Regional Corporation	127.53	105,720	830
Penal-Debe Regional Corporation	246.91	83,609	340
Princes Town Regional Corporation	621.35	91,947	150
Rio Claro-Mayaro Regional Corporation	852.81	33,480	40
San Juan-Laventille Regional Corporation	220.39	157,295	710
Sangre Grande Regional Corporation	898.94	64,343	70
Siparia Regional Corporation	510.48	81,917	160
Tunapuna-Piarco Regional Corporation	527.23	203,975	370

(Central Statistical Office, 2011)

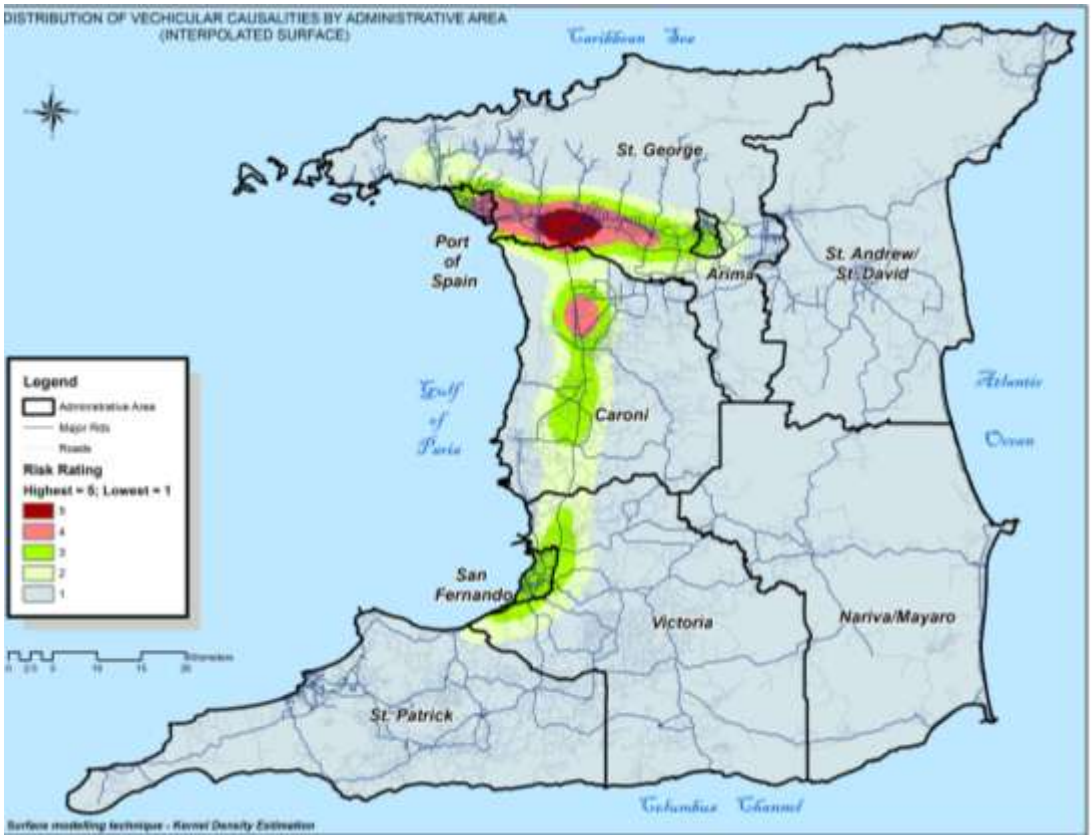

Figure 2. Map showing risk of accident by administrative areas.

From the map above, it is clear that the following regions that are prone to higher road traffic fatalities are Saint George, San Fernando, and Caroni administrative areas. In contrast, the Northern and Southern sections of the map have minimal collisions. This indicates that the areas that are more prone, have a higher number of road traffic casualties. On the other hand, areas less prone to collisions have few casualties. It can also be assumed

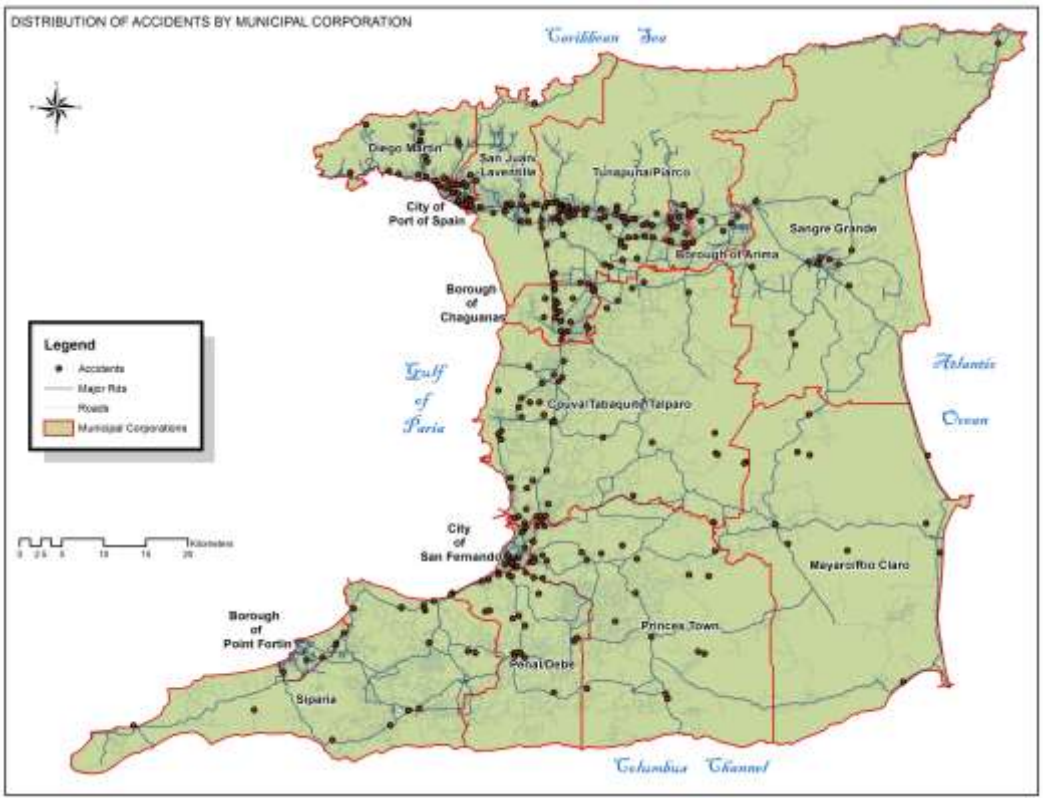

Figure 3. Map showing location of all accidents casualties by Municipal Corporation.

Table 1. The number of all cause deaths, number of collisions and fatalities which occurred from 2000 to 2011 in Trinidad and Tobago.

Year	All-cause mortality		Fatal road traffic collisions		Road traffic fatalities	
	No	%	No	%	No	%
2005	9885	0.8	196	8.8	216	2.2
2006	9664	0.7	188	8.4	214	2.2
2007	9653	0.8	188	8.4	214	2.2
2008	10,000	0.8	233	10.4	261	2.6
2009	10,200	0.8	192	8.6	222	2.1
2010	10,251	0.8	168	7.6	205	2.0
Total	119,071	0.9	2073	100	2360	1.9

Source: Trinidad and Tobago Traffic Branch (2011).

that the number of vehicles in the high prone collision areas is higher as compared to the lower prone areas. This leads to an increase in the number of casualties due to collisions in the high prone areas.

Accident casualties by Municipal Corporation

The map in Figure 3 demonstrates the number of collisions or events by Municipal Corporation. The number of collisions or events is greatly concentrated in the City of San Fernando, Tunapuna, City of Port of Spain, San Juan, Laventille and Diego Martin. The other regions have sparsely distributed road fatalities. The following is a list of the number of collisions in all regions in decreasing order; City of San Fernando, Tunapuna, City of Port of Spain, San Juan, Laventille, Diego Martin, Borough of Arima, Couva, Borough of Point Fortin, Siparia, Penal, Princes Town and Mayaro. Population distribution: Table 2 illustrates the regions with the highest population and population density in the area. All other areas have population densities that are below1000 / km^2. Information on the population and size of the regional corporations and municipalities are shown in the

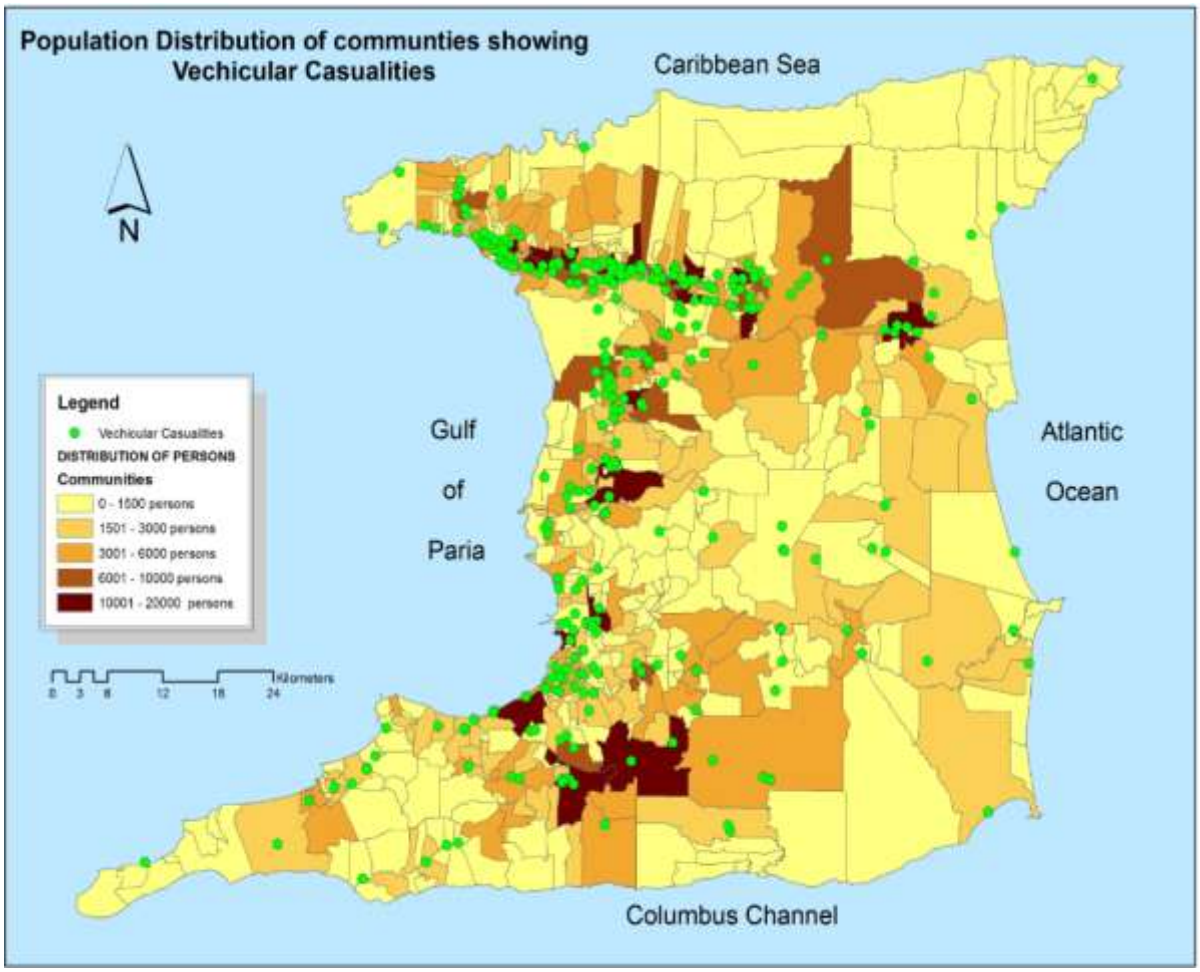

Figure 4. Map showing the distribution of vehicular casualties and the population distribution.

table below. Port of Spain City Corporation, San Fernando City Corporation, Chaguanas Borough Corporation, and Arima Borough Corporation represent the four major metropolitan areas in the country and have higher amounts of traffic flow given the fact that it is more populated than other regions within the country. From the table, these regions have a population density of 3,650 / km^2, 2,970 / km^2, 1,130 / km^2, and 2,890 / km^2 respectively.

The Arc GIS 10 Map in Figure 4 shows the distribution of vehicular casualties and the population distribution. It can be seen that in regions with low population density that is 0 to 1500 people and 1501 to 3000 people, the number of collisions are low. Only a few collisions have been noted in the 0 – 1500 people region. This is especially in the Northern and Southern regions of the map. The number of vehicular collisions is greatly concentrated in regions with populations of 6001 – 10000 people and 10001 and 20000 people. This indicates that collisions are prevalent in the regions that are densely populated.

Socio-Economic status of community

The map in Figure 5 shows the distribution of vehicular casualties and the socio-economic status of the communities. The map illustrates the regions with poor, lower and lower middle class communities the numbers of collisions are low. This is especially in the north eastern and south eastern regions of the map. The number of vehicular collisions is greatly concentrated in regions where middle class, upper middle class and upper class individuals. This is frequent for the regions that have upper class individuals. This indicates that collisions are prevalent in the regions where the population is of better socio economic status.

DISCUSSION

During the period from 2000 to 2011, 119,071 persons died from all causes in Trinidad and Tobago; of these, road fatalities accounted for 2360 deaths (≈2.0%) in

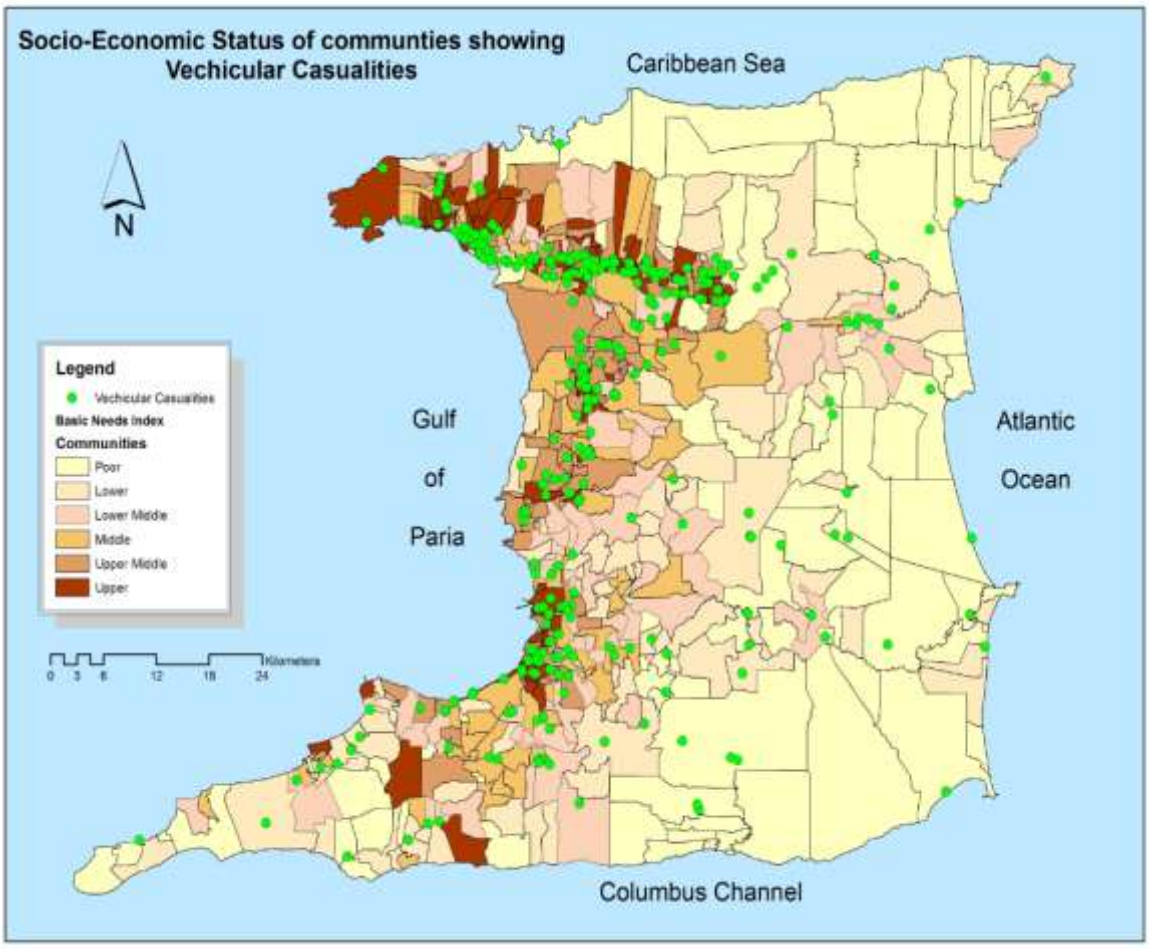

Figure 5. Map showing the social economic status of communities and the distribution of vehicular casualties.

2,073 fatal collisions (≈1.1 deaths per collision) (Trinidad and Tobago Traffic Branch, 2011). The annual number of fatalities caused by road traffic collisions averaged 196.6, ranging from a low of 126 (or 1.3%) in the year 2000 to a high of 233 (or 2.6%) in 2008. The year to year variation in the number of fatal collisions was 5.6% to 10.4%. Over 56% of the collisions (1170) and 56% of the fatalities (1323) occurred during the period 2005 to 2011. By studying the data retrieved from using the Arc GIS 10 Mapping software, inferences regarding road traffic incidents in Trinidad can be made and is useful in discussing the recommendations to reduce the incidence of such. Geographical representation of data helps the researcher identify the target population to which modifying risky driving behavior can be focused on as well as the areas where these should be implemented. It can also help suggest the type of safety implements that can be made e.g. crosswalks, more pavements, traffic signs, stronger traffic warden presence, given that there were a higher amount of road traffic incidents in the metropolitan areas (Port of Spain, Arima, San Fernando and Chaguanas) in Trinidad.

According to Abdalla et al. (1997), collisions are prone to occur in highly populated areas and areas with middle and upper class economic status. This is mainly because in these areas there are high populations as well as the number of vehicles in this region are high. Based on the data analyzed from the maps, it was found that there was a positive correlation between the number of fatalities and the economic status of an area as well as the population of the area (1001-20000 persons). Therefore, it is important to ensure that recommendations are made in order to ensure that casualties are reduced in these areas. Traffic enforcement cameras or speed cameras have been an important tool that has been used by law enforcement authorities in many countries (New Zealand, 2002). Speed cameras work by ensuring that motorists stick to laid out traffic rules such as maintaining a certain speed limit, correct use of lanes and the enforcement of traffic light regulations. This would be applicable in the municipalities where the numbers of casualties are high such as Port of Spain, Arima, Chaguanas and San Fernando as well as the administrative areas such as Saint George, San Fernando and Caroni. Government

policy can be used to ensure that in such areas traffic enforcement cameras are installed in order to ensure that accident casualties caused by drivers who do not stick to traffic rules are reduced (Hayes and Great Britain, 2008). Speed cameras should also be installed in areas where the population density is high, such as the City of San Fernando, Tunapuna, Port of Spain, San Juan, Laventille and Diego Martin. From the analysis carried out it can be inferred that the largest number of collisions occur in regions with the highest population. This may be due to the number of cars and commercial activity in the areas. Therefore, the installation of speed cameras in these areas will help reduce the number of collisions in this region (Pilkington and Kinra, 2005).

Automatic in-pavement lights can be installed to alert drivers of pedestrians in cases of inevitable poor visibility. Under such conditions, a driver is less likely to see a pedestrian or an oncoming vehicle leading to an accident. Increasing the visibility of road layouts can be used to reduce the number of road collisions. Drivers are involved in collisions, especially at night, for lack of proper road view (Gielen et al., 2006). This can be accomplished by using reflective surfaces to demarcate lanes. Road studs that use LED can also be used for demarcation (National Research Council (U.S.), 2000). These measures enhance the drivers' awareness of the road layout especially at night. This will reduce head-on collisions while increasing lane discipline at the same time. The study and data generated from the GIS approach indicates that regions with high population such as City of San Fernando, Tunapuna, Port of Spain, San Juan, Laventille, and Diego Martin, the number of road intersections is high. This is mainly because these regions are highly populated and have a high number of feeder roads joining the main roads. It is evident from the data analysis carried out and the maps developed that most accident fatalities occur between the Tragarete Road location and the Mausica region, which has a high population and a large number of intersections. Road intersections are also popular for having crashes involving pedestrians (Lee and Abdel-Aty, 2005). This can be attributed to high traffic as well as overwhelming coordinating demands on the drivers' part. This can be mitigated by replacing intersections with single-lane roundabouts (Lee et al., 2003).

Re-engineering of roadways can significantly reduce road fatalities. According to Elvik (2009) a black spot is a region on the road that a high number of collisions tend to occur due to the physical nature of the road. These spots on roads are normally known for the high number of collisions occurrence. Such spots include sudden sharp bends or congested intersections. Such places should be addressed so that technologies like markings to direct traffic at complex intersections, road signs, secure waiting areas to serve parked vehicles and sightlines can be implemented (Venglar et al., 2007). These measures can provide drivers with sufficient warnings. This reduces the number of decisions a driver has to make in collision-prone spots on the road. This in turn, reduces road fatalities resulting from collisions (Elvik, 2009). In regions with high population, multi-way stop signs can be employed where roundabouts cannot replace intersections (National Research Council (U.S.), 2010). These are stop signs placed where there is a junction. This helps to reduce number of accident casualties at intersections and junctions (National Research Council (U.S.), 2010). These multi-way stop signs are more effective at controlling vehicle speeds compared to two-way stop signs and traffic signal control. In addition, they will help in controlling the high population flow within the roads (National Research Council (U.S.), 2010).

In regions with high population and high economic status the conspicuity and visibility of pedestrians is important in order to reduce road fatalities. The implementation of proper measures can increase the conspicuity and visibility of pedestrians. This measure should be effective as most drivers blame poor visibility for pedestrian crashes (Elvik, 2009). The visibility of pedestrians can be increased in a number of ways. These include; crosswalk markings, increased roadway lighting intensity, bus stop relocation, warning signs with internal illumination and diagonal parking (Elvik, 2009) [1]. Increased lighting illuminates pedestrians especially at night. This reduces fatalities associated with nighttime road collisions (McGee, 2013). National Cooperative Highway Research Program, American Association of State Highway and Transportation Officials and United States, 2013). According to Zegeer and Turner-Fairbank Highway Research Center (2002), such measures have been implemented in the United States in order to reduce road fatalities. Traffic calming techniques have proven to be efficient in reducing the number of road fatalities and road collisions. These techniques include; speed humps, pedestrian refuge islands, roadway curvature adjustment and lane narrowing. When implemented, these techniques reduce vehicle speeds. Consequently, crashes involving pedestrians are reduced (Elvik, 2009). Barriers and fences can also be used to channel pedestrians towards safe crossing areas. These techniques can be used on intersections where traffic is managed using signals (Day et al., 2007).

Conclusion

The representation of geographical data assists with planning, monitoring and program design in terms of geographic location. The paper shows how data and statistical representation can easily be depicted via the use of maps to illustrate exactly where were prone to road fatalities and areas of high incidence. The analysis focused on how a GIS approach can be used to track and monitor road fatalities with the aim of reducing its incidence rate. The findings were represented in maps

generated using the Arc GIS 10 mapping software and contains key information pertinent that can be used to for program design and implementation to road traffic laws and regulations as well as communication campaigns. The data informs public health and program designers of the geographical areas that focus should be concentrated. The maps represented data on road fatalities based on municipalities, population density and socio-economic status. These factors can help devise ways to reduce road fatalities based on geographic findings and inferences.

Conflict of Interests

The authors have not declared any conflict of interests.

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Full Length Research Paper

Morbidity and mortality due to severe diseases in Kasungu District, Malawi, Central Africa

David S. Chung[1] , Moon-Jun B. Kim[2] , Richard E. Kang[3] , Jamie Yoon[4] , Seung Y. Choi[5] , Judy Lee[6], Hannah Son[7], Ye J. Song[8] , Jung Y. Choi[9], Peter Lee[10] , Sohyun Chang[5] , Sung M. Kang[11], Choongsung Lee[12] , Joseph Park[13], George Talama[14], Jerome Z. Nkambule[14] and Sung-Jae Chung[15]*

[1]Division of Biology and Medicine, Brown University, Providence, RI 02912, USA.
[2]Department of Biological and Environmental Engineering, Cornell University, NY 14850, USA.
[3]The School of Public Health, UC Berkeley, Berkeley, CA 94704, USA.
[4]UC San Diego, La Jolla, CA 92093, USA.
[5]Johns Hopkins University, Baltimore, MD 21218, USA.
[6]School of Human EcologyCornell University, Ithaca, NY 14850, USA.
[7]Department of Biology, UC Irvine, Irvine, CA 92697, USA.
[8]Smith College, Northampton, MA 01063, USA.
[9]St. Andrew's School, Middletown, DE 19709, USA.
[10]Collegiate School, New York, NY 10024, USA.
[11]University of Virginia, Charlottesville, VA 22904, USA.
[12]Glenelg High School, Glenelg, MD 21737, USA.
[13]South High School, Torrance, CA 90505, USA.
[14]Kasungu District Hospital, Kasungu District, Malawi.
[15]School of Arts and Sciences, Marymount University, Arlington, VA 22203, USA.

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Analysis of the distribution of patients and diseases in the Kasungu District Hospital of Malawi, a land locked country in south-eastern Africa, was presented. The statistics of reported diseases in the hospital data with variables such as disease types, patient types and times of the year were examined. It is shown in this study that many of the diseases endemic to Africa do generally occur in this selected district as well. However, the analysis presents the possibility of reducing the incidences of many diseases by preventive measures and access to health facilities on time. This work is the extension of previous efforts to make accurate data available and is placed in the larger context of the diseases affecting the African continent in general.

Key words: Malaria, tuberculosis, Malawi, childhood education.

INTRODUCTION

Africa is the world's second-largest and second-most-populous continent. Every geographic locale has diseases endemic to the region, and Africa is not different. However, the vast majority of the diseases that plague Africa can be prevented with basic measures such as preventative early childhood education regarding disease and adequate hygienic practices.

An overview of the diseases that are pandemic in

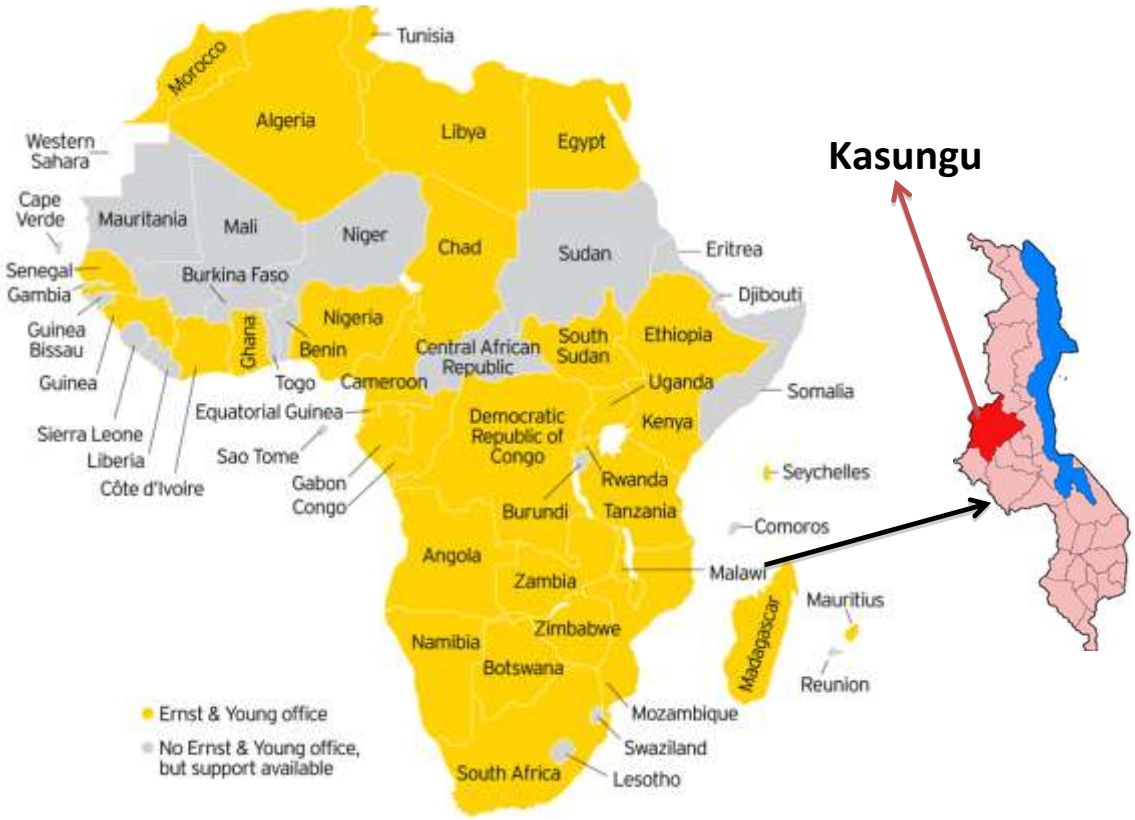

Figure 1. Map of Africa with Malawi and the Kasungu District highlighted.

Africa that claim most lives are listed. Syphilis is widely prevalent. This disease affects approximately 12.2 million people each year around the world and Africa has a major share with a quarter of these cases occurring, primarily due to the lack of basic sexual health education. Infection rates range anywhere from 6-30% in various African states. Next, tetanus, whooping cough and measles, diseases that are largely under control in the US and the Western world because of early childhood vaccinations, are endemic in northern and central Africa, and accounts for above of 800,000 deaths each year. Further, tuberculosis, the lingering debilitating illness kills up to 2,000,000 people each year. Deaths due to diarrhea are more than 2,000,000 because of the lack of basic hygiene causing contamination of the water supply, even as it could be otherwise easily preventable. Malaria affects 500 million people worldwide, and in the mosquito prone areas of Africa, this disease causes 1-3 million death per year. HIV/AIDS currently infects 33 million people in Africa, with the vast majority of these cases concentrated in sub-Saharan Africa, spreading primarily due to the lack of proper sexual education and preventative measures.

Even though, the foregoing is a numbing list of tragic mortalities, by far, the most virulent killer of Africans is pneumonia and related respiratory illnesses. Each year, pneumonia kills at least 800,000 Africans. This list is, by no means, exhaustive, but is indicative of how any socio-political approaches of prevention and control can severely reduce these incidents. It should be recognized that the diseases affecting Africa in general, and by extension, both Malawi and the Kasungu District are pneumonia, anemia, malaria, and diarrheal diseases (non-bloody). Fatalities from these diseases in severe form can be prevented by early diagnosis and prompt institution of effective treatment. However, the condition is often recognized late and not all cases are located in a place where timely access to health facilities is available. It is imperative that coordinated and well-funded efforts begin to educate communities on early recognition of the diseases, strengthening referral systems, and making pre-referral treatment available.

Malawi, officially called the Republic of Malawi, is a landlocked country in southeast Africa (Figure 1). Malawi

*Corresponding author. E-mail: schung@marymount.edu.

is over 118,000 km^2 (45,560 sq mi) with an estimated population of 16,777,547 (July 2013 estimate). Its capital is Lilongwe, which is also Malawi's largest city. Malawi has central hospitals, and also regional and private facilities. The public sector offers free health services and medicines, while non-government organizations offer services and medicines for fees. Private doctors offer fee-based services and medicines. Health insurance schemes have been established since 2000. Malawi's healthcare goal is for "promoting health, preventing, reducing and curing disease, and reducing the occurrence of premature death in the population".

Infant mortality rates are high, and life expectancy at birth is 50.03 years. There is a high adult prevalence rate of HIV/AIDS, with an estimated 930,000 adults (or 11.9% of the population) living with the disease in 2007. There are approximately 68,000 deaths a year from HIV/AIDS. Approximately 250 new people are infected each day, and at least 70% of Malawi's hospital beds are occupied by HIV/AIDS patients. The high rate of infection has resulted in an estimated 5.8% of the farm labor force dying of the disease.

There is a very high degree of risk for major infectious diseases, including bacterial and protozoal diarrhea, hepatitis A, typhoid fever, malaria, plague, schistosomiasis and rabies. Malawi has been making progress in decreasing child mortality and reducing the incidences of HIV/AIDS, malaria and other diseases. However, the country has been less successful in reducing maternal mortality.

The fact that access to health services in Malawi is limited affects a large number of Malawians. Only 46% of the population lives within a 5 km radius of any kind of health facility. Despite most public health services being free for the patients, the cost of availing them is not entirely free because of ancillary expenses. For example, there are often costs associated with transportation to and from a facility. These costs deter many individuals even as they may be in dire need of care but cannot afford to assume the costs of transportation. Additional transportation needs aggravate the matter when an individual is referred from either a rural hospital to a district hospital or from a district hospital to a central hospital (Chasimpha et al., 2015).

In 2011, the University of Malawi released an article by Cameron Bowie that listed the following as the top ten causes of death in Malawi (Bowie, 2011):

1. HIV/AIDS (25%)
2. Lower respiratory infections (12%)
3. Diarrheal diseases (8%)
4. Malaria (8%)
5. Cerebrovascular disease (4%)
6. Ischemic heart disease (4%)
7. Perinatal conditions (3%)
8. Tuberculosis (3%)
9. Road traffic accidents (2%)
10. Chronic obstructive pulmonary disease (1%)

MATERIALS AND METHODS

The hospital patients' records for all wards were made available by the Kasungu District Hospital offices. The data collection and analysis was focused on the most recent data available in complete form, that is, that of the year 2012 and 2013. The cure rate and the fatalities count per disease were extracted by the simple statistical analysis of percentages from the total reported cases. Admittedly, a larger sampling size than that of only two years would make the reported data more representative of the general trends, however, the data is construed to be large enough to make statistical sense and establish broader trends.

RESULTS

In the Kasungu district of Malawi, certain diseases affect a large number of children. According to the 2012 Kasungu District Hospital Annual HMIS Report 2012/2013 in the Pediatric Ward (Figure 2), there were almost 1200 cases of pneumonia. Trailing closely, were slightly over 1000 cases of malaria. At a distant third were 300 cases of anemia and the rest diseases or conditions were negligible as compared to these three.

There is a distinct division between the cases of diseases that affect children under five and the others that are older. For children five and below, the greatest infection is malaria. While infection rates for these children are high, there seems to be a danger threshold that children five and above have passed as evidenced by the infection rates for these children falling off precipitously. This may be due to the fact that older children have a relatively more developed and mature immune system that allows them to resist infection. However, pneumonia infection rates remain high across the board for all children in all categories. This may be due to the nature of this disease. Pneumonia is often times an opportunistic infection that attacks when the body’s immune system is low after a long and extensive battle with another illness, disease or ailment. It is interesting to know if the children who have become infected with pneumonia had been battling another illness before they came down with pneumonia. If so, this would lend great credence to this proposed hypothesis.

Falling in line with the previous analysis above, pneumonia has the highest prevalence of afflicting people in the Kasungu area, making up 38.7% of the diseases. Malaria comes in as second and makes up 33.6% of the illnesses plaguing this area.

In 2013, Malawi had a HIV/AIDS adult prevalence rate of 11% (CIA, 2014). In 2013, there were 920,000 people living with HIV/AIDS and 51,000 AIDS related deaths occurred. The incidence of Malaria deserves a special attention as it has a high rate of incidence in Malawi. Malaria affects numerous aspects of social and economic life in Malawi. High malaria prevalence affects fertility,

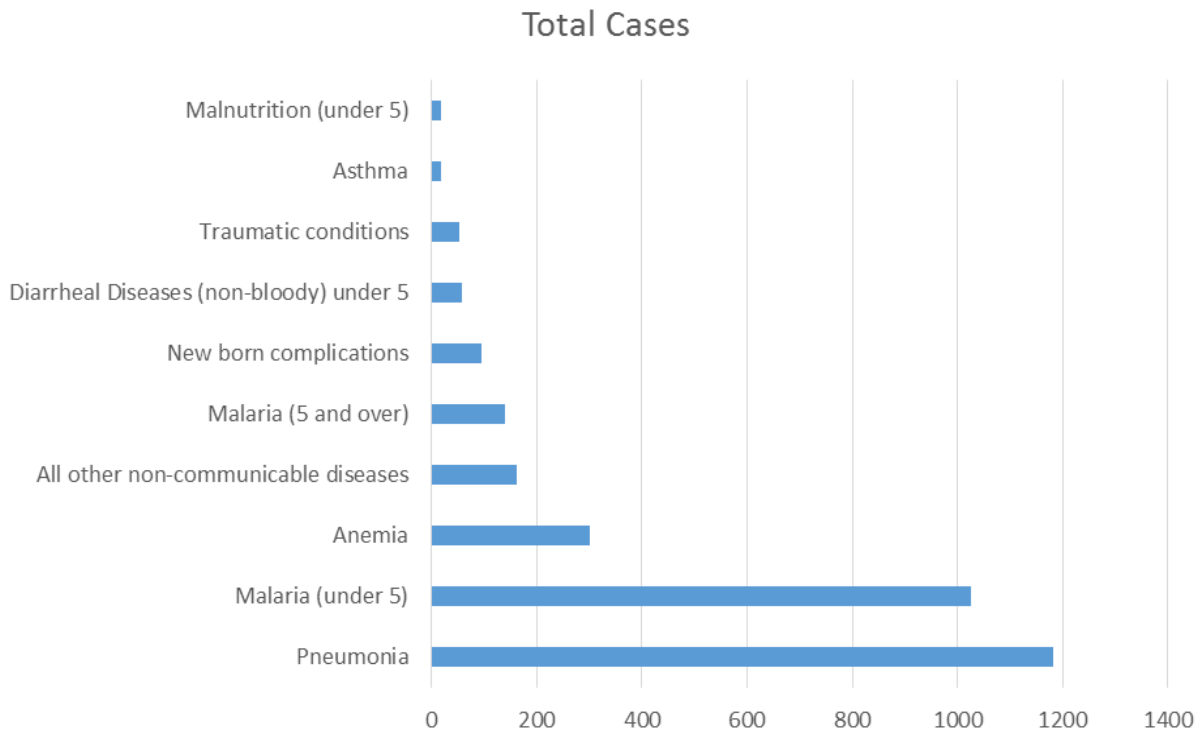

Figure 2. Diseases affecting children admitted in Kasungu District hospital pediatrics ward.

savings and investment rates, crop choices and schooling and migration decisions (Sachs and Malaney, 2002). There are a wide variety of cost-effective approaches to reduce the burden of malaria. Some current intervention tactics include case management, the use of insecticide-treated bed nets, indoor residual spraying, and environmental vector control measures such as larvaciding (controlling mosquitoes at the larval stage through the use of chemicals) and filling and draining of breeding sites. (Goodman and Mills, 1999). Each of these interventions has proven to have a high value of health gains achieved per dollar (Goodman and Mills, 1999). More specifically, mosquito nets are one of the most effective and widely used approaches. They are most effective in that they require a minimal amount of resource input and result in a large decrease in the prevalence of Malaria (Berthelemy et al., 2013).

While there is significant extant information on the diseases affecting Africans in general, and a certain compendium of data regarding diseases in Malawi proper, there was a dearth of statistics regarding the diseases affecting the people in the Kasungu district Malawi. The purpose of this study was to elaborate the literature and shed some light on this oversight and space. It is believed that a more detailed study and analysis on a specific region will not only enrich the research literature, but also enable preventive measures by ensuring more cognizance on any particular patterns. While there might be some logistical and financial obstacles that need to be overcome to provide better treatment for Malawians who have been already affected by diseases, it is believed that preventative measures can mostly alleviate this situation. It is hoped that the demographic research that is undertaken and the data gleaned from this research will be helpful in carrying out any future preventative initiatives.

DISCUSSION

Kasungu District is located in the Central Region of the Republic of Malawi. The district is bordered by Zambia in the West, Mchinji, Dowa and Lilongwe in the South, Mzimba in the North and Nkhotakota and Ntchisi in the East. It is the only district in Malawi sharing more district boundaries with other areas. The district headquarter is approximately 127 km from Lilongwe, the Capital City of Malawi. The total area of the district is 7878 sq km making up 8.4% of the total land area of Malawi, which is 94,276 sq km. The population in Kasungu is estimated at 764,859 from 480,659 in 1998. It has almost doubled over a 20-year period. Kasungu's population growth rate is estimated at 3.6%, predominantly due to the high total fertility rate (TFR), which is now estimated at 5.7, and the low contraceptive prevalence rate (CPR) of 35% among all women using any method. The ratio of female to male is 51.6 to 48.4. Almost half of the population is under 15 years of age and the dependency ratio rose from 0.92 in

1966 to 1.04 in 2010. About 5% of the population are infants aged less than 1 year, 23% are children under five years of age and about 46% are aged 18 years and above.

There are 28 registered health facilities in the district, of which one is a district hospital. The district hospital is often overcrowded, and suffers from a lack of nurses and anti-retroviral drugs. The hospital's 64-bed pediatric department can at times receive over 100 patients, leaving some patients on the floor, especially during the Malaria season from November-April.

In Kasungu, health care services are delivered by both the public and the private sectors. The public sector includes all facilities under the MoH and the Army (Mziza Health Center). The private sector consists of private for profit and private not for profit providers (mainly CHAM). The public sector provides services free of charge while the private sector charges user fees for their services. It is the policy of the Government of Malawi that the Essential Healthcare Package should be provided free of charge to all Malawians (Sachs and Malaney, 2002). The EHP includes diseases and conditions affecting the majority of the population especially the poor and includes the following conditions: HIV/AIDS; acute respiratory infections; malaria; diarrheal diseases; perinatal conditions; non communicable diseases (NCDs) including trauma; tuberculosis; malnutrition; cancers; vaccine preventable diseases; mental illness and epilepsy; neglected tropical diseases (NTDs); and eye, ear and skin infections.

Health services are delivered at different levels, namely: primary, secondary and tertiary. These different levels are linked to each other through an elaborate referral system that has been established within the health system. At the primary level, services are delivered through community initiatives, health posts, dispensaries, maternities, health centers and community rural hospitals. At community level, health services are provided by community-based cadres such as Health Surveillance Assistants (HSAs). The district hospital constitutes the secondary level of healthcare. It is a referral facility for both health centers and rural hospitals. The district hospital also service the local town population offering both in-patient and out-patient services. Kasungu district hospital refers its patients to Kamuzu Central hospital, a tertiary level of healthcare. The provision and management of health services has since been devolved to Local government (District Council) following the Decentralization Act (1997).

Low literacy levels, especially among women, and negative cultural practices that potentially impact health, do indeed affect the health of the people in the district. The 2006 Multiple Indicator Cluster Survey (MICS) and 2010 DHS reports show that the higher the educational level attained, the lesser the rate of prevalence of diseases such as malaria, diarrhea and acute respiratory infections; and more knowledgeable are the public about diseases such as HIV/AIDS. Educated people are more likely to access modern health care services as compared to those who have little or no education. Education is, therefore, an important determinant of health in the district. The prevalence of diseases such as malaria, ARIs and diarrhea is higher among poor people as compared to those who are rich.

Malawi is predominantly an Agricultural country: the sector accounts for 35% of the GDP and more than 80% of export earnings (primarily from tobacco sales). The Agriculture sector supports more than 85% of the population. Kasungu is arguably one of the districts in Malawi with high level of agro-business, contributing significantly to the economy of Malawi.

Over 100 people died in a famine in 2002, according to official estimates; Kasungu was the worst affected area in Malawi. In 2005 too, a famine occurred in Malawi, affecting 4.2 million Malawians. The efforts to distribute food to the needy were concentrated in Kasungu. During 2004 and 2005, there was an outbreak of cholera, with eight people recorded to have suffered the disease (Zachariah et al., 2002).

While there have been great strides made in controlling the spread, treatment and prevention of malaria in the past decade, malaria still remains endemic in Africa. It is not surprising that Malawi, and more specifically the Kasungu district, wrestles with this disease. The health care budget for the Malawian government for acute conditions and illnesses is inadequate most of the time, so expectations for funding of preventative measures would be very thin. The unfortunate nature of malaria is that the most efficacious treatment of this disease is not ex post facto, but before the disease has a chance to infect people. Thus it is inevitable to nip this calamity in the bud by taking every possible preventive measure. However, the preventive measures such as mosquito fumigation campaigns, draining of stagnant pools of water, mosquito nettings, etc. all which would cost money, fail to get allotments in the healthcare budget.

The leading cause of death among children was pneumonia, with 50 deaths due to this disease. The second leading cause of death was anemia with 40 fatalities followed by the third leading cause of death malaria with 38 deaths (Table 1 and Figure 3). There is a slight discrepancy in the data in that while there were substantially more cases of children afflicted with malaria rather than anemia, more children died of anemia rather than malaria. This may be explained in part that there might be more established procedures to deal with malaria, and that the disease is more readily treatable with medication. Anemia is easily diagnosed but urgently and adequately treated. The latter is also attributed to malaria especially in the children; thus those who had anemia most likely also had malaria.

As analyzed earlier, the total number of deaths due to malaria for children under five years of age falls in line with this study assertion of a younger child's less

Table 1. Diseases/death affecting children admitted in Kasungu District Hospital pediatrics ward (2013).

Pediatrics Ward	Pneumonia	Asthma	Diarrhea Diseases	Anemia	Malnutrition Under Age 5
Total Cases	1181	19	59	300	18
Total Deaths	50	0	6	40	10
	Malaria Under 5	**Malaria Over 5**	**New Born Complications**	**Traumatic Conditions**	**Others**
Total Cases	1025	140	95	53	161
Total Deaths	38	6	5	0	2

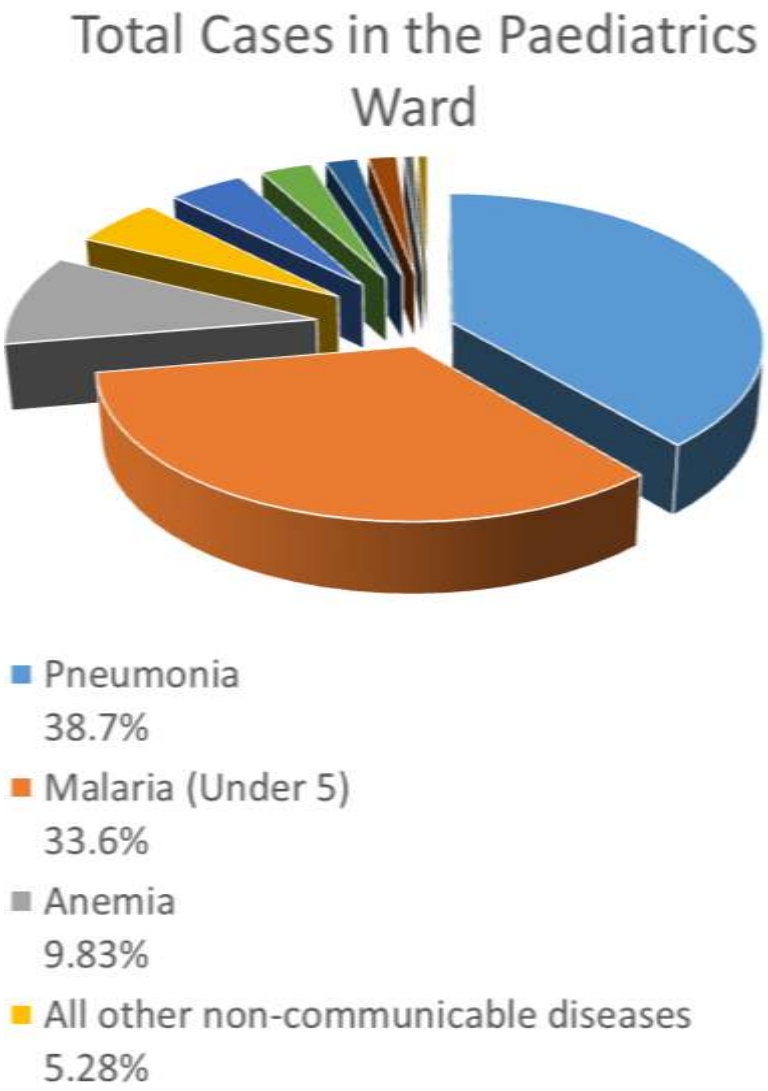

Figure 3. Statistics of illnesses distribution in the paediatric ward.

developed immune system not conferring sufficient immunity to the disease. For children under five, within the total number of 1025 malaria cases, there were 38 deaths. With children over five, within a total of 140 cases, there were 6 deaths. The case fatalities for malaria for children below five and above five are 3.7 and 4.2, respectively. Thus, it appears that both sides of the age 5 mark, suffer equal fatalities as though the developed immunity in older than 5 group should render higher survival rate as suggested earlier. However, the

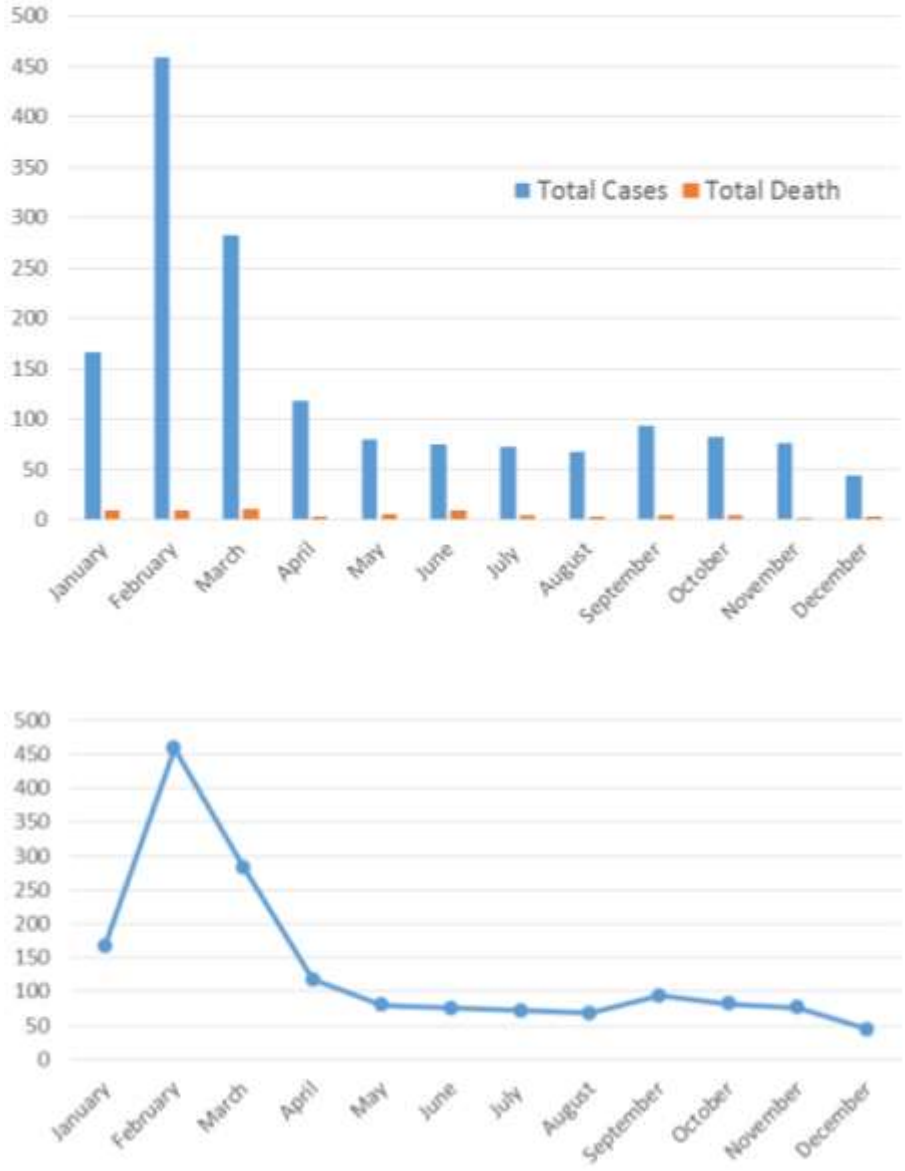

Figure 4. Number of pneumonia patients admitted by months in Kasungu District Hospital, Malawi in 2013.

registration of significantly lower cases of older than 5 children seems to indicate that the older children are less prone to the malaria.

Another point of significance is the number of cases and deaths due to anemia and malnutrition. There is a link between these two conditions, both are caused by the lack of adequate nutrition. While it is hard to intuit a causal relationship between the two, that is, anemia coming before general malnutrition or vice versa, it is of considerable interest that there are significantly more cases of malnutrition (18 cases, 10 deaths, 55.5% than anemia (300 cases, 40 deaths, 13.33%). This is a pointer to the extreme malnutrition that exists. It is apparent that while children may now be fed adequate number of calories in the Kasungu district, the quality and nutritional content of the ingested calories might not be functionally complete (especially protein from animal sources), thus leading to the higher rates of malnutrition. Finally, one cannot ignore the fact that the children who are afflicted with malnutrition are under five years of age, falling in line with the fact that younger children are at a more vulnerable stage in life and hence, might not have the nutritional reserves to rely upon as older children generally have.

For the overall population, the cases of pneumonia patients have been broken down on a month by month basis for the year 2013 (Figure 4a and b). The highest instance of pneumonia occurred in February with 459

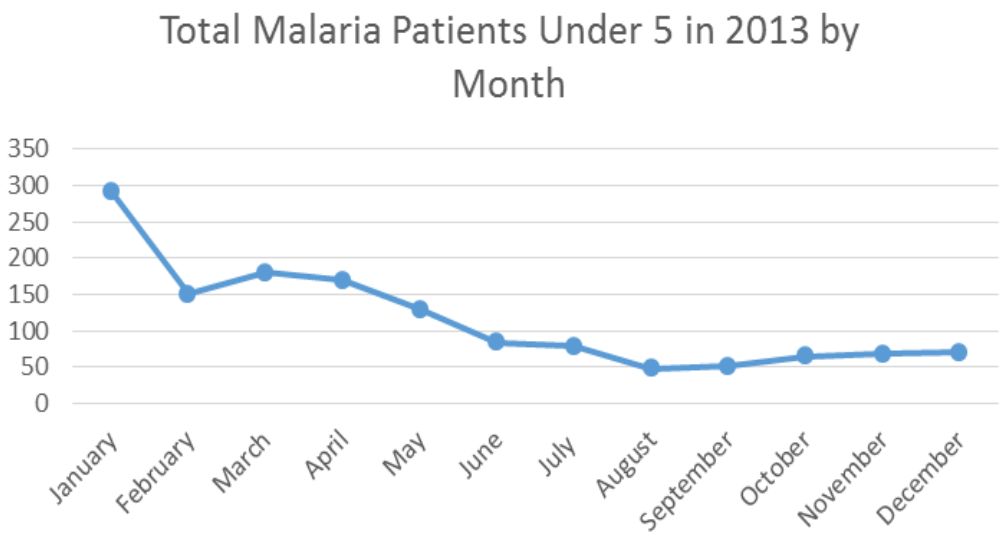

Figure 5. Number of malaria patients under 5 admitted by months in Kasungu District Hospital, Malawi in 2013.

cases followed by second in March with 282 cases and the third in January with 67 cases. The highest rates of deaths also occurred in these three months, with 10, 11, and 10 deaths occurring respectively. It is noteworthy that the highest incidence of pneumonia infection and fatality rates occurred within this short three month period, and it bears further interest and study. It is hypothesized that potential instigators for these higher rates of pneumonia during these aforementioned three months might be due to multiple causes, such as the end result of opportunistic infection from other yet unidentified illness or it may be due to the simple fact that food stores generally fall off at the beginning of the year before the new crops can be planted and harvested (Friends of Malawi), and as such, people's immune system may not be as robust since their diets are less than optimal.

For patients under 5 years of age who were admitted into the Kasunga District Hospital for malaria in 2013, the primary month of infection was in January with 292 cases (Figure 5). Though decreased, the number of malaria cases stayed significant but stable during the months of February, March, April and May. The death rates due to malaria during these months were 8, 3, 7, and 7 respectively. From June onwards to the end of the year, the rates of malaria infection and deaths dropped precipitously. Like pneumonia, the infection and death rates of malaria are clustered at the beginning of the year

The pediatric rates of infections and deaths correlate highly with the general infections and death rates. These higher levels of infections and deaths are understandable in that they correlate with the rainy season in Malawi, running from December through April, which are the prime breeding times for mosquitoes, the principle vector of malaria infections.

Conclusions

Deaths due to these rather easily preventable and once infected, easily treatable, diseases will continue to exact a staggering toll on the African people. Studies such as this will intensify the consciousness of administrations and associated public health organizations to this important public health management issue so that they act more proactively.

Conflict of Interests

The authors have not declared any conflict of interests.

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