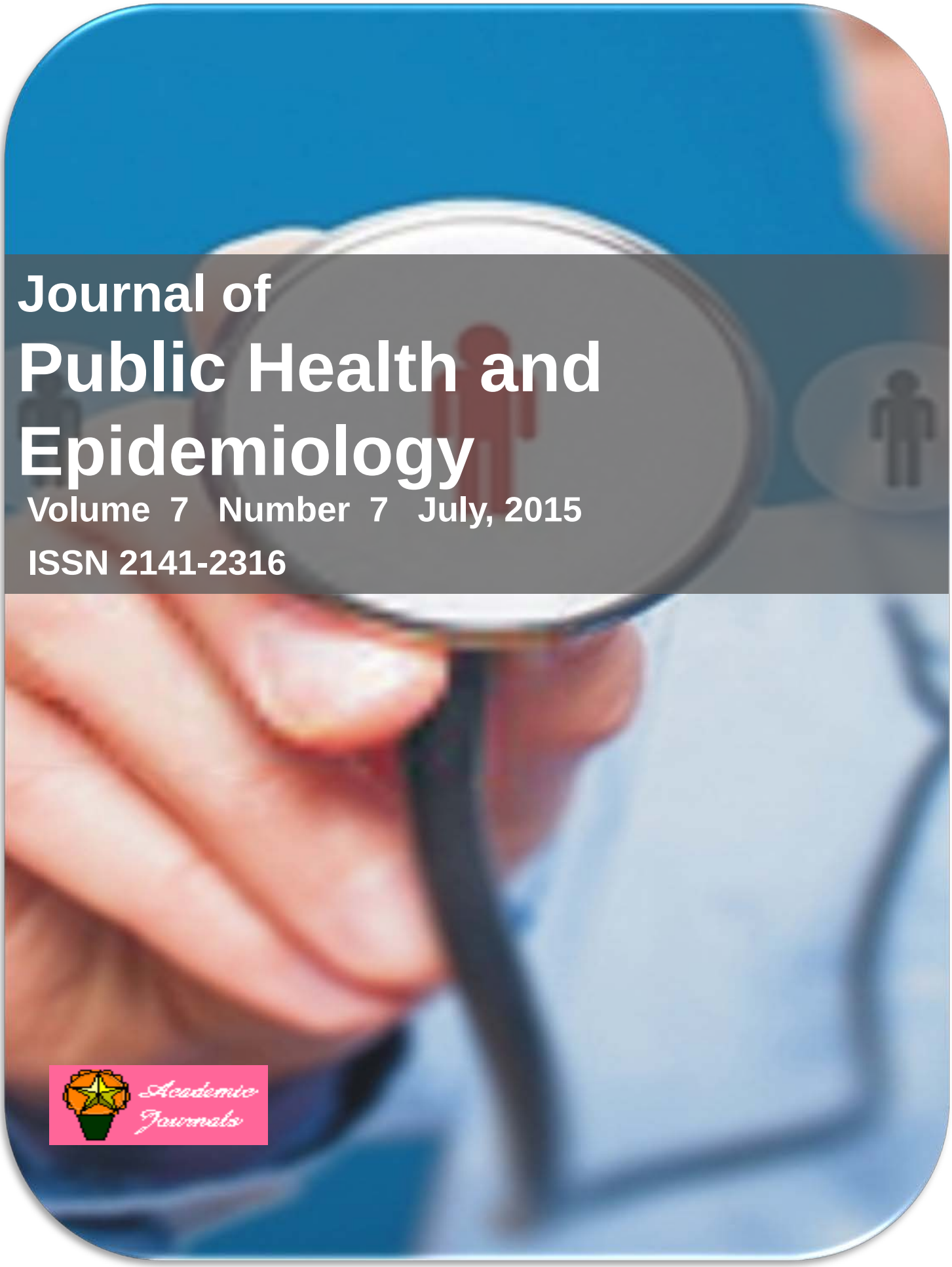

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Pitout JDD, Church DL, Gregson DB, Chow BL, McCracken M, Mulvey M, Laupland KB (2007). Molecular epidemiology of CTXM-producing Escherichia coli in the Calgary Health Region: emergence of CTX-M-15-producing isolates. Antimicrob. Agents Chemother. 51: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

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Journal of Public Health and Epidemiology

Full Length Research Paper

Inequalities in dental health: An ecological analysis of the interaction between the effects of water fluoridation and social deprivation on tooth decay in children living in England

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Oral health in England has improved considerably in recent years but continues to show a strong inequalities gradient. This study was aimed at investigating variations in dental decay and relation to social deprivation and local water fluoridation. An ecological analysis using the 2007 and 2008 National Dental Epidemiology Programme survey of 5 year old children in England. Postcode of residence was mapped to census lower super output area (LSOA). LSOAs were assigned a national deprivation quintile and a fluoridation category based upon therapeutic level of 1 mg/L. Multiple logistic regression was applied to determine independent influences on tooth decay. Analysis of covariance (ANCOVA) was used to investigate interactions between fluoridation and deprivation on the mean levels of dental caries. Analysis is based on 142,030 clinical dental examinations, representing 25% of estimated population of 5 year olds in England. Overall, 31% of children had at least one decayed missing or filled tooth (dmft). Multiple logistic regression showed that children living in the most deprived areas were three times more likely to experience tooth decay than those living in affluent areas; whereas children living in fluoridated areas were 1.5 times less likely to have dmft than those living in non-fluoridated areas. Therefore, although both are independently significant, living in the most deprived quintile of social deprivation doubled the impact on the likelihood of dental decay compared to non-fluoridation. ANCOVA showed a strong gradient of increasing mean dmft with increasing social deprivation in both water-fluoridated and non-fluoridated areas, with 3 times more dental decay in more deprived areas than in more affluent areas. In all deprivation quintiles, children living in fluoridated areas have significantly ($p < 0.001$) lower mean dmft than those living in equivalent deprivation with no water fluoridation. Fluoridated drinking water may moderate dental caries; however, socioeconomic deprivation has a stronger influence on dental decay than local fluoridation of water.

Key words: Fluoridation, tooth decay children, social deprivation, ecological epidemiology.

INTRODUCTION

Despite the considerable improvement in oral health experienced by most industrialised countries over the past 50 years, tooth decay remains the norm rather than the exception, globally (Beaglehole and Editions, 2009). The estimated impact on individual health and wellbeing

together with the economic burden of treating oraldisease is significant; as such oral health is an important public health issue (England, 2014; Patel, 2012).

The most common oral diseases are dental caries and periodontal disease both of which can eventually lead to loss of teeth; thus, the main global indicator of the dental health of populations is a measure of decayed, missing or filled teeth (dmft in children or DMFT in adults). Worldwide, 60 to 90% of school children have dental cavities (WHO, 2013a). In England, 27.9% of five-year-old children had experience of dental decay with over 30% of 12 year olds affected by tooth decay, with 6% of adults, but also increasing numbers of children living in the most socially deprived areas of the UK, such as Manchester, having few or no natural teeth (Davies et al., 2013). Despite improvements over time, there is considerable evidence that poor dental and oral health is associated with social deprivation (Costa et al., 2012; Moysés, 2012; Davies et al., 2013) ethnicity, old age, socio-economic status and living in a deprived area have all been linked to variations in dental health (NICE 2014; BDA, 2013; Petersen et al., 2005). Around a third of British 5-year olds suffer from tooth decay, missing teeth or fillings but in some parts of England, over 50% of children are affected (Pitts et al., 2005; Davies et al., 2013) illustrating inequalities in child dental health.

Efforts to reduce poor dental health commonly focus on changing oral health behaviours and have traditionally adopted a two-pronged approach incorporating both self-care since the 1940's/50's government intervention in the form of water fluoridation. Such universal utilitarianism (maximising benefits whilst minimising consequences) is contentious with much concern over the removal of individual choice. Arguably, successful precedents do exist, mass fortification of 'staple' foods with micronutrients for example have historically been used to prevent malnutrition (Gussow and Akabas, 1993). As relatively inexpensive forms of intervention, targeting whole populations, resulting in minor shifts in the normative curve (example, in health behaviour), is believed to be more effective than focused expensive intervention in high risk groups (Rose, 2008) (Rose, 2008). The UK has a fairly neo-liberal approach to health policy (Bambra et al., 2005) compared with the rest of the European Union, and is also described as having some of the most liberal approaches to fortification policies (European Directorate Safety of the food chain, 2006; Bonner et al., 1999). Although, fluoride is naturally occurring in water supplies, this is dependent on geography, and is not usually at adequate levels to protect (prevent dmft) dental health in young children. UK government has fortified natural water in geographic areas in areas of inadequate fluoride levels. Schemes to fluoridate water supplies in England have been in place for over 40 years with approximately 6 million people covered to-date (BFS 2012a).

Continuous improvement of oral health in the 21st century is one of the objectives of the World Health Organisation (WHO) Global Oral Health Programme, with the prevention of dental caries through the effective use of fluorides (not just water fluoridation) being a key aspect of the 'Health for All' programme (WHO, 2013b). Support for mass fortification is however equivocal. Water fluoridation is one of the most contentious public health issues debated globally with strong opposition on the one hand (Mcdonagh et al., 2000; Freeze and Lehr, 2009) and an assumption that it can level dental health inequalities on the other. The purpose of water fluoridation is to prevent tooth decay by adjusting the concentration of fluoride in public water supplies around one part of fluoride per million parts of water which is considered capable of providing protection against tooth decay(BFS 2012a). Allegedly, according to much of the oral health policy developed in England, water fluoridation overrides the effects of social deprivation on dental health as fluoridation is a 'great equaliser'. This belief stems from evidence gathered in the first evaluation of dental effects of fluoridation in 1962 (Bransby et al., 1963), followed by more recent attempts in the late 1990's (Yeung, 2008; Mcdonagh et al., 2000) and to the present day (Mcgrady et al., 2012). This most recent evaluation, comparing two socially deprived populations in England, concluded that water fluoridation appears to reduce the social class gradient in dental caries whilst increasing the risk of fluorosis. However, this study contend that the deprivation scale used to compare these social gradients were not comparing like-for-like (Tocque, 2013). Local quintiles of deprivation within the two cities did not account sufficiently for absolute variation in deprivation between the fluoridated and non-fluoridated populations. Despite the fact that national data has been recorded fairly consistently since the first survey in 1985/86, there has been no systematic analysis to determine the independent effects of fluoridation and deprivation on children's dental health.

Here, this study uses three national datasets with wide geographic coverage across all of England: survey data from the National Dental Epidemiology Programme for England; a national scale of deprivation; and geographic maps of reported drinking water fluoridation schemes. The aim of this study was to investigate variations in dental decay in children in relation to the social deprivation gradient in areas with and without local water fluoridation.

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MATERIALS AND METHODS

An ecological analysis was conducted on the most recently available data for the 2007/08 National Dental Epidemiology Programme survey of 5 year old children's dental health in England (TDO, 2009). Data were collected following the National Protocol developed for this survey which was a modified version of guidance on sampling for child dental health surveys (26). In 2007/08, the survey protocol was altered to include collection of the postcode of the child's residence so that ecological analyses could be improved and also in obtaining (positive) parental consent. A stratified sample of children attending mainstream schools aged 5 years at the time of the survey was conducted by each of the 302 English Local Authority's taking part. Details of the overall sample frame are published elsewhere (TDO, 2009). Data were collected by trained and calibrated examiners and involved visual-only detection of missing teeth, filled teeth and teeth with obvious dentinal decay.

The child postcode of residence was used to map to area based classifications using the Census Lower Super Output Area (LSOA) (ONS 2013). Each LSOA was then assigned a national deprivation quintile from the English Indices of deprivation (CLG, 2008). The 32,842 LSOAs were ranked and divided into 5 equal fifths of around 6,580 in each quintile. To investigate fluoridation, every LSOA was mapped to the most recently published zones of average fluoride levels in drinking water using geographic information systems (GIS) software. The static map for fluoride level zones in 2004 to 2008 (Appendix A; DWI, 2008) was imported into MapInfo 9.5 and overlaid with digital LSOA boundaries. Overlay analysis was used to allocate a fluoridation category to all 32,842 LSOAs. These comprised: 1, naturally below 0.5mg/l (or no water supplied); 2, naturally 0.5 to 0.99 mg/l; 3, naturally 1.0 to 1.5 mg/l; 4, Health Authority fluoridation scheme; and 5, LSOAs that were partially in a fluoridated area and partially not. Since recommended levels of fluoridation for public health benefit are 1mg/l, categories 1 and 2 were combined to 'non-fluoridated' and 3 and 4 to 'fluoridated'. The small proportion (0.3%) of LSOAs with a partial fluoridation category was assigned to 'non-fluoridated', following initial post hoc comparison tests (not presented).

Region of residence was retained in the analysis, because there are recognised regional differences in levels of water fluoridation (Law, 2013) and regional differences in the final sample frame (TDO, 2009). National Statistics Single Year of Age (SYOA) population estimates for 2007 were obtained for all LSOAs, and used to estimate the population base for the sample framework. The merged dataset was imported into statistical package for the social sciences (SPSS) v 15 for analysis. Multiple logistic regressions was used to determine the independent effects of region of residence, social deprivation and water fluoridation on the likelihood of experiencing tooth decay. Analysis of variance (ANOVA) was used to investigate interactions between fluoridation and deprivation on the mean levels of dental caries in children with some dental caries (dmft>0) and overall.

RESULTS

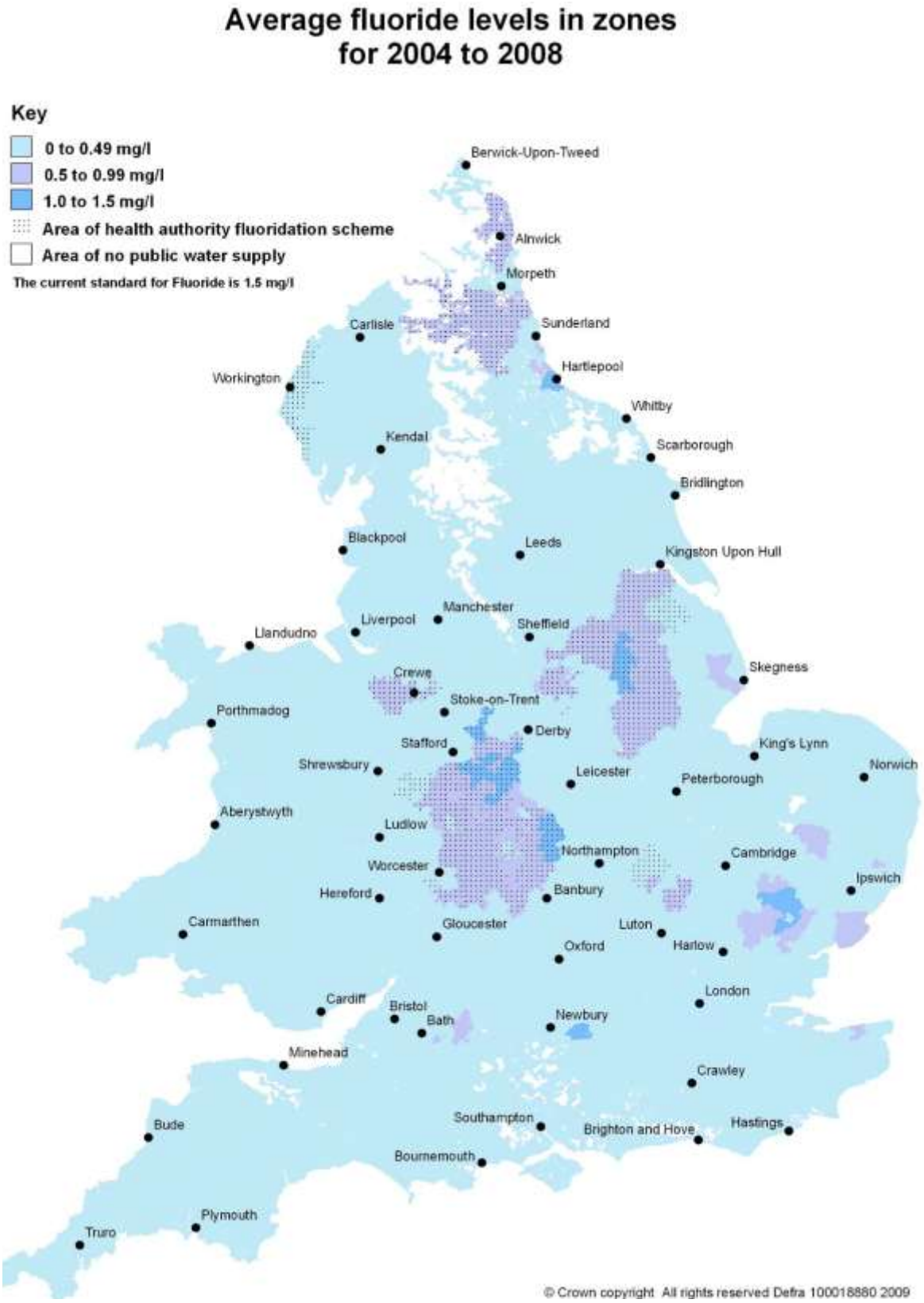
Analysis is based on 142,030 clinical examinations with a postcode of residence , allowing matching to Census Lower Super Output Areas (LSOA). National SYOA population estimates suggested that there were approximately 558,556 children aged 5 living in England in mid-2007. The overall sample of children included in this study represented 25% of estimated population base (Table 1).

Sampling

There was a large oversampling from the West Midlands region (28% of children measured compared to 11% of resident 5 year olds who lived in the West Midlands) and a slight oversampling from the North West region (20% of children measured compared to 13% of resident 5 year olds). Consequently, there was under-sampling from the other regions (Table 1). In addition, the population covered by water fluoridation schemes varied immensely between regions. West Midlands had 80% of its population covered, North East had 41% and East Midlands had 16%. All other regions had very small proportions or none of the population receiving fluoridated water supplies. Since the West Midlands is the most extensively fluoridated region and showed oversampling, across the whole of England nearly twice the proportion of children living in fluoridated areas were measured; 25.6% of children measured compared with 13% of resident 5 year olds lived in areas with fluoridated water supplies (Table 1). Therefore, data presentation and multivariate analysis use West Midlands as the benchmark. The proportion of the measured sample living in each of the five deprivation quintiles in England very nearly matched the distribution of the resident 5 year old population; almost a quarter of children live in the worst fifth of areas with slightly fewer than expected living in the middle 60% or areas.

Decay experience (prevalence)

Children with no obvious experience of tooth decay (dmft =0) accounted for 69% of the measured sample (Table 1). Thus, 31% of children aged 5 in England had at least one decayed missing or filled tooth (dmft>0) in 2007/08. There was a lower proportion of children that were decay-free in the more deprived northern regions 61 to 64% (North East, North West and Yorkshire and The Humber) than in more affluent southern regions 70-75% (East Midlands, East, and South East). West Midlands, typically a more deprived region had similar prevalence of decay-free children (72%) to more southerly regions. There was a very strong association between being decay-free and social deprivation, with 80% of children living in the most affluent areas being decay-free compared with only 56% of those living in the most deprived areas (Table 1). By contrast, there was only a small difference in being decay-free between fluoridated (73%) and non-fluoridated areas (68%). Multiple logistic regressions showed that, whilst controlling for social deprivation and fluoridation, the three deprived northern regions had significantly greater chance of experiencing tooth decay compared to West Midlands (Table 1). This is despite the fact that the North East has the second highest proportion of its population receiving fluoridated water.



Appendix A. Drinking water inspectorate map of average fluoride levels in zones which was published at the time of the 2007/08 dental survey was for 2004 to 2008. This map is no longer available online as it is regularly updated to current years. Source: http://dwi.defra.gov.uk/consumers/advice-leaflets/fluoride.pdf.

Table 1. The estimated population of 5 year olds, dental survey sample measured, proportion of the population fluoridated and survey results a) Government office regions; b) deprivation quintiles (CLG, 2008) ; and c) fluoridation water status.

Parameters	5 year old population		Measured sample		Fluoridated	Dental caries		
	n	%	n	%	%	% dmft-free	Mean dmft	Mean dmft>0
(a) Government region								
West Midlands	60.823	11	38.917	27	80	72	0.95	3.33
North East	25.997	5	2.940	2	41	61	1.44	3.63
North West	74.551	13	28.573	20	4	64	1.40	3.88
Yorkshire & The Humber	55.824	10	9.059	6	3	62	1.49	3.89
East Midlands	46.564	8	9.630	7	16	70	0.99	3.27
East of England	62.935	11	12.331	9	5	75	0.82	3.35
London	89.364	16	11.362	8	0	65	1.44	4.15
South East	90.952	16	20.488	14	0	74	0.89	3.41
South West	51.556	9	8.730	6	0	69	1.04	3.40
(b) Deprivation quintile (national)								
Least	112.118	20	28.874	20	10	80	0.57	2.78
Second	103.028	18	25.832	18	12	76	0.70	3.00
Third	101.302	18	25.392	18	12	71	0.96	3.33
Fourth	108.383	19	26.753	19	13	65	1.32	3.83
Most	133.735	24	35.179	25	19	56	1.81	4.15
(c) Fluoridation water status								
Fluoridated	75.059	13	36.361	26	100	73	1.97	3.22
No fuoridation scheme	483.507	87	105.669	74	0	68	2.41	3.72
Total sample								
-	558.566	-	142.030	-	13	69	1.11	3.42

Children living in East of England, London and South East had significantly less likelihood of experiencing decay than West Midlands. East Midlands and South West were not significantly different from West Midlands, despite the South East having no water fluoridation and East Midlands only 16% of the population receiving fluoridated water. There was an extremely strong independent influence of social deprivation on the likelihood of children experiencing tooth decay. Compared with the most affluent fifth of areas, children living in the most deprived fifth of areas were three times more likely to experience tooth decay. The relationship of decay experience with fluoridation was also significant: children living in fluoridated areas were 1.5 times less likely to have dmft than those living in non-fluoridated areas (Figure 1). Therefore, although both are independently significant, living in the most deprived quintile of social deprivation had twice the impact on the likelihood of dental decay compared to not having water fluoridation.The impact of water fluoridation was equivalent to the difference between the middle and the most affluent deprivation quintiles.

Mean dmft in children experiencing decay

Table 1 also shows that the mean dmft in children experiencing decay (dmft>0) is slightly higher (3.6-3.9 affected teeth) in the more northerly regions compared with southerly regions (3.3-3.4 affected teeth), with the exception of London. Children living in London who experienced decay had on average over 4 affected teeth. West Midlands was more similar to East of England and South West than other regions. The relationship between social deprivation and affected teeth was even stronger, with a mean of 2.8 affected teeth in the most affluent areas compared with 4.15 in the most deprived areas. The mean number of affected teeth was 3.2 in fluoridated areas compared with 3.7 in non-fluoridated areas.

Overall mean dmft

The overall population-level of tooth decay in children aged 5 is a combination of the prevalence of decay experience and the mean dmft in children with decay.

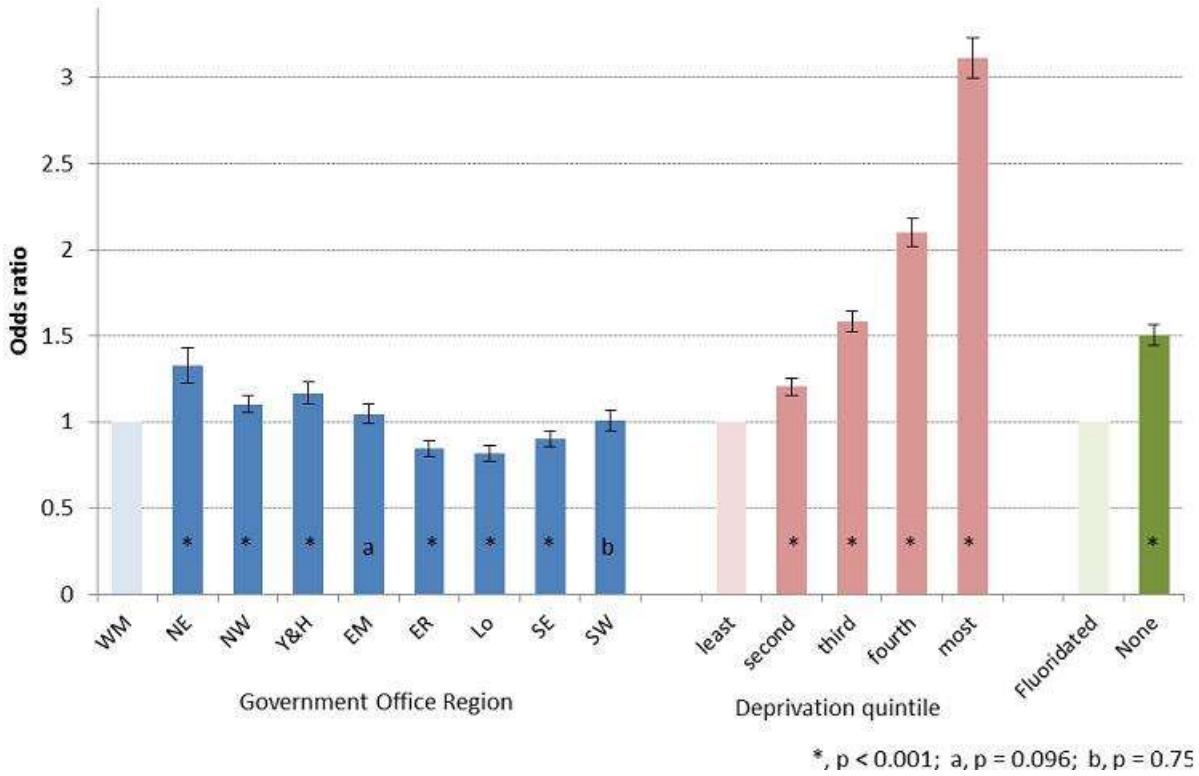


Figure 1. The likelihood (odds ratio determined by multiple logistic regression) of experiencing tooth decay compared with the base group by a) Government office regions; b) deprivation quintiles (CLG, 2008); and c) optimally fluoridated water supplies.

Both of these measures are independently related to both social deprivation and to the presence of drinking water fluoridation and both more strongly influenced by social deprivation. Appendix B shows that these measures vary little across the nine English regions. Region was retained in the analysis as a covariate to control for regional variations. ANCOVA shows the relationship between population level mean dmft and both factors (Figure 2). The strong gradient of increasing mean dmft with increasing social deprivation exists in both water-fluoridated and non-fluoridated areas, with 3 times more dental decay in more deprived areas than in more affluent areas. In all deprivation quintiles, children living in fluoridated areas have significantly ($p < 0.001$) lower mean dmft than those living in equivalent deprivation with no water fluoridation. There was a 33% reduction in mean dmft due to fluoridation which differs little across deprivation quintiles. In fact it is slightly lower in the most deprived and most affluent quintiles (30%) than in the middle quintiles (34 to 36%). However, there was overall 68% reduction in mean dmft by living in the most affluent areas compared to living in the most deprived areas, for both fluoridated and non-fluoridated populations (Figure 2). In fact, in non-fluoridated areas, each reduction in a deprivation quintile resulted in significantly lower mean dmft ($p < 0.001$) with a reduction by 20 to 27% at each step.

DISCUSSION

In 2007/08 a third (31%) of 5 year olds in England had at least one decayed missing or filled tooth (dmft>0), which is high in comparison to other European countries (XX Caries Res. 2009;43(2):155-62). This ecological study provides England-wide evidence that living in areas of high social deprivation has a greater detrimental influence on children's dental health than living in areas without water fluoridation. There is no doubt that water fluoridation results in an overall lower mean dmft in children but the independent effects of social deprivation are much greater than this benefit. There was a 68% reduction in mean dmft in more affluent areas for children living in both fluoridated and non-fluoridated areas. These differences are a combination of the greater influence of social deprivation than water fluoridation on both decay experience (prevalence of tooth decay) and on the mean number of affected teeth in children with decay. Despite statistically lower mean dmft in children living in the most deprived areas with fluoridated water compared to those

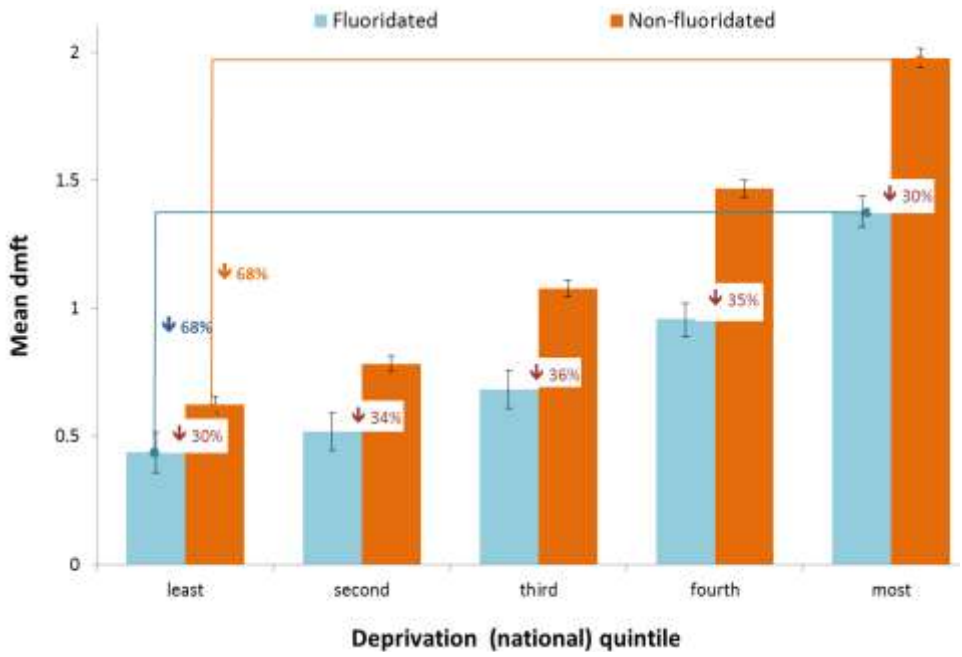
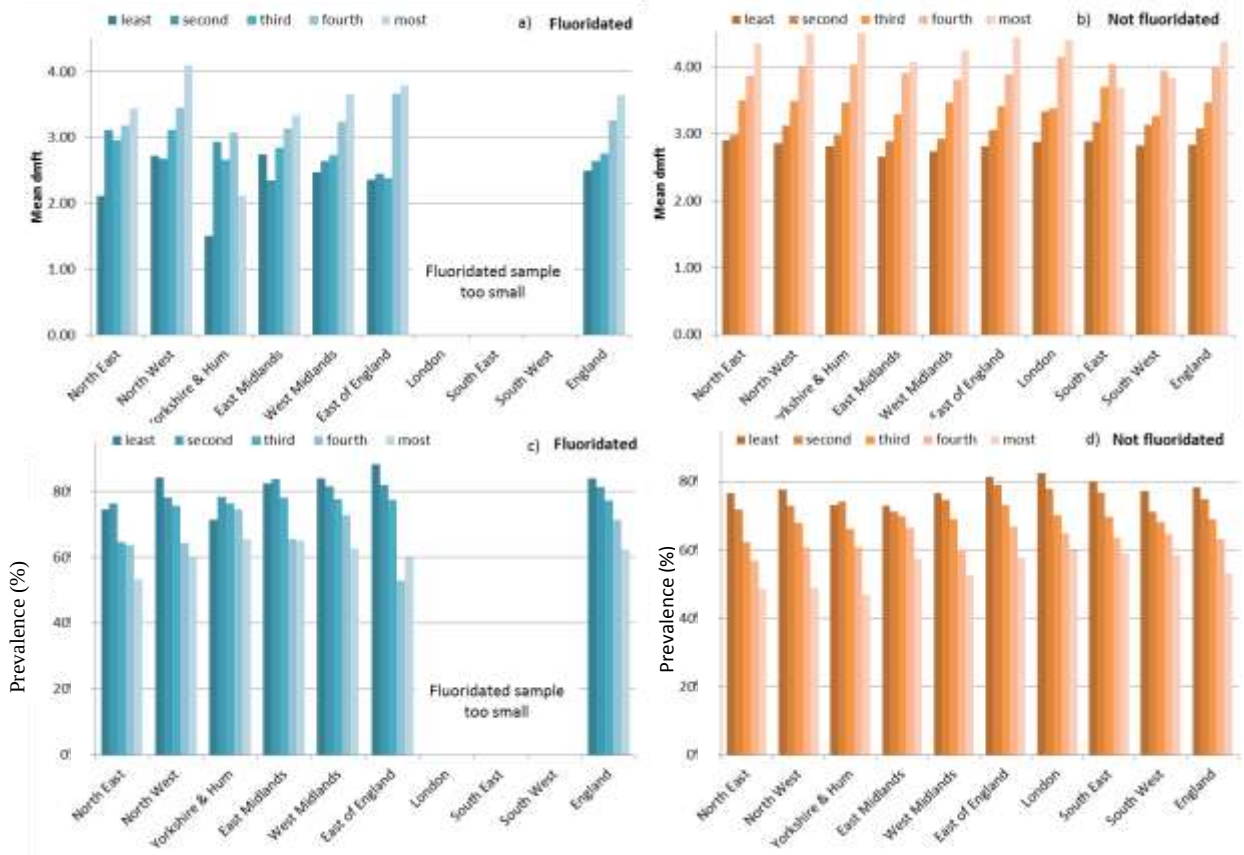


Figure 2. ANCOVA between deprivation quintiles (CLG, 2008) and fluoridated water status, with region as a covariate in the model.



Appendix B. Children's dental survey 2007/08 data showing mean dmft (where dmft>0) for a) fluoridated and b) non-fluoridated areas and prevalence of decay experience in c) fluoridated and d) non-fluoridated areas by English regions.

without fluoridation, there is no evidence that water fluoridation reduces inequalities in children's dental health; the social gradient remains the same whether children live in fluoridated areas or not. Each step down a deprivation quintile resulted in 20 to 28% lower mean dmft, resulting in an overall decrease of 68% in the most affluent areas; whereas the influence of fluoridation resulted in a 30% reduction overall. West Midlands (WM) is perceived to be the gold standard by health professionals who are pro water fluoridation (30) but even in this region, this study has shown that the detrimental effects of social deprivation outweigh any benefits of water fluoridation. The effects of deprivation are large and in all geographic areas, even fluoridated ones (WM). Therefore, other social, behavioural or nutritional aspects may help explain these variations in dental health. Although, fluoridation might not eliminate inequalities in oral health we recognise the beneficial role for fluoridation in helping to reduce treatment costs (through improved oral health) enabling this to resource prevention activities to help address inequalities in oral health.

Proximal determinants

It is widely acknowledged that many behavioural factors directly influence and/or interact to increase the dental decay experience of both adults and children living in deprived areas compared with those living in more affluent areas. Due to the ecological nature of the study design it was not possible to control for individual level confounding variable such as smoking, diet and dental hygiene practices, tap water consumption, water supply and access to and usage of dental care.

Dietary and oral hygiene practices

A systematic review of the risk factors for dental caries in children (Gibson and Williams, 1999) concludes that the aetiology of dental caries, particularly in children, is multi-factorial and complex. Furthermore, synthesis and interpretation of the evidence is hampered by the large number of different measures used to assess similar factors (for example tooth brushing frequency with various cut off points, supervision of tooth brushing, age tooth brushing started). They also concluded that children are more likely to develop caries if they have poor dental hygiene, including infrequent brushing (< once per day), use non-fluoride toothpaste, consume a cariogenic diet or more likely to adopt cariogenic dietary practices (bottle-fed, sugar-containing drinks etc.).

The significant contribution of sugars to cariogenic diet is widely recognised and much publicised in the media. To date, only one UK study has examined the relative significance of dietary sugars, tooth brushing frequency and social class as predictors of caries experience (caries vs. no caries). Gibson and Williams (1999) analysed data for 1,450 British pre–school children from the 1992 National Diet and Nutrition Survey (NDNS) and conclusions suggested that non-manual households tend to brush less, brush for shorter duration, use non-fluoride toothpastes and consume higher intakes of dietary sugars. The study found that children in non-manual groups were twice as likely to engage in tooth brushing and on two or more occasions, compared with children from manual households. The latter were also more likely to engage in cariogenic dietary practices (bottle feeds and high sugar). Based upon the strength of the association between social class and caries experience, the authors (ibid) concluded that regular brushing (twice a day) with a fluoride toothpaste may have greater impact on caries in young children than restricting sugary foods that is, dietary factors; the effect of social deprivation is important.

The main dietary factors involved in causing tooth decay, are sugar and in particular non-milk extrinsic sugars (NMES) such as sucrose (table sugar) sugar added to confectionary, drinks etc. Soft drinks (not diet), are the main source of non-milk extrinsic sugars (NMES) in the UK diet providing over 25% of intake; beverages (soft drinks) contribute 8% of total energy intakes; with 75% of this from soft drinks (not diet), both carbonated and not carbonated (NATCEN 2014). In the past decade, UK sales of soft drinks have been relatively stable, with consumption levelling off, with small increase in overall sales, from 225 to 235 litres per person p.a. Despite this, the most recent UK national dietary and nutritional survey (NDNS) outlines how children (aged 2 to 10 years) consume almost double the recommended level of NMES, 17% compared to 22% DRF of their total recommended food energy (NATCEN 2014). Consumption of non-diet soft drinks is greater in children in the Low Income Dietary and Nutritional Survey (LIDNS) than NDNS among the 4 to 18 year olds; most notably non-carbonated soft drinks (not diet) were consumed at almost twice the NDNS level (NATCEN 2014).

Clinical trials investigating the effectiveness of caries prevention programs in young children involving individual dietary counselling (see Community Dent Oral Epidemiol. 2010 Aug; 38(4):324-32), may reduce caries incidence by 22 % amongst low-income groups, but attrition is high (approximately one-third of subjects). Suggesting this type of preventive action is less effective and costly compared with population-wide interventions such as water fluoridation, even if directed at high risk patients only. The role of calcium in developing strong bones and teeth in childhood is widely recognised but the imperative role of Vitamin D in the regulation of calcium absorption is less known (NATCEN 2014). Nutritional

data from the LIDNS (NATCEN 2014) shows for boys and girls aged 2 to 3 years, mean daily intakes of vitamin D from food sources were only 22% of the recommended nutrient intake (RNI) whilst less than 0.5% of boys and 2% of girls had intakes that met or exceeded the RNI. The fact that intakes from food sources are so low in relation to the RNI does not necessarily imply a deficiency provided exposure to UV light is sufficient or dietary intakes are supplemented (NATCEN 2014). Recent government concern over social and geographic variations in Vitamin D, with consequences on bone and dental health, has been reported (Grimes, 2011). Hence, children from socially deprived households and those with reduced exposure to natural sunlight are at greatest risk of net loss of calcium from bones and teeth, resulting in increased likelihood of dental caries, due to Vitamin D deficiency.

Tap water trends

The Drinking Water Inspectorate (DWI), monitors tap water consumption in England and Wales; data for recent decades suggests an overall decline in tap water consumption from approximately 2.04 l/day in 1978 to 1.93 l/day 2008 (37); The 2012 report (DWI, 2012), shows on average boys drink more tap water than girls (591ml c.f. to 516ml), whilst children < 5 years consume the lowest (442ml/day), c.f to 6 to 10 yrs (560ml) and 11 to 15 yrs (659ml/day). No statistically significant differences are reported in tap water consumption across social groups; households living in the South West of England drank the highest levels of tap water, while children living in Greater London drink the least (645ml and 485ml respectively, compared to a total average for all children of 554ml) (DWI, 2012). In terms of consumption of bottled water, sales data suggests that consumption of bottled water by children is lower than tap water and has fallen slightly since 2005 (35.5 l p.p in 2005 compared with 33.6 litres bottled water in 2011), whether consumption is higher in professional occupational groups and regions in the south of the UK is unknown. Although, inherently difficult to monitor with precision, the data suggests that nationally fewer children are consuming tap water, fluoridated or not, regardless of geographic region or social class.

Access to dentistry

Other fluoride therapies, administered by dentists, have shown potential in preventing tooth decay and include toothpaste, mouth rinses, gels/foams and varnish however insufficient evidence exists on effectiveness of slow-release devices (Marinho, 2009) and although likely to be beneficial evidence is inconclusive for milk fluoridation (Marinho, 2009, Yeung et al., 2005). In the period of 2006 to 2013 the proportion of children living in England who had access to a dentist was consistent at around 70% (DHSSPS 2004). Trends on dental access for children are equivocal; as all under 18-year olds in the UK are entitled to free dental treatment. However, in Northern Ireland data suggest that people living deprived areas were 12% less likely to be registered with a dentist than people in the country as a whole (DHSSPS, 2004). Whereas, in Scotland, there is no association between registration with an NHS dentist and deprivation (all quintiles) with around 88% of all children registered (ISD, 2014). As stated, Marinho (2009) asserts that the benefits of topical fluorides are firmly established, based on a sizeable body of evidence from randomized controlled trials. The size of the reductions in caries increment in both the permanent and the primary dentitions emphasizes the importance of including topical fluoride delivered through toothpastes, rinses, gels or varnishes in any caries preventive program. A systematic review of the efficacy and safety of fluoridation (see 22) highlights that fluoridation of drinking water remains the most effective and socially equitable measure in caries prevention at present. This study however contends that a blanket approach is not sufficient to target and reduce inequalities in oral health.

Limitations

A number of limitations exist for this study. There may be issues around accuracy of fluoridation maps as some regions for example may operate a switch on and off system (example, North East), accuracy of LSOA mapping to fluoridation including its resolution and also the questions of mobility of people into and out of fluoridated areas. It is however plausible to assume that these movements would largely be to similar deprivation quintiles. Over sampling from fluoridated areas could explain the reduction in dmft observed in 2007/08 compared with 2005/06. This analysis is based on 2007/08 data but more recent data are now available (2012/13) since health inequalities have persisted and there is a strong correlation between local authority measures of dental decay in both years, there is no reason to assume that the analysis presented here would differ using more recent data.

CONCLUSION

This ecological study has shown that, on a national scale, local measures of socioeconomic deprivation have much greater influence on dental decay than local fluoridation of water supplies. Despite the fact that fluoridated drinking water can help moderate dental caries, in reality human behaviour such as beverage

consumption, dental hygiene, other nutritional factors and access to dental services are more likely to influence overall dental health. Thus, reducing the disparities in dental health might better be achieved by focusing resources on reducing the effects of socioeconomic deprivation on overall health and wellbeing; strategies tailored to the determinants and needs of each group along the social gradient (Northern Ireland Executive 2009).

This study contend that Government and Health Authorities would have a better chance of improving dental health in children and adults by tackling social determinants of health and influencing lifestyle choices of individuals, rather than mass fluoridation. Community water fluoridation is often branded as one of the most successful and ground-breaking contributions to public health in the 20th century. Perhaps this is because governments have continually failed across the board to solve the influences of social deprivation on poor health, which, if successfully addressed, would actually have a much greater achievement in improved overall health and wellbeing rather than trying to tackle one single disease at a time.

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Competing interests

The authors declare that they have no competing interests.

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Full Length Research Paper

Investigations on the transmission potentials of *Simulium damnosum* and the risk of human onchocerciasis in Kaduna Metropolis, Kaduna State, Nigeria

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Onchocerciasis is transmitted to humans by the black fly, *Simulium damnosum*. Preliminary investigations were carried out between the months of June, 2008 and February, 2009 to verify the transmission potentials of *S. damnosum* for *Onchocerca volvulus* in a Public Amusement Park and its environs in Kaduna Metropolis of Kaduna State, Nigeria. Out of the 224 female black flies caught and dissected during the period of study, 48.21% (108/224) were found to harbor different larval stages of *O. volvulus*. Of the total infected flies recorded, 36.75% (68/185), 41.08% (76/185) and 22.16% (41/185) had larval stages of *O. volvulus* in their head, thorax and abdominal segments, respectively. The high percentage of black flies found to harbor different larval stages of *O. volvulus* is indicative of active transmission in and around the park. There is therefore the need for relevant Governmental agency to take a proactive step aimed at controlling the insect vector before the disease attains an epidemic proportion.

Keywords: Black flies, onchocerciasis, prevalence, Public Amusement Park.

INTRODUCTION

Onchocerciasis commonly referred to as river blindness is a terminally blinding human disease caused by a filarial parasite *Onchocerca volvulus*. It is non- fatal but mainly incapacitating chronic disease that can last about 14 years in the human host (Plaisier et al., 1991). It is transmitted to the human victim by a blood sucking black fly *S. damnosum* as a filariform larva (L3). The fly vectors of this disease breed along fast flowing streams and rivers regularly visited by users of the water bodies for drinking, recreation, washing and irrigation

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(Eezzuduemhoi and Wilson, 2006). Human onchocerciasis is characterized by initially painless skin manifestations such as itching of the body and pruritis or papular onchodermatitis, followed by fibrosis, atrophy, depigmentation and nodular swellings containing adult filarial worms (males and females). Tekie et al. (2014) and Njepuome et al., (2014) estimate that 37 to 86 million people in 35 Onchocerciasis endemic countries of tropical Africa, Latin America and Yemen are infected with *O. volvulus*, while 2 million and 50,000 out of these exposed individuals are blind and visually impaired respectively. In Nigeria, onchocerciasis has been reported as the commonest single cause of bilateral blindness among endemic communities and is responsible for between 27.3 and 50.0% of blindness cases (Umeh et al., 2010). This, among other socioeconomic burden imposed by onchocerciasis led to the launching of Onchocerciasis Control Program (OCP) by the World Health Organization (WHO) in 1974 with the mandate to effectively control onchocerciasis through the eradication of the black fly vector in seven endemic areas of West Africa including Nigeria (WHO, 1999; Hall and Pearlson, 1999). In spite of the significant successes achieved by spraying DDT along fast flowing rivers where the insect vector breeds, the use of this insecticide was abandoned because of the high toxicity to humans and the environment. Similarly, the relative therapeutic successes achieved in the attempts to control the scourge of onchocerciasis using Diethyl Carbomazine (Forgione, 2006) and Suramin (Cupp et al., 2011) had to be abandoned due to their high toxicity to the human patients being treated (Thylefors and Rolland, 1979; Frames et al., 1985). In 1987, a pharmaceutical firm (Merck) developed and introduced oral formulation of ivermectin (Mectizan) as the most effective, free and safest larvicide for the treatment of onchocerciasis (WHO, 1995). In Kaduna State, mectizan distribution started in 1988 in 2 Local Government Areas (LGAs) and later was expanded to cover 15 other LGAs under the African Program on Onchocerciasis Control (APOC) (WHO, 2003). It was believed that mectizan clearance of *O. volvolus* microfilaria in human host will disrupt the transmission chain of onchocerciasis and subsequently lead to gradual clearance of infective larval load in the black fly vector since microfilaria will increasingly be unavailable in human host for the fly vectors to pick during blood meals.

The study site was therefore selected because of its characteristic suitable breeding site for *Simulium* species and its social role as an amusement park where people from different works of life and communities go to relax. In addition, there is paucity of published report on the prevalence of *O. volvulus* infection in *S. damnosum* in the study area despite report of the presence of larvae and pupae of *S. damnosum* on floating vegetations of river Kaduna within the recreational park area by Nuhu et al. (1986). The study was aimed at determining *O. volvulus* infection rates in *S. damnosum* within the park area and environs.

MATERIALS AND METHODS

The study was conducted on river bank of a section of river Kaduna that is located within Hassan Katsina recreational park and its environs (Figure 1) between June 2008 and February 2009. The park is equipped with facilities to accommodate large number of recreational visitors which are located on recreational lawns with well-trimmed grass and ornamental shrubs. Many shops and office complex daily visited by people are also located within the park. The fast flowing water, bathing the rocks and leaves of elephant grass suitable for *S. damnosum* (Black flies) infestation and breeding are readily visible along the river within the park. Several high density residential buildings can be seen within close vicinity of the amusement and recreational park.

Harvest of *S. damnosum*

This was done by scooping with nets fitted with handles through the tall grasses and the recreational lawns for two hours during each monthly sampling day (Johnson and Bailey, 1999). Flies caught were demobilized by dipping the scooping nets in water and removing same after approximately 10 seconds. These flies were harvested from the net by hand picking and dropped in labeled specimen bottles containing formalin before conveying to the laboratory in the Department of Biological Sciences, Nigeria Defence Academy.

Laboratory analysis

The standard external and sex keys previously used by Maikaje et al., (2008) were used for the identification of the harvested flies, after which all the females used during this study were counted. The head, thorax and abdomen of black flies caught in each month during the survey were dissected under the dissection microscope and larval stages (L2 to L3) of *O. volvulus* seen were isolated (Maikaje et al., 2008). The number of larvae isolated from each morphological segment of flies dissected were stained with haematoxylin, identified and counted.

Statistical analysis

Data generated were subjected to analysis of variance, chi square test of association using online statistical package (www.physics.csbsju.edu/stats) while prevalence was calculated as simple percentages. Probability level < 0.05 was considered significant.

RESULTS

A total of two hundred and twenty four (224) adult female

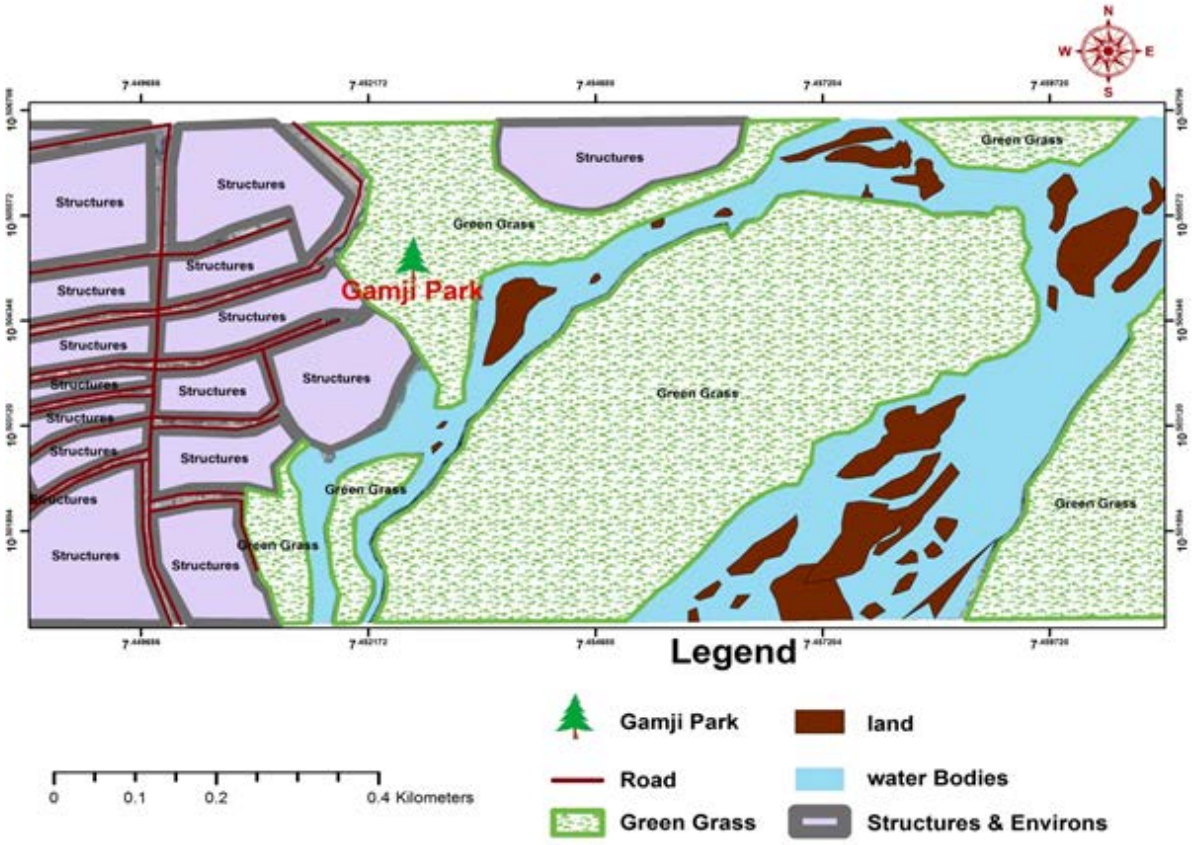

Figure 1. Sketch map of Hassan Katsina Recreational Park (Gamji Park) Kaduna.

S. damnosum were caught and examined for larval stages of *O*. *volvulus* during the nine months study. Of the total black flies examined, 48.21% (108/224) were found to be infected. The distribution of *O. volvulus* in *S. damnosum* in the Public Park and environs shows a significant difference between the months ($P < 0.05$) (Table 1). The highest prevalence (72.27%) was recorded in the month of October, followed by the months of December and January with infection rates of 68.42 and 63.33%, respectively. The least prevalence of 26.67% was recorded in February. However, prevalence of *O. volvulus* in black flies for the months of June through September ranges between 39.13 and 48.0%. Table 2 shows the seasonal prevalence of *O*. *volvulus* in *S*. *damnosum* in Kaduna Public Park and environs. Although there is no significant difference in prevalence between the seasons ($P > 0.05$), prevalence was higher (50.0%) during wet season. The prevalence of *O*. *volvulus* larvae by segments (Head, Thorax and Abdomen) of *S*. *damnosum* caught and dissected during the study period is shown in Table 3. Of the infected black flies, 22.32% had *O*. *volvulus* larvae in the thorax, 16.07% in the head and 9.82% in the abdomen. Similarly, 41.08% of the total larvae were isolated from the thorax while 36.76 and 22.16% were isolated from the head and abdomen, respectively. The approximate mean of larvae isolated from either of the morphological segment ranges from 2 ± 0.5473 to 2 ± 0.8425. Although there is a significant difference in the prevalence of *O*. *volvulus* in the three anatomical segment of infected black flies ($P < 0.05$), *O. volvulus* larvae were present in all three segments all through the survey period except July where no larvae was detected in the abdomen of infected black flies (Figure 2). However, relatively high percentage of black flies were found to harbor larval stages of *O*. *volvulus* in the months of September, October and January while relatively high percentage of black flies were found to harbor larvae in their abdomen in June.

DISCUSSION

Bich and Inuwa (2010) using baits, pooter and hand nets

Table 1. Monthly distribution of *O. volvulus* in *S. damnosum* in Kaduna public amusement park and environs.

Month	No. of black flies examined	No. of black flies infected	Percentage infected (%)	Relative percentage (%)
Jun	32	14	43.75	12.96
Jul	23	09	39.13	08.33
Aug	18	08	44.44	07.41
Sept	25	12	48.00	11.11
Oct	22	17	72.27	15.74
Nov	25	08	32.00	07.41
Dec	19	13	68.42	12.04
Jan	30	19	63.33	17.59
Feb	30	08	26.67	07.41
Total	224	108	48.21	100

Table 2. Seasonal prevalence of *O. volvulus* in *S. damnosum* sampled at Kaduna public amusement park and environs.

Season	No. of black flies examined	No. of black flies infected	Percentage (%) infected
Wet	120	60	50
Dry	104	48	46
Total	224	108	48.21

Table 3. Distribution of *O. volvulus* larvae in the head, thorax and abdomen of invected black flies in Kaduna public amusement park and environs.

Body segment	No. of black flies examined	No. (%) infected	No. (%) of larvae isolated	Approximate mean ± SD
Head	224	36 (16.07)	68 (36.76)	2±0.8425
Thorax	224	50 (22.32)	76 (41.08)	2±0.8404
Abdomen	224	22 (09.82)	41 (22.16)	2±0.5473
Total	224*	108 (48.21)	185	2±0.5473

* Not additive

caught a total of 310 black flies in a survey along river Muvur, Mubi, Adamawa State. Although the use of scoop net only might not have been a very efficient method for maximum collection of black flies, the observed prevalence of 48.21% out of the total *S. damnosum* caught and examined in the study area during the study period (9 months) suggests that *O. volvulus* is endemic in the park area and environs. The presence of larval stages of *O. volvulus* in *S. damnosum* all year round indicates the availability of human sources of blood meal some of which may be carrying the parasites. It also shows that black flies within the park and environs are moderately infected as indicated by the average number of larvae isolated from infected flies. However, the observed high presence of microfilariae in the abdomen of infected black flies in the months of June, October and January coincides with periods of high agricultural activities such as land preparation for the new cropping season, weeding and harvesting of crops which the farmers usually carry out manually and unprotected along the river bank. These activities avail the flies with enough source of blood meal, furthermore temperatures are optimal and the rivers have enough turbulence that provides the larval stages of *S. damnosum* with enough Oxygen.

Transmission of Onchocerciasis occur when infective larvae (L3) which is found in the head region of infected flies enter the human host through bite wound when female black fly takes blood meal (WHO, 2015). The relatively high presence of infective stages of *O. volvulus*

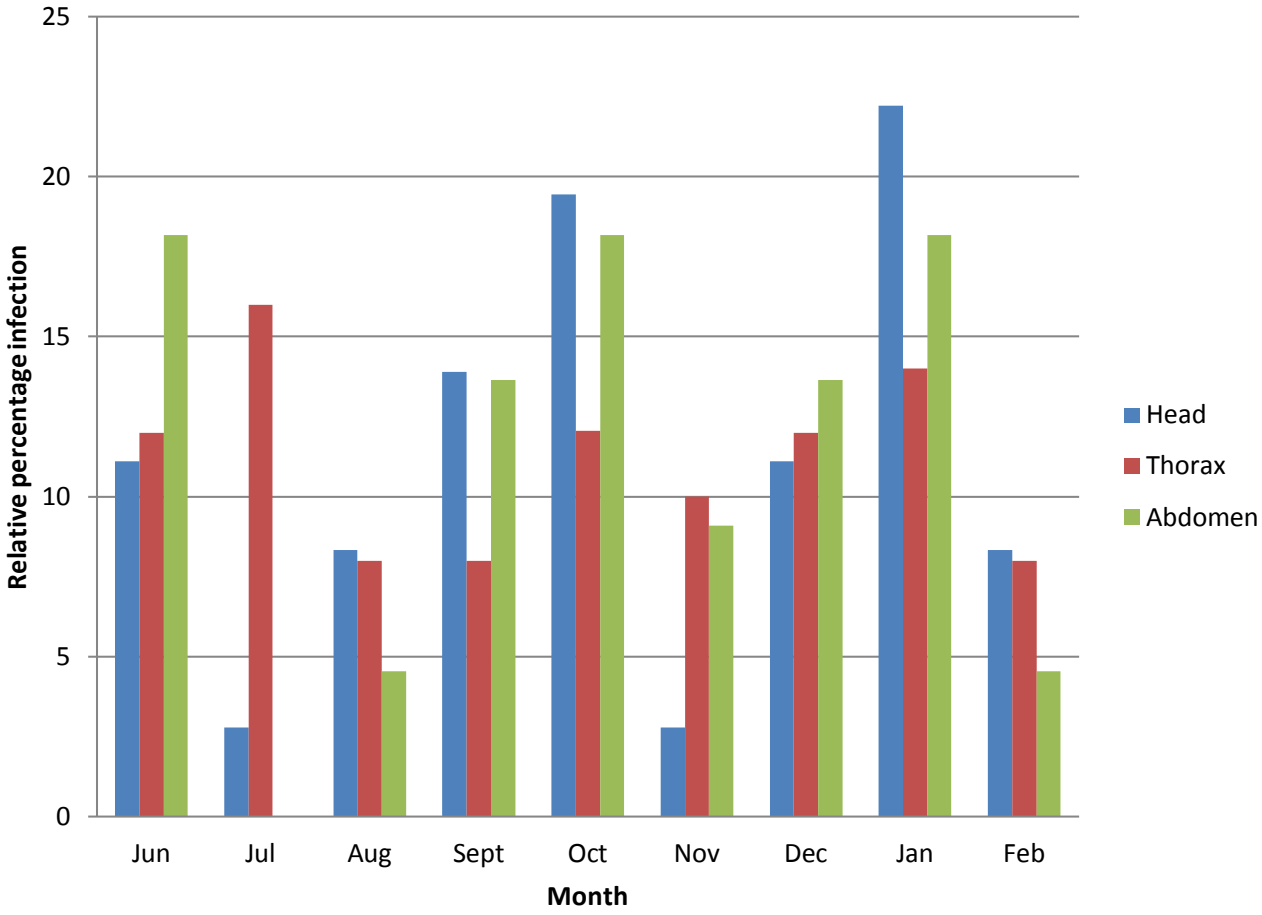

Figure 2. Distribution of *O. volvulus* in different anatomical segment of *S. damnosum* sampled in Kaduna public amusement park and environs.

in the head segment of black flies trapped within the park during the months of October and January therefore is of significant concern. This is because many people visit the park with their families during this period to mark the nation's independence or to celebrate New Year which usually comes up in October and January, respectively thus becoming exposed to risk of contracting onchocerciasis.

CONCLUSION

The isolation of *O. volvulus* larvae in the dissected head, thorax and abdomen suggest that these flies are actively engaged in the transmission of these parasites. It is also an indication of the availability of human sources of blood meals some of which probably are reservoir hosts of these filarial parasites. The apparent human Onchocerciasis risk indicator revealed by the results of this study must not be ignored.

RECOMMENDATION

A comprehensive strategic work plan should be drawn up by the Kaduna State Ministry of Health and other stake holders to assess the epidemiological factors, the infestation profile of *S. damnosum* along the whole length of Kaduna metropolis section of river Kaduna for the institution of effective control measures. The use of Rapid diagnostic test kits must be employed by management of the park to routinely assess the prevalence of human Onchocerciasis within the Park and environs for the institution of effective chemotherapeutic management.

Conflicts of interest

Authors have none to declare.

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Coverage of child health services in rural districts of Ethiopia with the health services extension program

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Improving access to health care services has been advocated widely since the Declaration of Alma-Ata. Despite the efforts to realize this in Ethiopia, it is only in the year 2003 that the intention to take the package of essential health services to the kebele level (smallest administrative unit) was realized through the introduction of the Health Services Extension Program (HSEP). The objective of this study was to explore whether introduction of HSEP has improved the coverage of child health services in the rural areas of Jimma Zone. A cross sectional study was conducted in three randomly selected districts of Jimma Zone, Southwest Ethiopia. The data collection was undertaken during the months of May, June and July, 2009. A structured questionnaire was used to interview female heads of sampled households from nine kebeles randomly selected in three Woredas (districts). Data were collected on the socio-demographic characteristics, use of health posts, child vaccination and childhood diarrhea. Checklists were used for record review. Data obtained were analysed using statistical package for social sciences (SPSS) V14. Only 64.0% of the kebeles had functional health posts, although another 32.0% of the kebeles in the zone had health posts under construction. However, most (93.7%) of the kebeles in the zone already had two health extension workers (HEWs) assigned. Vaccination coverage as measured by DPT3 was 67.9%, and 10% of the under-two year old children included in this survey had diarrhoea during the past two weeks. Of the 34 (51.5%) mothers who sought help during diarrhoeal attacks, 12 (35.3%) of them went to the health post. The first places of treatment seeking were health centres and health posts, with equal proportion for both (43.5%). Treatment was sought within a day or two after commencement of diarrhoea for 70.6% of the children. Thirty nine (69.7%) of the 56 children who were given recommended fluids received oral rehydration solution (ORS) or homemade solution. In addition to continuing efforts to improve coverage, there is a need to ensure that activities are linked with follow up of vaccination, early treatment seeking and proper home management of diarrhoea.

Key words: Health services extension program, health extension workers, childhood diarrhoea, vaccination.

INTRODUCTION

The web page of the Global Health Observatory (GHO) stated that “6.6 million children under age five died in 2012, nearly 18,000 every day (GHO, 2014).” These deaths are mainly from preventable causes and occur mainly in the developing world. In 2002, 174 of every 1,000 children under the age of 5 died in sub-Saharan

Africa and two-thirds of deaths occur in just 10 countries (United Nations Children Fund (UNICEF), 2004). An Ethiopian child is 30 times more likely to die by his or her fifth birthday than a child in Western Europe (United Nations Children Fund, 2005). According to the demographic health survey (DHS) Ethiopia (Central Statistical Agency (CSA) and ORC Macro, 2006), the child mortality rate was 132 per 1000 live births, which is among the highest in the world.

More than 70.0% of about 7.8 million child deaths every year are attributable to six causes: diarrhoea, malaria, neonatal infection, pneumonia, preterm delivery, or birth asphyxia. Within the forty years period 1960 to 2002, a 50.0% reduction in under-five mortality has been observed. A major contributor is immunization program that have protected the lives of nearly 4 million children (United Nations Children Fund, 2005).

The Federal Government of Ethiopia realized that coverage of basic health services was poor and therefore introduced an innovative community-based approach. This approach aimed at creating a healthy environment as well as healthy behaviour by introducing Health services Extension Program (HSEP) as a sub-component of the Health Sector Development Program II (HSDP II, 2002 to 2005). The main objective of the HSEP is to improve equitable access to essential health interventions. This is achieved through community (kebele) based health services with a strong focus on sustained preventive health actions and increased health awareness. The core objective of HSEP is to identify and provide a list of essential health services to households, especially mothers and children, at the kebele level. The four major components of the package are disease prevention and control, family health services, hygiene and environmental sanitation, and health education and communication (Federal Ministry of Health, 2004a).

Health extension workers are employed by government and receive short vocational training (about a year) on 16 packages of health services which are under the four components of the HSEP. The health extension workers are all females who have at least completed grade 10 and who are residents of the kebele in which they work. The female sex was preferred based on the fact that they need to visit women at their houses. In most parts of Ethiopia it is not acceptable for a man to talk to a woman in the absence of her husband. The plan was to deploy two health extension workers per kebele and to construct and equip health posts (one health post per kebele) in an accelerated expansion of PHC facilities. These health extension workers offer key technical services such as immunization, family planning and health education to the approximately 5,000 inhabitants of each kebele. The workers are provided with a monthly salary of 565 Ethiopian Birr ($ 50) (Federal Ministry of Health, 2004b, 2005).

Village level health services such as the HSEP in Ethiopia have been developed in other countries. Pakistan introduced large-scale primary health-care programs and multipurpose community health workers where effects on mortality and life expectancy are discernable (Rhode et al., 2008; Haines et al., 2007). In Thailand, community volunteers play an important role in promoting behaviour change and providing selected maternal, newborn, and child health, nutrition services, and promoting immunization. Thailand still has more than 800,000 health volunteers for primary health care. This country was one of the first to offer injectable contraceptives at a community level, contributing to a high level of contraceptive prevalence even by the 1980s. During the 1990s, bolstered by a stronger economy, universal clean water and sanitation were achieved (Rhode et al., 2008).

A literature review of community health programs pointed that among other factors recognition and involvement by local and national government and community involvement (especially in recruitment and selection) are key factors in the design and implementation of community health programs in several countries (Shakir, 2010). Javanparast et al. (2012) reported that recognition of the community health workers and their training in the national health planning and financing “facilitates the implementation and sustainability” of village health services.

Such approaches aimed at community and family level health services are of paramount importance, especially in countries with restricted access to facility care or shortages of human resources for health, as is the case in Ethiopia. To track regional and worldwide trends of success or failure of these and other such programs national data are important. Importantly, such data should be used for appropriate action within countries and to ensure that governments are accountable for provision of services to the poorest citizens (Rhode et al., 2008).

For this reason, this study aimed to explore whether introduction of the health services extension program in Jimma Zone had improved coverage of child health care services delivered to the population in the rural areas of the Zone. Hence, the research question was: Did the introduction of the health services extension program in Jimma Zone improve coverage of child health care services in the population?

MATERIALS AND METHODS

Study area and period

The study was conducted in Jimma zone, one of the 17 zones

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Table 1. Number of rural kebeles according to the time of introduction of the HSEP in districts of Jimma Zone, Southwest Ethiopia, May, 2009.

S/No.	Name of districts	Total number of rural Kebeles	Number of Kebeles according to the time of HSEP introduction		
			Latest (less than 1 year)	Medium (1-3 years)	Earliest (>3 years)
1	Chora Botor	30	15	13	2
2	Dedo	53	21	28	4
3	Gera	29	25	4	0
4	Gomma	36	12	23	1
5	Gumayi	14	6	6	2
6	Limmu Kossa	40	29	10	1
7	Limmu Seka	37	0	33	4
8	Manna	24	3	17	4
9	Nono Benja	19	6	13	0
10	Omo Nada	39	32	5	2
11	Kersa	30	9	13	8
12	Setemma	21	2	17	2
13	Seka Chokorsa	36	15	19	2
14	Shebe Sombo	20	6	12	2
15	Sigimo	19	0	19	0
16	Sokoru	36	0	32	4
17	Tiro Afeta	27	5	15	7
	Total	510	187 (36.8%)	282 (55.4%)	40 (7.8%)

in the Oromia Regional State, from May to August, 2009. The zone's capital, Jimma Town, is located about 350 km southwest of Addis Ababa, the capital city of Ethiopia. The zone has a total area of 18,412.54 km square. The population of the zone is estimated to be 2.6 million of which 11% are urban and 89% are rural dwellers. In Jimma Zone, an estimated 60 to 80% of the health problems are due to communicable diseases and nutritional problems. The health coverage of Jimma zone as measured by the ratio of health facilities to the population is about 52%. Currently, health care provision within the zone is carried out through 92 health centers, 459 health posts, and 3 hospitals. During the data collection, there were 35 different privately owned and NGO clinics that also rendered health services to the community.

Study design and participants

A cross sectional study design was employed. All households in rural areas of the 17 districts of Jimma Zone were eligible for the study, whereas sampled households of the selected rural kebeles of districts in Jimma Zone were taken as study population. Three districts out of the 17 rural districts of Jimma zone were randomly selected using lottery method. The kebeles in the 17 rural districts of Jimma zone were at different stages with respect to the introduction of the HSEP. The kebeles in the selected districts were grouped according to the period since the HSEP was initiated with the latest (within the past year), medium (within 1 to 3 years) and earliest (more than 3 years) (Table 1). The 9 kebeles included in the study (1 from each of the three strata of the 3 districts) were randomly identified using lottery method and the total sample of households was proportionally allocated to each of the kebeles. The unit of study was a household. To determine the number of households to be included in the study, single population proportion formula for sample size calculation was used. The diphtheria, pertussis and tetanus 3 (DPT 3) coverage in rural Ethiopia of 29% was used as the p in the sample size calculation (Central Statistical Agency (CSA) and ORC Macro, 2006). This was chosen since it provided the largest sample size as compared to proportions of interest in the study. Other assumptions in the calculation of the sample size included margin of error (d) of 0.05 and confidence interval of 95% (Birhanu et al., 2010).

$$n = \frac{z^2_{1-\alpha/2}\, p(1-p)}{d^2}$$

After multiplying by two to compensate for the design effect of cluster sampling and adding 10% for possible non-response, the final sample size was determined to be 695. Finally, the households from each kebele were selected by systematic sampling. The interval was obtained by dividing the required number of households by the total households in the kebele. Table 2 gives the list of the kebeles in the three districts categorized by time of HSEP introduction.

Study variables

The major outcome variable is coverage of child health care services. This was measured by availability of health post, number of health extension workers per kebele, distance from the nearest health post, utilization of health post, DPT 3 and measles coverage, and prevalence of childhood diarrhea. Time of introduction of the HSEP as expressed by the three categories of kebeles described above was the main independent variable.

Data collection instruments

A structured questionnaire and record review checklist were

Table 2. List of kebeles in three rural districts according to the time of introduction of HSEP, Jimma Zone, Southwest Ethiopia, May, 2009.

Name of the districts	Kebeles by time of introduction of HSEP		
	Latest (<1 year)	Medium (1-3years)	Earliest (>3 years)
Shebe Sombo	Sombo darruu, Hane Do'oo, Kishee, Machii, Atroo gafare, Yangaa duugamaa	Aloo godante, Angaccaa, Damma gamacho, Ganbo migira, Gasara qaqaro, Halo Sabbaaqqa, Lakku migira, Mirgano basoo, Sabbaqa dabiyyee, Shabee dasoo, Urgeyii, Waallaa kella	Anja ganbo, Sabbaqa walla
Kersa	Sunkule, Folla gubata, Gora Sariti, Mera kabericho, Showa Xoxobi, Adare dika	Tuqur Abulu, Balla Wajo, Bulbul, Gello, Ankaso, Girma, Gunjuu, Kalacha, Kitinbile, Kombolchaa, Kusaye beru, Osso, Qarsaa Sumee, Qujo muja, Siba, Wadiko	Tuqur balto, Babo, Bussa bacanee, Dogosoo, Karo gora, Marawwaa, Tolii Qarsu, Awaye sebu
Mana	Seyee bontuu, Biliiddaa, Baballaa kosaa	Urgeyyi, Buxuree, Dawaa, Doyyo tolii, Gubbee bosoqaa, Gubbee mullataa, Hunda qananii, Hudaa Tolii, Haroo, Ittisaa guddaa, Kellaa Gudda, kamisee waraabaa, Lemmii Lalisa, Meexii, Somoddoo, Baballaa karaa	Sombo manaa, Guddataa bulaa, Kenterii, Doyyo biqiilaa

Note: Kebeles in bold are those selected from the categories in each district.

prepared based on instruments used in similar studies (unpublished) and national and regional guidelines for the implementation of the HSEP (Federal Ministry of Health, 2004a, b). The structured questionnaire for the household survey had parts on household socio-economic characteristics, child vaccination status, childhood diarrhea and use of health post. The review checklist was designed to obtain date on the availability and status of health posts and number of health extension workers in the districts of Jimma Zone.

Data collection methods and procedures

Data were collected through review of relevant records at health posts, woreda (equivalent to district) health offices and the Jimma Zonal Health Department. Face to face interviews of the female heads in the sampled households were conducted using a structured questionnaire. Data were collected on socio-demographic characteristics, use of health posts, child vaccination and childhood diarrhea. In assessing vaccination status, data were obtained only for children in possession of a vaccination card at the time of interview. Individuals who completed grade 12, were trained and used as research assistants to collect the data

Data analysis

Data were cleaned and entered into SPSS version 14 to obtain summary figures and percentages. Chi-square test was applied to look for differences in the coverage of child health services among the three categories of kebeles.

Quality control

The instruments used in the study were pre-tested on a similar population (35 households: 5% of the actual sample size) which was not included in the study. The data collectors and supervisors were trained on the overall purpose of the research project and the tools for data collection. Continuous checking of the completed questionnaires (10% of the questionnaires completed each day) were carried out by the Principal Investigator. Incomplete questionnaires were referred back for completion.

Ethical considerations

The study protocol was approved by the ethical review committee of Jimma University. Each of the health managers received a letter from the Research and Publication Office of Jimma University requesting his/her cooperative participation. The importance of accessing relevant records was also mentioned in the letter to the health managers. Written informed consent was obtained from each of the respondents. The right to refuse to respond to any of the questions or refusal of participation by the respondents was respected. All data accessed have been kept confidential.

RESULTS

Characteristics of the respondents

As described earlier, the categories of the kebeles were latest, medium and earliest. The proportion of the respondents coming from latest, medium and earliest kebeles were: 35.7, 34.4 and 29.9%, respectively. A total of 683 households from the determined sample of 695 were included in this study giving a response rate of 98.3%. A majority of the women interviewed (86.7%) were in the child bearing age group. Married women comprised 609 (89.2%) of the respondents and the religion with the largest share was Islam, 535 (78.3%). The majority (79.9%) of the participants were Oromo by ethnicity. Five hundred and nineteen (76.0%) of the women were unable to read and write. About 17.0% of the women were literate and had formal education. More than three

Table 3. Origin and characteristics of the respondents, Jimma Zone, 2009 (n=683).

Variables	Number (%)
Age	
15-49	592 (86.7)
>49	91 (13.3)
Woreda	
Mana	240 (35.2)
Kersa	227 (33.2)
Shebe sombo	216 (31.6)
Kebele category	
Latest (<1 year)	244 (35.7)
Medium (1-3 years)	235 (34.4)
Earliest (>3 years)	204 (29.9)
Marital status	
Married	609 (89.1)
Widowed	43 (6.3)
Divorced	23 (3.4)
Never married	8 (1.2)
Ethnicity	
Oromo	545 (79.8)
Amhara	57 (8.3)
Yem	55 (8.2)
Kefa	26 (3.7)
Religion	
Muslim	535 (78.3)
Orthodox	131 (19.2)
Protestant	17 (2.5)
Educational status	
Unable to read and write	519 (76.0)
No formal education*	52 (7.6)
Have formal education	112 (16.4)
Grade attained	
1-8	98 (88.3)
9-10	10 (9.0)
11-12	3 (2.7)
Occupation	
Farmer	530 (77.6)
Trader	78 (11.4)
Housewife	38 (5.6)
Others**	37 (5.4)
Family size	
< 5	357 (52.3)
5-9	291 (42.6)
>9	35 (5.1)
Annual income ($)* (n=663)**	
<408	166 (25.0)
408-780	170 (25.7)
780.1-1266.0	163 (24.6)
>1266.0	164 (24.7)
Annual expenditure ($) (n=678)	
<150	179 (26.4)
150-300	231 (34.0)
300.1-500.0	138 (20.4)
>500	130 (19.2)

*Able to read and write but have no formal education. **Others include government employee and daily labourer. ***$1=10 Eth. Birr

quarters of the householders were subsistence farmers. The family size of 357 (52.3%) of the households surveyed was less than the average household size (5 individuals) of the Oromia Regional State (Table 3).

Availability and use of health posts and health extension workers

Within the 17 rural districts of the Jimma Zone, there are a total of 510 rural kebeles. As Table 4 demonstrate, 478 (93.7%) of the rural kebeles in the zone have got two health extension workers (HEWs) per kebele. An examination of the coverage of the rural kebeles with health posts reveals that 327 (64.1%) of the kebeles had a functional health post during the time of data collection. Also, 162 (31.8%) of the rural kebeles have got health posts in the process of construction while 21 (4.1%) do not have any (Table 4). However, 660 (96.6%) of respondents reported being aware of the health post in their kebele, with no statistically significant difference between the three kebele categories ($p > 0.05$).

Of the total 683 respondents in the survey 661 (96.8%) managed to make a rough estimate of the time taken to reach the nearest health post from their home. Five hundred and eighty eight (89.0%) of these respondents reported that a walk of less than an hour is adequate to reach their health post. The other 73 (11.0%) reported that it takes more than an hour to reach the health post. The differences were statistically significant ($p = 0.003$) and correlated with the timing of the introduction of the HSEP in the kebele (Table 5).

Six hundred and fifty eight (96.3%) of the respondents were able to answer the questions concerning use of the health post in their kebele. More than half (349) of these respondents said that they can ‘always’ use it any time if the need arises while 270 (39.5%) of them replied ‘sometimes’ and another 39 (5.7%) said ‘never’. The possibility of using the health post was significantly different among the three categories of kebeles implying an association with time of introduction of the HSEP ($p = 0.008$). However, the fact that health posts were the first place to seek help when a family member become ill was not shown to have statistically significant association with the time of introduction of the HSEP into the kebeles ($p = 0.053$) (Table 5).

Table 4. Availability of health extension workers (HEWs) and health posts in rural kebeles of Jimma Zone, Southwest Ethiopia, May 2009.

S/No.	Name of district	Total number of rural Kebeles	Availability of HEWs in the kebeles			Number of kebeles with health posts		
			Two per Kebele	Only One HEW	None	Available	On construction	Not available
1	Chora Botor	30	28	2	-	24	6	
2	Dedo	53	52	1	-	20	26	7
3	Gera	29	21	8	-	29	0	-
4	Gomma	36	34	1	1	16	14	6
5	Gumayi	14	13	1	-	10	4	-
6	Limmu Kossa	40	40	0	-	24	16	-
7	Limmu Seka	37	36	1	-	35	2	-
8	Manna	24	23	1	-	13	11	-
9	Nono Benja	19	16	3	-	15	2	2
10	Omo Nada	39	37	2	-	30	9	-
11	Kersa	30	30	0	-	18	12	-
12	Setemma	21	20	1	-	8	13	-
13	Seka Chokorsa	36	36	0	-	15	21	-
14	Shebe Sombo	20	19	1	-	14	4	2
15	Sigimo	19	18	1	-	16	3	-
16	Sokoru	36	33	3	-	21	11	4
17	Tiro Afeta	27	22	5	-	19	8	-
	Total	510	478 (93.7%)	31 (6.1%)	1 (0.2%)	327 (64.1%)	162 (31.8%)	21 (4.1%)

Table 5. Time of introduction of the HSEP with availability and use of the health posts in rural kebeles of Jimma Zone, Southwest Ethiopia, 2009.

Variables	Category of kebeles			p-value
	Latest (%)	Medium (%)	Earliest (%)	
HP* is available				
Yes	233 (95.5)	226 (96.2)	201 (98.5)	0.184
No	11 (4.5)	9 (3.8)	3 (1.5)	
Walking distance to the HP				
<1 h	213 (91.4)	189 (83.3)	186 (92.5)	0.003
>1 h	20 (8.6)	38 (16.7)	15 (7.5)	
Able to use the HP any time				
Always	112 (48.1)	123 (54.9)	114 (56.7)	
Sometimes	99 (42.5)	87 (38.8)	84 (41.8%)	0.008
Never	22 (9.4)	14 (6.3)	3 (1.5)	
Place of first help				
HEWs**	107 (43.9)	112 (50.0)	15 (6.1)	
Other health professionals	112 (47.7)	109 (46.3)	14 (6.0)	0.053
Non-health professionals	118 (57.9)	78 (38.2)	8 (3.9)	

*HP=health post, **HEWs=health extension workers

Child health services

Of the family health services component of the HSEP, this study concentrated on the child health measured by vaccination coverage and occurrence of diarrhoea and its management. In this survey, 118 (17.3%) of the households had at least one child in the age group of 0 to 23 months having a vaccination card. Vaccination status

Table 6. Vaccination status of children under the age of two years who had vaccination card at the time of the survey, Southwest Ethiopia, 2009.

Vaccine	Yes (%)	No (%)	Total
BCG	92 (82.1)	20 (17.9)	112
Polio 1	108 (93.9)	7 (6.1)	115
Polio 2	91 (81.2)	21 (18.8)	112
Polio 3	73 (66.4)	37 (33.6)	110
DPT 1	106 (93.0)	8 (7.0)	114
DPT 2	89 (80.9)	21 (19.1)	110
DPT 3	74 (67.9)	35 (32.1)	109
Measles	45 (39.8)	68 (60.2)	113

of these children is depicted in Table 6. As is usually the case, the proportion of children who received earlier doses are higher than those given at a later age, with children who received measles vaccination showing the lowest coverage (39.8%) (Table 6). Unlike other measures of the HSEP, there was no statistically significant association in vaccination coverage with the time of introduction of the HSEP into the respective kebeles.

Of the 683 households, 67 (10%) had at least one child 0 to 23 months old with diarrhoea during the 2 weeks preceding the survey. The presence of diarrhoea in the under-two year age group was not statistically associated with the time of introduction of the HSEP. With regard to management, more than one in four of the children were given nothing to drink during the diarrhoeal attack, while about 30% of the children received somewhat less than the amount of fluid they normally were given. On the other hand, about 18.0% of the children with a diarrhoeal episode were given the same amount of fluid as they usually took and 21.0% of them were provided more than the usual amount.

It was also found that about half of the mothers did not seek help from any source for the diarrhoeal episode. The chance of seeking help during the diarrhoeal episode was not statistically associated with the time of the introduction of HSEP. Of the 34 (51.5%) mothers who sought help during the diarrhoeal episode, 12 (35.3%) of them did so at the health post. However, the choice of a health post over other sources of treatment for diarrhoea did not show any statistical association with the time at which the HSEP had been introduced into the kebeles. The first places of treatment seeking were the health centres and the health post in equal proportion (43.5%), while private clinics and government hospitals received the remaining share. Treatment seeking for the diarrhoeal episode occurred within a day or two of its commencement in the majority (70.6%) of cases. About 15.0% of the children received help on the same day while the remaining proportion of the children received it 3 or more days after the attack. Thirty nine (69.7%) of the 56 children who were given recommended fluids during the attack received oral rehydration solution (ORS) or homemade sugar/salt solution. None of the parameters related with management of diarrhoea showed statistically significant difference with the time of introduction of the HSEP.

DISCUSSION

The Health Services Extension Program aims to improve primary health services in rural areas through an innovative community-based approach that focuses on prevention, healthy living and basic curative care. It introduced a new cadre of health worker, Health Extension Workers (HEWs), and defined a package of essential interventions for them to deliver from village health posts. This study has highlighted some of the early limitations and achievements of this innovative approach.

The average number of rural kebeles in a district is 30 with a minimum of 14 in Gumayi district and a maximum of 53 in Dedo district. The physical presence of health posts in the study kebeles falls short of the plan of the government to achieve 100% coverage. Only 64% of the kebeles had functional health posts although about 32% of the kebeles in the Jimma Zone had health posts under construction. Most (93.7%) of the kebeles in the Zone, however, already had two HEWs assigned. This approximates the plan of the government with regard to deployment of the HEWs in rural kebeles (Federal Ministry of Health, 2004b); 96.6% of the interviewees in the nine kebeles indicated the existence of a health post in their respective kebeles.

Close to 90.0% of the respondents said that a walk of less than an hour is adequate to reach the health post in their kebele. The maturity of the HSEP was statistically associated with the reported distance from the health post. This relates to the fact that construction of permanent health posts in each kebele happened slowly. As time goes by each of the kebeles and off course the households in the kebeles will have a health post located

at central locations accessible to the majority of the residents. For the same reason it was noted that there is significant association between the time of introduction of the program into a kebele and possibility of using the services at the health post by householders. However, health posts as the first place to seek help when a family member gets ill showed no difference among the three categories of kebeles. This fact may change as the program gets older and more mature.

Vaccination status of children as measured by DPT3 was 67.9%. This coverage is well below the national 76.8% reported in the 2005/06 health and health related indicators of the Ministry of Health. It is even lower than the pentavalent3 coverage (81.6%) reported for the years 2008/09 (Federal Ministry of Health, 2009). Taking both the findings of this study and the latest EPI coverage reported by the Ministry, Ethiopia in general and the study area in particular have a lower level of vaccination coverage than countries categorized to practice selective PHC in an earlier article (Rohde J. et al, 2008). However, this coverage is more than double of what was reported by the Ethiopian Demographic and Health Survey (EDHS) 2005 and 2011 for both the Oromia region (26.8 to 28.5%) and the country as a whole (31.9%) (CSA and ORC Macro, 2006; CSA and ICF International, 2012).

Dropout of those who have started taking the vaccinations was a problem in this study. We have noted that coverage of vaccinations included earlier (for example, OPV1) in the vaccination schedule have higher coverage than those scheduled later (e.g. measles). Similar pattern was picked up by a recent study from the North West part of Ethiopia (Debie and Taye, 2014). If the finding of the EDHS (2005) (28.5%) is taken as the baseline, it is plausible that the introduction of the HSEP has contributed substantially to the current level of 67.9% in the kebeles of Jimma Zone. This is significant, given the important role played by immunization in reducing under-five mortality. Earlier records also showed that globally a share of the 50% reduction in under-five mortality observed during the sixty years period (1960-2002) was due to immunization programs (United Nations Children Fund, 2005).

In our study, 10% of the under-two age group had diarrhoea, as reported by the householders. This figure is lower than that found in the EDHS (2005), which reported that 18% of under-five children had diarrhoea both nationally and in the Oromia region (CSA and ORC Macro, 2006). However, the EDHS (2011) reported a rate of 11.3% for the Oromia region (CSA and ICF International, 2012). More than 5 out of 10 mothers who had a child with diarrhoea sought some help from health care providers. The percentages of children with diarrhoea taken to a health facility were reported to be 23.3% and 35.3% in the 2005 and 2011 EDHS reports, respectively (CSA and ORC Macro, 2006; CSA and ICF International, 2012).

Assuming the 2005 EDHS to be baseline, treatment seeking behaviour for diarrhoea in children has shown notable changes. Similarly, those who were treated received oral rehydration therapy (ORS) or recommended homemade solutions in about 70.0% of the cases. This value is much higher than the 42.2% reported in the EDHS 2005 (CSA and ORC Macro, 2006). However, the chance of seeking help and using appropriate fluids during the diarrhoeal episodes were not significantly associated with the time of the introduction of HSEP.

The limitations of the current study are that some of the questions forwarded to respondents required appropriate recall of events. Difficulty in recall might have introduced recall bias in the data obtained. Moreover, including only those children who have a vaccination card may have resulted in selection bias.

CONCLUSION

The distribution of HEWs and availability of health posts throughout Jimma Zone has improved significantly since the introduction of the HSEP. There are only a few kebeles without health post/HEWs, most of which have at least HEWs and a health post under construction. The majority of the households reported that they are at ease of making use of the services at the health post. Access and coverage of child health services have significantly improved since the introduction of the HSEP. Coverage of DPT3 was found to be significantly increased following the HSEP. The rate of diarrhoea among under-two year children has fallen remarkably and more than half of the children with diarrhoea were taken to a health care provider some time during their illness. Moreover, the use of ORS and recommended homemade solutions was practiced by the majority of the mothers. Since vaccination coverage tends to be lower for later doses, follow up is required to make sure that children complete the recommended schedule. Home management of diarrhoea and treatment seeking behaviour should be given more emphasis during household visits conducted by the HEWs. This will ensure the sustainability of the current gains and further improvements in the management of diarrhoea. Moreover, health information provision methods should be designed in such a way that behavioural change is effected in the areas of health seeking for childhood diarrhoea.

Conflict of interest

The authors declare that they have no competing interests.

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The epidemiology of congenital heart diseases in Saudi Arabia: A systematic review

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Several studies have been conducted on congenital heart disease in different regions of Saudi Arabia. However, no recent systematic review has examined the growing scientific evidence with respect to the epidemiology of CHD in the Kingdom. The aim of this review is to provide a comprehensive summary of CHD incidence, prevalence, burden and impact on the Saudi population. A literature search was conducted through PubMed and Google Scholar using relevant keywords to identify studies performed in Saudi Arabia regarding CHD from 1993 to December 2013. Articles written in English that described or investigated the epidemiology, etiology, distribution, impact and burden of CHD in the Saudi Arabian population were included. Twenty one articles met these criteria. Cross-sectional studies found the prevalence of CHD ranging between 2.1 and 10.7 per 1,000 persons. The most prevalent type of CHD was the ventricular septal defect ranging from 29.5 to 39.5% of all diagnosed CHDs, followed by atrial septal defect (8.9 to 18.1%) and pulmonary stenosis (6 to 12.4%). Overall, the incidence of severe CHD was approximately 5.4 per 1,000 live births per year. Occurrence of CHD in Saudi Arabia was significantly associated with Down's syndrome, consanguinity and maternal diabetes. Studies on the burden of these anomalies on children, families and society are scarce. This systematic review found that prevalence of CHD is comparable to that in other developing countries. Several modifiable risk factors have been identified emphasizing the importance of public health programs that are aimed at tackling such potentially preventable risk determinants.

Keywords: Heart, congenital, defect, epidemiology, prevalence, Saudi.

INTRODUCTION

Congenital Heart Disease (CHD) has been defined as "a gross structural abnormality of the heart or intrathoracic great vessels that is actually or potentially of functional significance" (Mitchell et al., 1971). The range of defects

varies from a single simple defect with no symptoms to multiple complex of defects with several symptoms (Bernier et al., 2010). Minor heart defects may not affect the quality of life of the patient and may not require any intervention; on the other hand, severe heart defects would require extensive medical support (Koshnood et al., 2010; van der Bom et al., 2012). Different studies give wide variation in the incidence of CHD varying from 4/1000 to 50/1000 live births (Hoffman et al., 2004). Variation is primarily due to the use of different methods of diagnosis (Hoffman et al., 2004). The highest prevalence for CHD was observed in a population based study from Taiwan with a prevalence of 13.1 per 1,000 live births between 2000 and 2006 (Wu et al., 2010). In most CHD cases, the etiology is not known, but some studies have found that CHD is linked with either genetic or environmental predispositions (Blue et al., 2012). Several studies have been conducted on CHD in different regions of Saudi Arabia. However, no recent systematic review has examined the growing scientific evidence with respect to the epidemiology of CHD in the Saudi population. The aim of this review is to provide a comprehensive summary of CHD incidence, prevalence, burden and impact on the Saudi population in order to better understand the disease's magnitude and aid in future public health initiatives.

METHODOLOGY

An electronic search was conducted from January 3 to January 25, 2014 using PubMed, Google Scholar and local Saudi journals. The following keywords: “Heart”, “Cardiac”, “Congenital”, “Defect” and “Epidemiology”, “Prevalence”, “Incidence”, “Risk”, “Impact”, and “Saudi Arabia” were used in the search strategy. The articles included in the study were from Pubmed and local journals, written in English and they describe or investigate the epidemiology, etiology, distribution, impact or burden of CHD in Saudi Arabia. Treatment or interventional studies were excluded. The search identified 108 articles. Titles, abstracts and at a later stage full texts were reviewed independently by two researchers to identify articles that met the predefined inclusion criteria. After mutual consensus of the two researchers 21 articles met the inclusion criteria with publication dates ranging from 1993 to 2013. Figure 1 shows a flow chart of the search with justification for exclusion at each stage. A supplementary search for articles by the primary investigator was conducted by cross-referencing and reviewing locally published journals that were not indexed in PubMed.

RESULTS

The 21 studies included were conducted in a variety of geographical areas in Saudi Arabia. The supplementary search by cross-referencing and searching in local journals did not identify any additional papers. Of the 21 articles, five reported on prevalence and pattern of CHD and seven reported on the association of CHD with Down's syndrome and its prevalence. Nine studies reported on risk factors only such as consanguinity, maternal diabetes, maternal obesity, the social impact of CHD and fetal outcome (Table 1).

Prevalence and pattern of CHD

A study investigated the clinical features of 320 patients diagnosed with CHD at a Saudi hospital in the period between 1988 and 1991 found that both sexes were equally affected. Relative frequency of VSD was higher than Atrial Septal Defect (ASD), Pulmonary Stenosis (PS), Patent Ductus Arteriosus (PDA) and Atrio-ventricular Septal (AVSD) with percentages of 38.5, 11.5, 9, 8% and 5%, respectively (Jaiyesimi et al., 1993). Bhat et al., (1997) screened all children referred to the cardiology clinic at the Madina Maternity and Children Hospital for three years and documented very similar findings with VSD representing 29.7% of all CHD diagnoses, ASD (26%), PS (16.1%) and PDA (13.2%) (Baht et al., 1997). Abbag (1998) documented that the most common defect was VSD 32.5% (Abbag, 2006). Likewise, Alabdulgader (2001) studied the prevalence of CHD using a cross-sectional design and concluded that VSD was the most common defect (39.5%), followed by ASD (11.5%), PS (8.9%), PDA (8.6%), AVSD (3.5%), Tetralogy of Fallot, TOF (4.2%), Coarctation of Aorta COA (2.7%), Aortic Stenosis (AS) (3.5%) (Alabdulgader, 2001). Few studies estimated the prevalence of CHD at the population level. Greer et al. (2005) showed that Southwestern region had the highest burden of CHD with a period prevalence of 748 cases per 100,000 persons (Greer et al., 2005). Alqurashi et al. (2006) determined the prevalence of CHD in children and adolescents by randomly sampling households in all regions of Saudi Arabia. The results found the prevalence of CHD over all as 21 per 10,000 persons. VSD was the most common defect with 10 cases per 10,000 (Alqurashi et al., 2006). Alnajjar et al., (2009) found that CHD represents 34.4% of all cardiac problems diagnosed at Al Madina city. Ventricular septal defect period represented 34.5% of all CHD diagnoses, followed by ASD (8.9%), PS (7.9%), PDA (6%), AVSD (3.8%), TOF (3%), AS (3.5%), COA (3.4%), Transposition of the Great Arteries (TGA) (3.5%),

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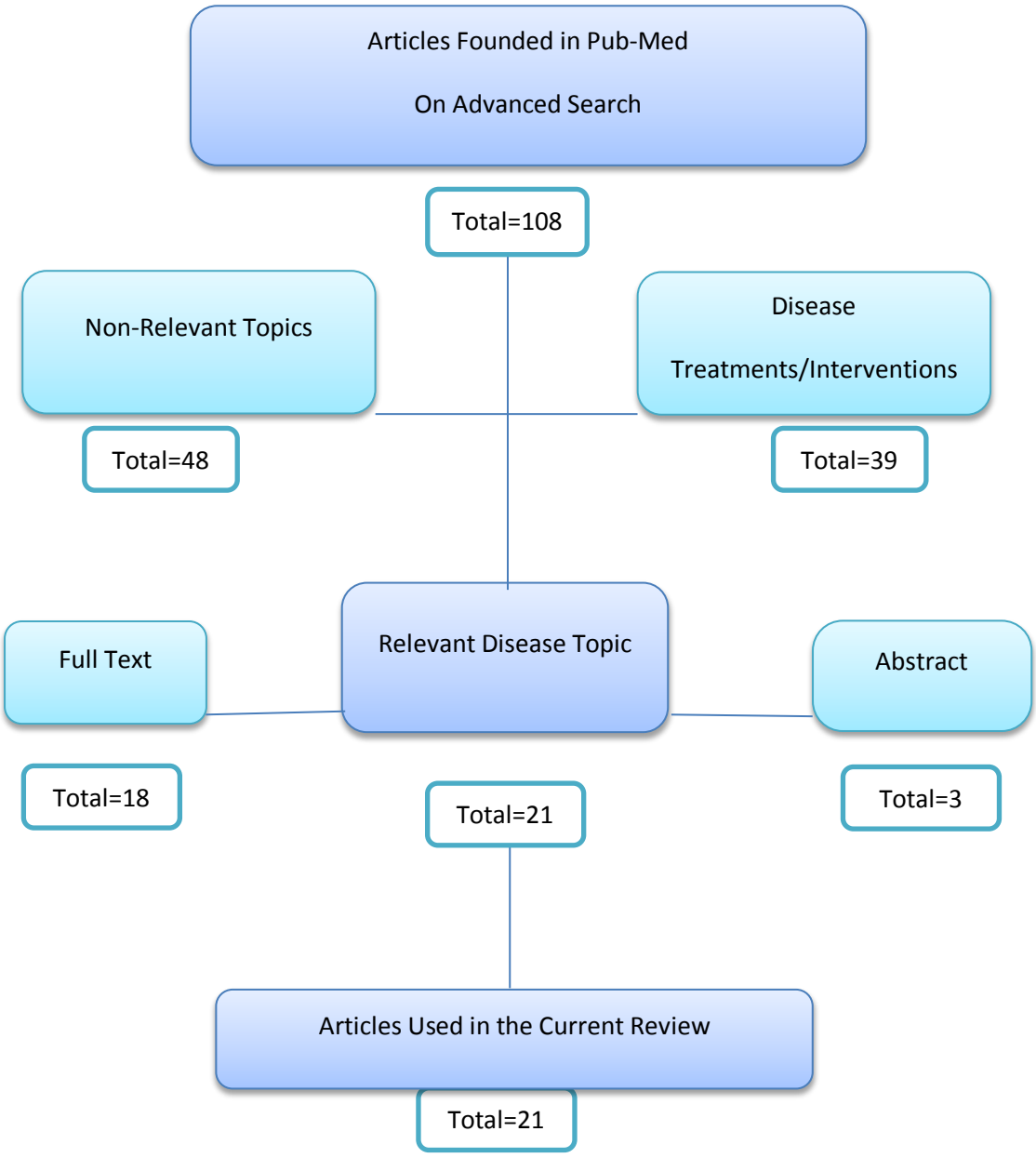

Figure1. Flow chart of the literature review search.

and others (26%) (Alnajjar et al., 2009). Almawazini and Al-Ghamdiin (2011) studied the proportion of CHD among all diagnoses in the Southwestern Albaharegion. Of all cardiac patients, 26.8% were diagnosed with CHD (Almawazini and Al-Ghamdiin, 2011). Al-Mesned et al., (2012) reported on the incidence of severe CHD in Al-Qassim. The incidence of severe CHD was 5.4/1,000 live births/year. VSD defect was the most common lesion 22.5/1,000 live births/year (Al-Mesned et al., 2012).

Risk factor studies

***Down syndrome* (DS)**

Alabdulgader, (2001), reported that Down syndrome was found in 6% of all patients with CHD. Down syndrome patients with CHD presented with higher proportion of non-cyanotic lesions, than cyanotic lesions (Alabdulgader, 2001). Al-Jarallah (2009) reported a 49%

Table 1. Summary of studies included in the systematic review.

Study	Sample Size	Study setting	Year of data collection	Prevalence/incidence	Other findings
Prevalence/incidence and relative frequency Studies					
Jaiyesimi el al. (1993)	320 cases of CHD	Hospital	1988-1991	-	Relative frequency of VSD was 38.5% followed by ASD (11.5%).PS (9%), PDA (8%) and finally AVSD (5%). A relatively high incidence of trisomy -21 was found in 10%.
Bhat et al. (1997)	1209 CHD cases	Hospital	1992-1995	-	Frequently detected types of CHD were VSD (29.7%) followed by ASD (26%), PS (16.1%) and PDA (13.2%). DS was found in 79% of patients with AVSD
Abbag (1998)	608 cases of CHD	Hospital	1994-1996		Relative frequency of VSD (32.5%), followed by PDA (15.8%), ASD (10.4%), PS (10.1%), AVSD (3.6%), TOF (4.5%), AS (2.7%), COA (2.7%), and TGA (1.5%)
Greer et al. (2005)	5,865 cases of CHD	National Registry	1998-2002	748/100,000	The southwestern region having the highest burden of CHD
Alqurashi et al. (2007)	95 cases of CHD	Household	2004-2005	21/10,000	The Central region had the highest prevalence with 27 cases per 10,000 persons; the Northern and Eastern region had prevalence of 25 cases per 10,000 persons each, and Southwestern Region prevalence of 21 cases per 10,000 persons. The VSD was the most common defect with 10 cases per 10,000
Alnajjar et al. (2009)	4348 cases of CHD	Hospital	2007-2208	-	Relative frequency of VSD 34.5%, followed by ASD (8.9%), PS (7.9%), PDA (6%), AVSD (3.8%), TOF (3%), AS (3.5%), COA (3.4%), TGA (3.5%), and others (26%)
Almawazini et al. (2011)	2610 cases of CHD	Hospital	2005-2010	-	VSD (29.6%), PDA (9.5%), ASD (9.3%), PS (7.9%), AVSD (6.0%), TOF (4.7%), COA (3.4%), AS (3.0%), and TGA (1.9%)
Down Syndrome as a risk factor					
Alabdulgader (2001)	740 CHD cases	Hospital	1997-2000	-	VSD was the most common defect (39.5%), followed by ASD (11.5%), PS (8.9%), PDA (8.6%), AVSD (3.5%), TOF (4.2%), COA (2.7%), AS (3.5%).DS patients with CHD presented with higher proportion of non-cyanotic lesions (VSD-30%, AVSD -25%, PDA -20%, ASD-16%), than cyanotic lesions (TAPV -5%, TOF -4%).
Abbag (2006)	98 DS cases	Hospital	1994-2005	-	VSD being the most common (33.3%) followed by AVSD (22.8%), ASD (21.1%), PDA (14%) and TOF (5.3%). Sixteen patients (16.3%) died at a mean age of 19 months of which 15 of them (93.8%) had anomalies.
Al-Jarallah (2009)	110 DS cases	Hospital	2001-2004	-	Incidence of CHD in DS was 49%, the incidence of VSD was the highest (43%), followed by ASD (25%), AVD (15%), PDA (7%), and finally TOF (4%).
Al-Mesned et al. (2012)	316 DS cases	Hospital	2008-2010	5.4 /1,000 live birth (incidence)	VSD was the most common lesion (22.5%), COA (14.9%), AVSD (8.5%), PS (7.6%), and TOF (5.7%). 15% of the subjects suffered from other syndromes of which DS was the most common (14.2%).

Table 1. Cont'd.

Al-Aama et al. (2012)	130 DS cases	Hospital	2007-2011	7.1 per 1,000 live births	86.8 % children with DS had CHD. PDA (47.8%), followed by ASD (41.3%), trivial tricuspid regurge (33.7%), VSD (29%), and PFO (28.3%).
Consanguineous marriage as a risk factor					
Al-Abdulkareem and Ballal (1998)	-	PHCC and the Maternity and Children's Hospital	1998	-	No significant differences between children of consanguineous and non-Consanguineous marriageswith respect to rates of inherited diseases and reproductive wastage.
Becker and Halees (1999)	949	Congenital Heart Disease Registry	1998	-	The prevalence of CHD which was significantly higher among first-cousin marriages (41.6%) as compared to the general population (28.4%). Down's syndrome was found in 49 patients (5.2%) with 23 from consanguineous marriages.
Seliem et al. (2007)	37 families	Hospital	1996-2000	-	Consanguineous marriages resulted in twenty-three of these families (62%). The prevalence of dilated cardiomyopathy was considerably higher between consanguineous cases; 26 vs. 2 in non-consanguineous marriages
El Mouzan et al. (2008)	11554	Community-based survey	2004-2005	-	56% of the respondents were in consanguineous marriages and CHD to be the only statistically significant disease associated with first cousin consanguinity
Becker (2012)	891	Congenital Heart Disease Registry		-	Consanguinity was significantly higher in the sample (40.4%) compared to the general population (28.4%). Consanguinity was found to be significantly associated with some types of CHD such as VSD, ASD, AVSD, PA, and PS while no significant relationship was found with TOF, TA, AS, COA, and PDA
Diabetic Mothers					
Abu-Sulaiman and Subaih (2004)	100	Hospital	2000-2001	-	Incidence of CHD in children of diabetic mothers was determined to be higher than in the general public; 150 per 1,000 live births, (after excluding PDA and hypertrophic cardiomyopathy). The predominant lesions were PDA (70%) followed by PFO (68%), HCMP (38%), ASD (5%), VSD (4%), MVP (2%)
Maternal Obesity					
Khalil et al. (2008)		Registry data	1998-2005	-	No significant association in incidence of CHD and maternal obesity
Social Impact					
Almesne et al. (2013)	41 parents	Hospital	2011-2012	-	Families of children with complex CHD had significantly higher IFS score, 62 vs. 51 (p=0.005) with a significant difference in both the family impact and mastery domains
Fetal outcome					
Bader et al. (2013)	-	Hospital-based database	2002-2012		Overall mortality rate for fetuses with AVSD was 48%. Extra-cardiac anomalies are an independent risk factor for prediction of mortality.

VSD: Ventricular Septal Defect, ASD: Atrial Septal Defect, PS: Pulmonary Stenosis, PDA: Patent DutusArteriosus, AVSD: Atrio-ventricular Septal, TOF: Tetralogy of Fallot, AS: Atrial Stenosis CoA: Coarctation of Aorta, TGA: Transposition of the Great Arteries, IFS: Impact on Family Scale, and DS: Down syndrome.

prevalence of CHD among DS patients (Al-Jarallah, 2009). Al-Aama et al. (2012) described the prevalence of CHD among DS patients in a prospective hospital-based study conducted between 2007 and 2011. A total of 130 DS patients aged 0 to 33 years (mean 5 ± 4.9) were included. The results found CHD in 86.8% of the patients with a prevalence of 7.1 per 1,000 live births (Al-Aama et al., 2012). Abbag et al., in 2006 documented that CHDs was found in 61.3% of DS patients (Abbag, 1998). Al Massned et al., found that DS is the most commonly encountered syndrome among children with CHD (Al-Mesned et al., 2012).

Consanguineous marriage

Al-Abdulkareem and Ballel, (1998) documented a non-significant difference for rates of inherited diseases between families of consanguineous and non-consanguineous marriages (Al-Abdulkareem and Ballel, 1998). Becker and Al Halees (1999) studied the relationship between CHD and consanguineous marriages (Becker and Al Halees, 1999). First-cousin marriages among families of children with CHD (41.6%) were significantly higher than that in the general population (28.4%) (Becker and Al Halees, 1999). Becker et al. (2001) documented the prevalence of various CHD lesions in patients who were the product of first-cousin marriages and found consanguinity was significantly higher in the sample (40.4%) compared to the general population (28.4%). Consanguinity was found to be significantly associated with some types of CHD (Becker et al., 2001). Seliem et al., (2006) investigated the influence of consanguinity on the pattern of familial aggregation in CHD. Consanguineous marriages resulted in twenty three of these families (62%) (Seliem et al., 2006). El Mouzanet et al. (2008) observed the role of consanguinity in genetic disorders and found that 56% of the respondents were in consanguineous marriages and that CHD to be the genetic disease most significantly associated with first cousin consanguinity (ElMouzan et al., 2008).

Diabetes and obesity

Abu-Sulaiman and Subaih, (2004) used a prospective cohort to investigate the relationship between CHD and insulin dependent diabetic mothers. Incidence of CHD in children of diabetic mothers was determined to be higher than in the general public; 150 per 1,000 live births (Abu-Sulaiman and Subaih, 2004). Khalil et al. (2008) conducted a retrospective study and documented no significant association in incidence of CHD and maternal obesity.

Impact and mortality studies

Almesned et al. (2013) measured the social impact of CHD on families of children with a complex CHD. Results showed that families of children with complex CHD had significantly higher Impact of Family Scale (IFS) score, 62 vs. 51 ($p = 0.005$) with a significant difference in both the family impact and mastery domains (Almesned et al, 2013). Bader et al. (2013) evaluated risk factors for prediction of outcome in fetal of AVS defect through retrospective design documented that overall mortality was 48% for fetus with AVSD (Baderet al., 2013).

DISCUSSION

There were 21 articles included in the review. Of those, the prevalence of CHD in Saudi Arabia was addressed in two studies. Alqurashi et al. (2006) conducted a community-based national prevalence study and reported approximately 21 cases per 10,000 persons. While Greer et al. (2005) and Alqurashi et al. (2006) used the CHD registry of KFSH and found it to be three fold at 74.8 per 10,000 persons. International studies have reported prevalence rates ranging from 10 to 119 per 10,000 persons (Samánek et al., 1989; Marelli et al., 2007; Dolk et al., 2010; Koshnood et al., 2010; van der Bom et al., 2012). Various factors may contribute to the differences in prevalence and relative frequencies of CHD between these studies including the study setting. Hospital based studies, for example, will often report a higher prevalence than community based studies due to the higher relative frequency of VSD, the most common type of CHD, which often closes spontaneously in early childhood and would not be detected in most studies outside of the hospital. In addition, minor forms of CHD, such as small PDA and ASD, may go undetected outside of hospital settings due to their subtle clinical signs. On the other hand, children with severe forms of CHD may die before one year of age thus reducing prevalence in community based studies. Nonetheless while the study methodology must be taken into consideration when making any comparisons, community based studies in China and India have reported higher prevalence's of 50 and 42 per 10,000 persons, respectively than that conducted in Saudi Arabia (Chadha et al., 2001; Jiang et al., 2005). Another important factor is the definition used for CHD as some studies excluded structural abnormalities that were not of functional significance (Abbag, 2006; Alqurashi et al., 2006; Alnajjar et al., 2009; Almawazini and Al-Ghamdiin, 2011).

Bhat et al. (1997) for example, did not exclude ASD in neonates and reported a relative frequency of 26% while in other studies in Saudi Arabia they ranged from 8.5 to11.5% (Baht et al., 1997). The sensitivity of the diag-

nostic tools used is another factor affecting detection rates of CHD between studies as echocardiography was used in all studies in Saudi Arabia but was not available in previously conducted international studies. The most common cardiac congenital lesion reported in KSA was VSD ranging from 29.5 to 39.5% which is consistent with other parts of the world (Rose et al., 1964; Hoffman et al., 2004; Koshnood et al., 2010). The order of frequency of other forms of CHD however is less consistent. The second most common type of CHD in Kingdom of Saudi Arabia was ASD, which was the second most frequently reported disorder in terms of incidence in the US, Canada and Bohemia while other studies found it to be less common; the fourth most common form in Hungary at 10.4% and the fifth most common type in Sweden at 4.3% (Rose et al., 1964; Mitchell et al., 1971; Mészáros et al., 1975; Samánek et al., 1989; Sípek et al., 2010).

Variation in frequencies has been attributed to methodology and sensitivity of diagnostic tools, particularly as older studies have not used echo-cardiogrphy, which was used in all of the studies in KSA. The cause of congenital heart disease is largely multi-factorial and occurs through a combination of genetic and environmental factors. However, the role of chromosomal abnormality is conspicuous with approximately 20% of cases attributed to chromosomal anomalies (Blue et al., 2012). The association of CHD with DS was first described by Evans in 1950 (Carlgren, 1959). Since then a number of studies have consistently shown an association between the two conditions (Evans, 1950; Granzotti et al., 1995; Wells et al., 1994; de Rubens Figueroa et al., 2003; Vida et al., 2005; Roizen et al., 2014). As CHD is the greatest cause of death in infants and young children with DS, describing the prevalence and types of defects found in DS is relevant in facilitating early intervention and appropriate management (Evans, 1950).

Presence of CHD in children with Down's Syndrome in central KSA was reported as 49% while in the Southwest region where CHD is more prevalent, it was higher (61%) (Abbag, 1998 and Al-Jarallah, 2009). Al-Aama et al. (2012) reported a greater prevalence of 86.6%, possibly due to the study being conducted from a genetic referral center. International studies ranged from 40 to 55% (Evans, 1950; Wells et al., 1994; de Rubens Figueroa et al., 2003; Vida et al., 2005; Al-Aama et al., 2012; Roizen et al., 2014). Similar to CHD in the general population, VSD was the most common lesion in DS, which is also consistent with most international studies (Abbag F, 1998; Al-Jarallah, 2009 and Al-Aama et al., 2012). Relative frequency of other types of CHD, however, varied among the studies due in part to the variation in method used for categorization. For example when multiple types of CHD were detected, Al-Jarallah (2009) reported only on the dominate one while Al-Aama (2012) reported on them both in isolation or in combination, therefore PDA, for example, was only 7% in the former and 47.8% in the latter. The role of consanguinity in recessive diseases is well known, however, its potential role in certain common birth defects is unclear. Most studies support the view that consanguineous marriages increase susceptibility of CHD, particularly at first cousin level (Shieh et al., 2012). This is particularly the significant as consanguineous marriages are common in Saudi Arabia (Al Husain and Al Bunyan, 1997; Al-Abdulkareem et al., 1998 and Shieh et al., 2012).

Prevalence of consanguineous marriages was found to be as high as 51% in Riyadh, 47 and 52% in the Eastern province (Al-Abdulkareem and Ballal, 1998). El-Hazmi screened 3212 families in all regions of KSA and found 57.7% were consanguineous with first cousin marriage the most common type (28.4%) (El-Hazmi et al., 1995). In Kingdom of Saudi Arab first cousin marriages were significantly associated with VSD, ASD, AVSD, PS, and PA (Becker et al., 2001). Similarly, septal defects (VSD and ASD) were consistently found to be associated with consanguinity especially at first cousin level, in several international studies (Shieh et al., 2012). The less common forms of CHD with lower incidence (AVSD, PS, PA) may not have achieved enough power to determine the effect of consanguinity in international studies and may require large population based trials to accurately determine this relationship. The relationship of DM and CHD has been well established in Type 1, Type 2 and gestational DM (El-Hazmi et al., 1995; Narchi and Kulaylat, 2000 and Schaefer-Graf et al., 2000). Loffredo found a strong association between maternal diabetes and CHD (OR = 4.7, 95% CI 2.8 to 7.9) with all-cause mortality of children with CHD more than double in diabetic mothers than in non-diabetic (39 and 17%, respectively) (Loffredo et al., 2010). Similarly, Lukas A. also had identified a strong association of CHD and the offspring of diabetic mothers (p-value < 0.05) (Lisowski et al., 2010). Schaefer-Graf et al., (2000) reviewed 4,180 pregnancies complicated by gestational or type 2 DM and found the initial fasting serum glucose levels were significantly higher in the mothers of children born with anomalies.

The most common major anomalies were cardiac (37.6%) (Schaefer-Graf et al., 2000). Narchi and Kulaylat, (2000) estimated that CHD occurs in 5% of infants born to diabetic mothers with the highest relative risk for major defects occurring in mothers with gestational diabetes and developing insulin resistance in the 3rd trimester (Narchi and Kulaylat, 2000). In Saudi Arabia, Abu-Sulaiman and Subaih (2004) reported incidence of CHD in mothers with insulin dependent DM as 150 per 1,000 live births. This is significantly higher than the incidence

reported in the general population (2.1 to 10.7 per 1,000 live births) (Greer et al., 2005; Alqurashi et al., 2006). The detection and inclusion of minor forms of CHD may have contributed to this higher incidence. The limitations of this review includes limiting our search for articles in English. However, most if not all studies by research institutes and universities are in English in the Arab world. We might have missed some articles as we did not search into different databases like KoreaMed and Embase but local journals were reviewed to include all the study related to the Saudi Arabia. Publication bias, which is the tendency for publishing manuscripts positive finding is a potential limitation of all systematic reviews including our review, and certainly might explain, partially the significant association between CHD and some factors like maternal diabetes and advanced age. Limitations of this systematic review derive also from limitations of the individual studies included. Most of the studies conducted in Saudi Arabia were cross-sectional with an aim of characterizing patients diagnosed with CHD in terms of defect type or associated factors with very few follow-up studies that aims to know the prognosis, burden and consequences of these conditions on the society and healthcare services.

CONCLUSION

The results of this systematic review give a general understanding of the CHD epidemiology in Saudi Arabia. These diseases, that pose a considerable impact on children and their families, have higher prevalence than that in Western countries and comparable to those reported in other developing countries. Consanguineous marriages, maternal age, diabetes and Down syndrome and were among risk factors related to CHD in studies conducted in Saudi Arabia. Identified risk factors are potentially modifiable, emphasizing the importance of public health programs that are aimed at tackling such determinants. Studies that explored the prognosis and burden of these diseases on the Saudi society and healthcare services are scarce and should be the focus for future research.

Conflict of interest

The authors declare that they have no conflicts of interest.

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Full Length Research Paper

Knowledge and attitudes of adult HIV positive patients to HIV/AIDS in Yola, Nigeria

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Though cases of AIDS are visible in Nigeria and high awareness of human immunodeficiency virus (HIV), correct knowledge on human immunodeficiency virus (HIV) transmission and prevention has remained low with significant numbers of people living with HIV/AIDS having low attitudes towards life and the disease itself. This study determined the baseline knowledge on human immunodeficiency virus (HIV) transmission and prevention and attitudes towards HIV/AIDS of adult HIV positive patient enrolled into care at all 4 comprehensive antiretroviral therapy (ART) sites in Yola, Nigeria. Baseline reports on the knowledge and attitudes of adult HIV positive patients were obtained from a 3 arm randomized single blind clinical trial involving 386 randomly selected and allocated adult HIV patients who were enrolled into ART care at all 4 comprehensive ART sites in Yola. The intervention was 10 to 15 min clinic based Clinician Client Centred counselling and the 3 groups were; intervention group1, intervention group 2 and the control group. An interviewer administered validated and reliable structured questionnaire was used for data collection. Outcome measures were sound knowledge on HIV transmission and prevention and attitudes towards HIV/AIDS. Data was analyzed using SPSS version 22. Test of significance was at α level 0.05. Overall 237 (61.4%) had sound knowledge on HIV transmission and prevention, while 346 (89.6%) of respondents had high attitudes towards HIV/AIDS. Though majority of respondents had sound knowledge on HIV transmission and prevention as well as high attitudes towards HIV/AIDS, interventions to improve knowledge and attitudes among this group of individuals would improve positive preventive strategies.

Key words: Adult HIV patients, knowledge, attitudes, HIV/AIDS.

INTRODUCTION

HIV/AIDS is recognized as a major challenge to public health in recent times. An estimated 34.0 million people are presently known to be living with HIV/AIDS globally (UNAIDS, 2012). Variations in the distribution of this epidemic are seen among countries and regions; with Sub-Saharan Africa remaining the most severely affected

(UNAIDS, 2012). Nearly 1 in 20 adults (4.9%) are living with HIV in Sub-Saharan Africa accounting for about 69% of the global burden (UNAIDS, 2012). Nigeria has a HIV prevalence of 4.1 % (FMOH, 2010). This prevalence accounts for about 3.2 Million Nigerians out of which 2.8 million are aged 15 years and above (UNAIDS, 2013). Adamawa state with Yola as capital located in the north-eastern region has a prevalence of 3.8% (FMOH, 2010). The primary mode of transmission of HIV in Nigeria is heterosexual sex, and it accounts for 80 to 95% of HIV infections in the country (Dibua, 2009).

Cases of AIDS are very visible in Nigeria. One out of every four persons in the country has seen someone with HIV or has known someone who died of AIDS. Awareness of HIV is high (93.8%), but correct knowledge on all routes of possible transmission and methods of prevention have remained low (54 and 52.5% respectively) (NARHS, 2007).

Prevention of spread of HIV/AIDS can only be possible with sound knowledge on the various modes of transmission and spread of the disease especially among those living with the disease. Many studies have assessed the level of HIV knowledge among individual who are HIV negative or of unknown status (Asekun-Olarinmoye and Oladele, 2009; Fawole et al., 2011; Osonwa et al., 2013). However there is paucity of research that has assessed the level of sound knowledge of HIV transmission and prevention among people living with HIV/AIDS (PLWHAs) in Nigeria. This paper describes the baseline knowledge on HIV prevention and transmission and attitudes towards HIV/AIDS of adult HIV positive patients enrolled into ART care at all 4 comprehensive ART sites in Yola, north-eastern Nigeria.

MATERIALS AND METHODS

Baseline knowledge and attitudes were obtained from a 3 arm randomized single blind clinical trial involving 386 randomly selected and allocated adult HIV patients who were enrolled into Antiretroviral Therapy (ART) care; the 4 comprehensive ART sites in Yola. These comprehensive sites were the; Federal Medical Centre (FMC) Yola, State Specialist Hospital Yola (SSHY), St Francis Hospital Jambutu and Adamawa Hospital. The study took place from January to September 2014. A Clinician Client Centred training module was developed based on the Information Behaviour and Motivation (IBM) Model. Nine Clinicians involved in ART care were trained with this module to deliver a 10 to 15 min clinic based intervention (Clinician Client Centred (CCC) counselling). Intervention group 1 received 2 counselling sessions; at baseline then at 2 months. Intervention group 2 received 1 counselling session at baseline only and the control group received routine care. Follow up was at 2 months and 6 months.

Participant selection criteria and recruitment

Criteria for inclusion into this study included all persons diagnosed with HIV ≥ 18 years of age presenting to the 4 comprehensive ART clinics in Yola. Patients excluded from this study were those patients who declined consent or who were HIV positive but diagnosed with mental illnesses rendering them unfit to participate in the study.

The sample frame was the list of patients for clinic at each recruitment site. Using the list of patients for clinic at recruitment sites, a systematic random sampling technique was used with a regular interval of 5 after an initial random selection of the first client. A total of 526 HIV positive patients were assessed for their eligibility out of which 140 were excluded. Reasons for exclusion included 56 patients who did not meet inclusion criteria (50 children and 6 mentally unfit) and 60 patients who declined consent. Twenty four others excluded for other reasons included 20 patients who intended to transfer out to other ART care clinics outside Yola (the study area) and 4 pregnant women who expected to give birth during the period of the research and believed that their deliveries may affect compliance with the study protocol. Eligible patients who gave their consent were randomized and blinded (Figure 1).

Data collection

A validated and pretested questionnaire was employed as the data collection tool. Questionnaires were interviewer administered and baseline data was obtained from all 386 respondents. The questionnaire was a modified version of those used by Carey, Morrison and Johnson (HIV knowledge and prevention) in 1997 (Carey et al., 1997), Misovich, Fisher and Fisher (A measure of AIDS prevention information, motivation, behavioural skills and behaviour) in 1998 (Misovich et al., 1998) and the AIDSCAPS/WHO/CAPS Counselling an Testing Efficacy study: C and T Baseline instrument of 1995 (AIDSCAPS, 1995). It consisted of 5 sections; Section 1 on socio-demographic variables, Section 2 consisted of questions on the knowledge of HIV transmission and prevention and had a total of 17 statements and answers that had the options of ‘yes’, ‘no’ and ‘don’t know’. Section 3 consisted of 5 statements to address patient’s attitude towards HIV/AIDS. Answer options to these questions were from a 5 point Likert scale ranging from strongly agree, agree, don’t know, disagree and strongly disagree. Section 4**;** addressed sexual behaviour patterns and section 5 addressed issues of status disclosure. The questionnaire was reviewed by a panel of experts who gave a consensus that existing items in the questionnaire were valid and measured knowledge on HIV transmission and prevention, attitudes of ART patients to HIV/AIDS, sexual behaviour and status disclosure. Reliability test for knowledge gave a Cronbach’s alpha of 0.811and that of attitude gave a Cronbach’s alpha of 0.761.

Sample size

The sample size was calculated using the formula by Lemeshow et al. (1990). The largest sample size was obtained for the outcome variable of attitude towards HIV/AIDS, taking into account 10% for attrition the final sample size used was 386.

$$n = \frac{\{z_{1-\alpha/2}\sqrt{2\bar{P}(1-\bar{P})} + z_{1-\beta}\sqrt{P_1(1-P_1)+P_2(1-P_2)}\}^2}{(P_1-P_2)^2}$$

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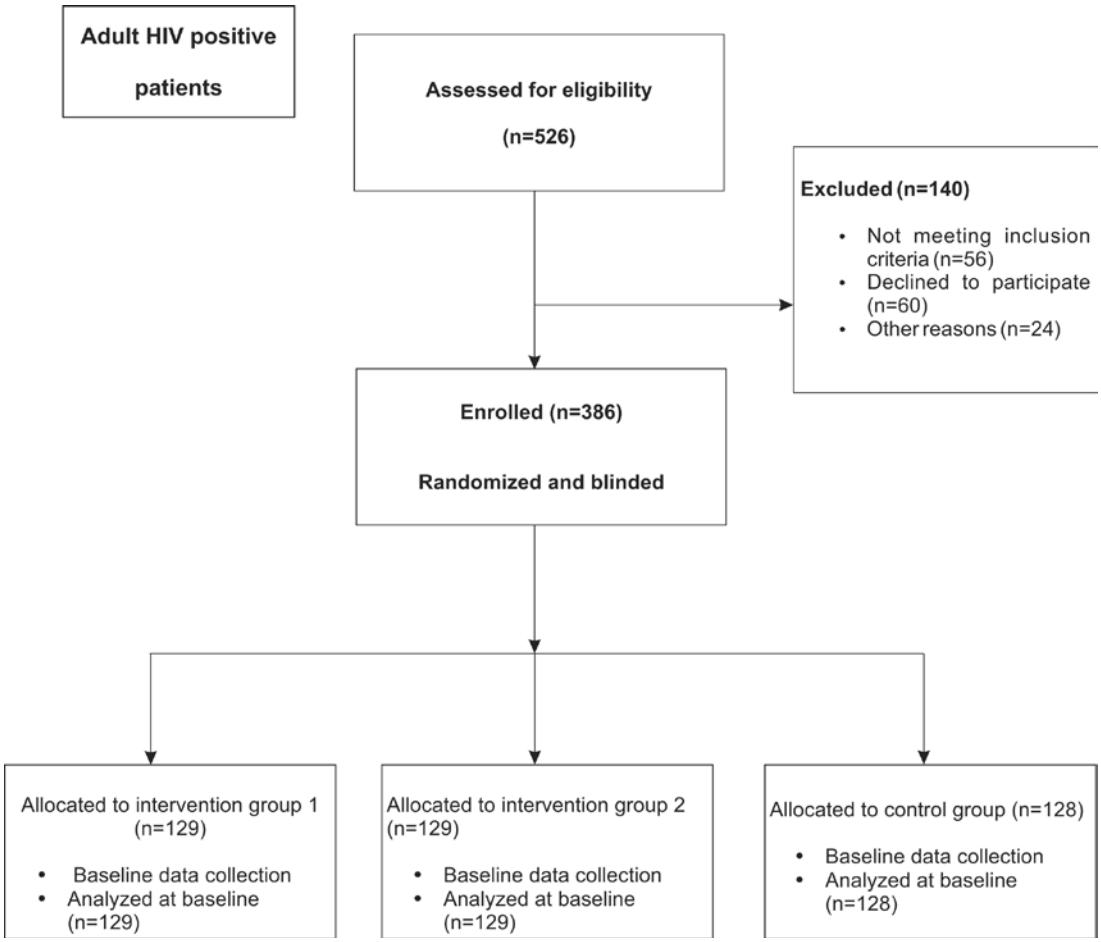

Figure 1. Flow diagram of patient participants in a randomized clinical trial conducted among HIV positive patient in the 4 comprehensive ART sites in Yola Nigeria.

Definition of terms

An adult HIV patient in this study was a person ≥ 18 years of age, reactive to HIV antibody in his or her serum.

Sound knowledge

An HIV positive client who responded correctly to 2 specific questions on HIV prevention; "that consistent condom use can reduce risk of contracting HIV" and "having sex with more than one partner can increase the risk of contracting HIV" (context adjusted from the original statement "having sex with one faithful HIV sero-negative partner can reduce a persons' chance of getting infected with HIV"). And 2 specific questions on incorrect beliefs of HIV transmission; "that HIV can spread by mosquitoes" and "that a person with HIV can look and feel healthy" (BSS, 2000). A correct response to all 4 questions was considered sound knowledge.

Not sound knowledge

An HIV positive client who did not responds correctly to 2 specific questions on HIV prevention; 'that consistent condom use can reduce risk of contracting HIV' and 'having sex with more than one partner can increase the risk of contracting HIV'. And 2 specific questions on incorrect beliefs of HIV transmission; 'that HIV can spread by mosquitoes' and 'that a person with HIV can look and feel healthy'.

High attitude

An HIV positive client that scored 16 to 25 on the attitudinal scale was considered to have a high attitude towards HIV/AIDS.

Low attitude

An HIV positive client that scored 5 to 15 on the attitudinal scale was considered to have a low attitude towards HIV/AIDS.

Ethical clearance

Ethical approval was obtained from the University Human Research Ethics Committee of the Faculty of Medicine and Health Sciences University of Putra Malaysia before conducting the study. Ethical clearance was also obtained from the Health Research Ethics Committee of Federal Medical Centre Yola Nigeria. A written and signed informed consent was obtained from each participant. This written consent was made available in English, Hausa and Fulani (Hausa and Fulani being the two major native languages in Yola).

Data analysis

Data was analyzed using SPSS version 22. A correct response to a knowledge statement earned a mark of 1 and an incorrect response 0. For the 5 point Lickert scale used, ranging from strongly disagree to strongly agree, a mark of 1 was awarded for strongly disagree, 2 for disagree, 3 for neutral, 4 for agree and 5 for strongly agree. All scores were added to give aggregate score. Test of significance was at α level 0.05. Primary outcome variables were sound/not sound knowledge on HIV transmission and prevention and high/low attitudes towards HIV/AIDS.

RESULTS

Socio-demographic characteristics of respondents

Of the 386 patient, 106 (27.5%) were male and 280 (72.5%) female. Most 150 (38.9%) respondents were between the ages of 30 to 39 years. The largest indigenous tribe was the Bwatiye tribe consisting in total 70 (20.5%) of respondents. Two hundred and ninety six (76.9%) were from Adamawa state in Nigeria. Majority were married 207 (53.6%). One hundred and thirty three (34.5%) had attained tertiary education while 40(10.4%) had no form of education; formal or otherwise. Civil servants (government employed) made up 102 (26.4%) of all occupations but 86 (22.3%) were neither gainfully employed nor involved in self financial generating activities. Most respondents; 207 (53.9%) had known about their HIV status for less than 36 months (< 3 years) with 377 (97.7%) already on highly active antiretroviral therapy (HAART) (Table 1).

Knowledge on HIV/AIDS and attitudes towards HIV/AIDS

Tables 2 and 3 show frequencies of respondents' responses to knowledge and attitude statements. Overall 237 (61.4%) and 149 (38.6%) of respondents had sound knowledge and not sound knowledge on HIV transmission and prevention respectively. Three hundred and forty six respondents (89.6%) had a high attitude towards HIV/AIDS while 40 (10.4%) had low attitudes towards HIV/AIDS. No statistical significant difference was seen for knowledge and attitudes among the 3 study groups (Table 4).

DISCUSSION

Sound knowledge of HIV transmission and prevention among PLWHAs

At baseline, more than half (61.4%) of the respondents had sound knowledge on HIV transmission and prevention with 149 (38.6%) not having sound knowledge. The findings of this research are higher than that seen in the country's National Reproductive Health Survey, were it was noted that correct knowledge on all routes of possible transmission and methods of prevention had remained low (54% and 52.5% respectively) (NARHS, 2007). In a Study carried out in North central Nigeria among 318 PLWHAs receiving care at a treatment clinic with similar socio-demographic characteristics as respondents in this research, a higher knowledge on possible means of transmission and prevention of HIV was seen. The study reported that overall; 77.7% of respondents had good knowledge on HIV and AIDS of which 82.1% of these respondents agreed that proper condom use could be protective against HIV/AIDS, 81.1% answered correctly that unprotected sexual intercourse between a man and a woman could result in transmission of HIV infection while 83.0% answered correctly that having sex with multiple sexual partners could increase the risk of getting infected with HIV (Olowookere et al., 2012). Proportions of good knowledge reported in this study are higher than that seen in this research; 237 (61.4%). However regarding that condoms could be protective against HIV, a higher proportion (88.1%) of a correct response to this statement was seen in this research.

In a study conducted in Maiduguri (northeast Nigeria) to assess the knowledge, attitude and perceptions of 185 people living with HIV/AIDS towards HIV/AIDS, 78% of respondents had good knowledge on the cause of HIV and 90% had good knowledge on the means by which HIV could be transmitted. Still in this study a low proportion (5 to 29%) of respondents believed that HIV/AIDS could spread via handshakes, use of public toilet seats, coughing and sneezing and also by mosquito bites (Ajayi et al., 2013). Similar levels of misconception were reported in this research with 47 (12.2%) of respondents believing that HIV could spread by coughing and sneezing while 80 (20.7%) believed that HIV could spread by mosquitoes.

An intervention study to improve condom use among HIV positive individuals in southeast Nigeria showed at baseline that 39.7% of respondents were aware of the risk of HIV spread via unprotected sex (Obi et al., 2009). This level of knowledge on condom use during sex to prevent spread of HIV is relatively lower than the findings of this research; 340 (88.1%).

A gender based study conducted among women living with HIV in Southwest Nigeria again showed good knowledge on HIV transmission. Reports in this study showed 90.2% of respondent were aware that HIV could spread through unprotected intercourse (Joda et al., 2011). Though a gender based study a comparison to this research is done as most respondents in this research were female. Still in Africa, studies have been conducted to determine HIV knowledge among HIV positive individuals. One of such study was that carried out in Gondar University in North West Ethiopia to determine knowledge, attitudes and determinants of condom use among people living with HIV/AIDS. On

Table 1. Socio-demographic characteristics of adult ART patients by groups.

Variables	Frequency, n (%)			Total	p-value
	Intervention 1	Intervention 2	Control group		
Age group (years)					
≤30	29 (22.5)	26 (20.2)	33 (25.8)	88 (22.8)	
30-39	47 (36.4)	62 (48.1)	41 (32.0)	150 (38.9)	
40-49	40 (31.0)	25 (19.4)	39 (30.5)	104 (26.9)	0.217
50-59	11 (8.5)	12 (9.3)	13 (10.2)	36 (9.3)	
≥60	2(1.6)	2 (1.6)	4 (3.1)	8(2.1)	
Total	129(100.0)	129(100.0)	128(100.0)	386(100.0)	
Mean, SD	37.47 (9.45)	37.12 (9.76)	37.07 (10.02)	37.22(9.72)	0.938
95% CI	(35.82-39.12)	(35.42-38.82)	(35.32-38.82)	(36.24-38.19)	
Gender					
Male	38(29.5)	32(24.8)	36(28.1)	106(27.5)	0.690
Female	91(70.5)	97(75.2)	92(71.9)	280(72.5)	
Total	129(100.0)	129(100.0)	128(100.0)	386(100.0)	
Occupation					
None	18(14.0)	34(26.4)	34(26.6)	86(22.3)	
Student	6(4.7)	9(7.0)	7(5.5)	22(5.7)	
Civil servant	39(30.2)	29(22.5)	34(26.6)	102(26.4)	
Business	34(26.4)	30(23.3)	27(21.1)	91(23.6)	0.284
Farming	9(7.0)	9(7.0)	8(6.3)	26(6.7)	
Applicant	2(1.6)	1(0.8)	5(3.9)	8(2.1)	
retired CS	4(3.1)	3(2.3)	0(0.0)	7(1.8)	
Others	17(13.2)	14(10.9)	13(10.2)	44(11.4)	
Total	129(100.0)	129(100.0)	128(100.0)	386(100.0)	
Marital status					
Single	25(19.4)	19(14.7)	30(23.4)	74(19.2)	
Married	66(51.2)	75(58.1)	66(51.6)	207(53.6)	
Divorced	9(7.0)	12(9.3)	7(5.5)	28(7.3)	0.591
Separated	5(3.9)	4(3.1)	2(1.6)	11(2.8)	
Widowed	24(18.6)	19(14.7)	23(18.0)	66(17.1)	
Total	129(100.0)	129(100.0)	128(100.0)	386(100.0)	

p value calculated using Chi square test (X^2) for categorized variables, One way ANOVA (*F*) used to calculated p value for age as a continuous variable, *significant at $p < 0.05$.

knowledge of use of condoms in respect to HIV prevention and transmission 86.8% of the respondents answered correctly that condoms will prevent spread of HIV/AIDS, while 84.9% also answered correctly that correct use of condoms will reduce peoples' chances of getting HIV (Kafale and Kafale 2013). Though close in proportions to the findings of this research, these reported proportions of correct responses are lower than those seen in this research.

A study conducted among PLWHAs in Mozambique showed high levels of HIV prevention knowledge with 75% of respondent acknowledging that HIV could be prevented by abstinence (Dokubo et al., 2014). In the same study 89 and 86% had the knowledge that having a single sexual partner and using condoms during sexual intercourse could prevent transmission of HIV respectively (Dokubo et al., 2014). These reported proportions are lower than that seen in this research. In this research 360 (93%) of respondents responded correctly to the fact that having sex with more than one partner could increase one's chance of being infected with HIV while 340 (88.1%) acknowledged that using a condom could lower someone's chance of getting HIV.

In a study carried out in rural Kenya to determine the level of HIV transmission knowledge between HIV positive and HIV negative individuals; knowledge of

Table 2. Knowledge on HIV transmission and prevention and of ART patients.

Variable	Yes (%)	No (%)	Don't know (%)
HIV and AIDS are same thing	51 (13.2)	270 (69.9)	65 (16.8)
There is a cure for AIDS	58 (15.0)	291 (75.4)	37 (9.6)
Coughing and sneezing spread HIV	47 (12.2)	301 (78.0)	38 (9.8)
HIV can be spread by mosquitoes	80 (20.7)	279 (72.3)	27 (7.0)
Eating healthy food can keep a person from getting HIV	45 (11.7)	327 (84.7)	14 (3.6)
Bathing or washing one's genitals after sex can keep a person from getting HIV	24 (6.2)	326 (84.5)	36 (9.3)
A pregnant woman with HIV can give the virus to her unborn child	295 (76.4)	64 (16.6)	27 (7.00)
All pregnant women infected with HIV will have babies born with AIDS	60 (15.5)	288 (74.6)	38 (9.8)
Using a condom can lower a person's chance of getting HIV	340 (88.1)	29 (7.5)	17 (4.4)
A person with HIV can look and feel healthy	374 (96.9)	9 (2.3)	3 (0.8)
There is a vaccine for HIV	60 (15.5)	263 (68.1)	63 (16.3)
A person can get HIV by donating blood	91 (23.6)	283 (73.3)	12 (3.1)
Having sex with more than one partner can increase a person's chance of being infected with HIV	360 (93.3)	19 (4.9)	7 (1.8)
A woman can get HIV if she has vaginal sex with a man who has HIV	377 (97.7)	4 (1.0)	5 (1.3)
A woman can get HIV if she has anal sex with a man who has HIV	227 (58.8)	35 (9.1)	124 (32.1)
Having a HIV test one week after having sex will tell if a person has HIV or not	58 (15.0)	270 (969.9)	58 (15.0)
Sharing a needle or razor blade with a person with HIV/AIDS can increase a person's chance of being infected with HIV	372 (96.4)	12 (3.1)	2 (0.5)

sexual transmission was high (> 80%), while knowledge on HIV prevention was lower with only 40% of HIV positive respondents correctly responding falsely to the statement “condoms makes intercourse completely safe” (Hong et at., 2012). Similar high proportions of knowledge of HIV sexual transmission were seen in this study with 377 (97.7%) of respondents correctly responding to the statement that “A woman can get HIV if she has vaginal sex with a man who has HIV” and 360 (93.3%) acknowledging correctly that having sex with more than one partner can increase a person's chance of being infected with HIV.

Attitudes towards HIV/AIDS among PLWHAs

At baseline majority 346 (89.6%) of respondents (10.4%) of respondents had low attitudes towards HIV/AIDS. A factor contributing to these high attitudes towards their disease could be that most respondents in this study had known about their HIV status for quite some time and had come to terms with it. Another factor is that majority were on antiretrovirals (ARVs) and doing well on their medications. High attitudes towards HIV/AIDS among PLWHAs were seen in the study conducted by Olowookere and his group. In his study majority of respondents had a positive attitude to their disease with 84.0% believing that a person with HIV/AIDS had hope for a better future. Also in his study 83.0% believed that having HIV was not the end of someone’s life and another 63.5% believing that it was not shameful to have HIV/AIDS (Olowookere et al 2012).

Similar high attitudes towards HIV/AIDS were seen in this research. In this research 219 (56.7%) and 54 (14.0%) strongly agreed and agreed respectively that being HIV positive was not the end of one’s life, while 149 (38.6%) and 152 (39.4%) disagreed and strongly disagreed respectively that it was shame to have HIV/AIDS. Similarly the study conducted by Ajayi et al. (2003) among PLWHAs showed a positive attitude towards HIV/AIDS with 63.0% of respondents responding affirmatively that they were living positively with their disease. But among this group of PLWHAs, 21.0% admitted that they would not mind passing on their infection to others (Ajayi et al., 2013).

Though not in exact same context; 12 (3.1%) and 35(9.1%) of respondents in this research disagreed and strongly disagreed respectively that a HIV positive person who decided to have sex should always use a condom. Lower attitudes towards their disease were seen among PLWHAs

Table 3. Attitudes of ART patients to HIV/AIDS.

Statement	Strongly agree (%)	Agree (%)	Don't know (%)	Disagree (%)	Strongly disagree (%)	Total
Being HIV positive is not the end of one's life	219(56.7)	54(14.0)	8(2.1)	48(12.4)	57 (14.8)	100 (100.0)
It is shame to have HIV/AIDS	23(6.0)	55(14.2)	7(1.8)	149(38.6)	152 (39.4)	386 (100.0)
If a HIV/AIDS positive person wants to have sex he or she should always talk about safe sex with his or her partner	205(53.1)	115(29.8)	19(4.9)	115(2.6)	37 (9.6)	386 (100.0)
A HIV positive person who decides to have sex should always use a condom	250(64.8)	79(20.5)	10(2.6)	12(3.1)	35 (9.1)	386 (100.0)
A sexual/spouse of HIV positive person should get tested to know his/her HIV status	296(76.7)	56(14.5)	2(0.5)	6(1.6)	26 (6.7)	386 (100.0)

Table 4. Knowledge (sound or not sound) and attitude (high or low) among groups.

Variables	Frequency, n=386 (%)			Total	Test	p-value
	Interventio 1	Intervention 2	Control group			
Sound knowledge						
No	47 (36.4)	56 (43.4)	46 (35.9)	149 (38.6)	X^2	0.387
Yes	82 (63.6)	73 (56.6)	82 (64.1)	237 (61.4)		
Total	129 (100.0)	129 (100.0)	128 (100.0)	386 (100.0)		
Attitude						
Low Attitude	16 (12.4)	10 (7.8)	14 (10.9)	40 (10.4)	X^2	0.456
High Attitude	113 (87.6)	119 (92.2)	114 (89.1)	346 (89.6)		
Total	129 (100.0)	129 (100.0)	128 (100.0)	386 (100.0)		

Chi square test (X^2), Significant at $p < 0.05$.

in a rural community in Southern Nigeria, where 52% of respondent admitted to feeling bad at the time of their diagnosis with 14% actually feeling like killing themselves and 12% feeling ashamed (Udiminue and Adindu, 2012). In this research similar proportions of low attitudes were seen with 23 (6%) strongly agreeing and 55 (14.2%) agreeing that it was shameful to have HIV/AIDS." Though findings of this study showed that majority of respondents had sound knowledge on HIV transmission and prevention as well as high attitudes towards HIV/AIDS, interventions to improve knowledge and attitudes among this group of individuals would help improve positive preventive strategies.

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Conflicts of interest

Authors declare that there is no competing interest.

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Full Length Research Paper

Assessment of use of lavender lotion as repellent for protection against sand fly bites in endemic area with visceral leishmaniasis in Eastern Sudan

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This study was an epidemiological study regarding the prevalence of visceral leishmaniaisis among first year students (as new comers) in Gadarif University, Eastern of Sudan, in 2013. It was conducted to evaluate the use, efficacy and comfortability of the use of commercial lavender lotion as vector control tool among group of 10 students from first year (5 male and 5 female). Health education regarding use of repellents and sand flies was put into operation in the end of the rainy season before the start of the study. The repellents used in this study were commercial lavender lotion which was made from the essential oil extracted from the fresh flowers of the lavender plant, also known as insect repellent. The field evaluation showed protection up to mean time for 7 h and 40 min against the species. Application of commercial lavender lotion can be safe and low-cost means of personal protection against sand fly bites in endemic areas of Gadarif, if the community is advised and encouraged to use it. Significant correlations between post leishmanin skin test results and using of repellents has been reported (p = 0.001).

Key words: Lavender lotion, Gadarif State, repellents, *Phlebotomus orientalis*, leishmaniasis, vector, epidemiology, efficacy.

INTRODUCTION

Leishmaniasis is a disease caused by protozoan parasites of the genus Leishmania. The genus Leishmania is divided into two subgenera on the basis of the development in the sand fly vector (TDR, 2005). Members of the genus Leishmania are polymorphic and are present in two forms: the amastigote form which shows a round to oval body without free flagellum, and the promastigote which is longer than the amastigote, with a central nucleus, anterior kinetoplast and a well-developed flagellum (El-Hassan and Zijlstra, 2001). Leishmaniasis is transmitted by sand flies, members of the Phylum Arthropoda and belong to the class Insecta. This class is the largest group of animals with respect to the number of species (~773,000) or individuals. Animals as reservoirs of infection includes dogs, monkeys, and ponies. It was also found that other animals such as hyenas and jackals could not be ruled out as potential reservoirs (TDR, 2005). Man-biting sand flies pose a

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threat to humans in different parts of the world by serving as vectors of sand fly fever, bartenollosis and Leishmaniasis (Gorgina, 2007). The last, existing in two broad categories (cutaneous and visceral Leishmaniasis), is the most widespread and serious disease in tropical and subtropical regions of the world. The disease was diagnosed for the first time in Sudan in an 8 years old boy, from Meshra-er-Req in Bahr-el-Ghazal district, southern Sudan in 1904 (University of Glasgow Archives, 1996). In subsequent years several tens of cases including 2 British officials, were reported from the east of the country in the area extending from Senar to Kassala and the borders of Ethiopia (Rolleston, 2004).

The first epidemic was documented in 1940 with a death rate of 80%. From the beginning of 1984, an epidemic (unrecognized until 1988) devastated the Western part of Upper Nile state, ultimately causing around 100,000 deaths in a population of 280,000 over a 10-year period (University of Glasgow Archives, 1996). Passive case-detection data on kala-azar in Southern Sudan, collected by the World Health Organization (WHO) since 1989, indicated a cyclic pattern of kala-azar with considerable variation in the caseload from one year to another (El-Hassan and Zijlstra, 2001). Recurrent outbreaks of visceral leishmaniasis have been reported in Southern Sudan, with 6363 cases and 303 deaths (case fatality rate of 4.7%) recorded since outbreaks began in September, 2009. The number of cases was more than six times higher than the same period starting in 2007 (758 cases) and 2008 (582 cases). Most affected patients were children aged less than 15 years (70%). There are over 1,680 patients currently undergoing treatment in various local health facilities in the greater Upper Nile region (WHO, 2010).

Currently, the disease is confined in the state of Gedarif in East Sudan, with some sporadic cases in Kassala, Blue Nile and Senar State (Federal Ministry of Health, 2009). The control of phlebotomine sand flies (Diptera: Psychodidae), the vectors of leishmaniasis, is directed mostly against adults as larvae develop in unknown or inaccessible habitats. Depending on application techniques, timing and target species. Sandflies are known to be highly susceptible to insecticides (Theodor and Mesghali, 1964).

In Sudan, most leishmaniasis transmission appears to be extradomicilliary as in the rest of Eastern Africa, where the conventional malaria vector control tools such as long lasting insecticide treated nets (LLITNs) and indoor residual sprayings (IRSs) may be less important. With no effective means of sand fly control for exophagic and exophilic species so far in Sudan or elsewhere, the first line of defense for individuals might be the personal use of insect repellents. Use of natural or synthetic repellents, or protective clothing, may be the only preventive measures available to reduce man–vector contact in these situations (Siddig et al., 1990).

Leishmaniasis transmission is intradomicilliary and control tools such as LLITNs and/or IRS might be in place. Repellents may still be more advantageous as most sandflies bite early (before bed time). It has been shown that use of a combination of nets and repellents greatly reduces malaria infection. Similar effects could be expected with leishmaniasis. Diethyl-3 methylbenzamide (DEET) is one of the best and most widely used synthetic insect repellent developed and has been the gold standard for public use, emergencies and military operations (Banũls et al., 1999)

However, although DEET and other synthetic repellents are effective, cost is too high for daily use within poor communities in tropical Africa. Moreover, DEET is not always ideal, as few cases of side effects have been reported (WHO, 1990). For these reasons, new compounds are being screened continuously for their repellent actions. Lavender is a plant with aromatic leaves and flowers that is a member of the mint family. Oil from the flowers has been used in some cultures to treat certain medical problems, to keep insects away, and to wash in. It is also used in aromatherapy. Perillyl alcohol, a substance found in lavender, is being studied in cancer prevention and treatment. The scientific name is Lavandula angustifolia (National Institute of health, National Cancer Institute, 2010).

MATERIALS AND METHODS

Study design

This is a community based-experimental study, among first year students in University of Gadarif, Sudan, 2013.

Study area

Gadarif state is situated in the Eastern part of the Sudan 413 km from Khartoum, between longitudes 34 and 36 East, and latitudes 12 and 17 North.

Study population

Ten students in the age group 15 to 25 years of age from first year, coming from outside the study area and with no history of Leishmaniasis were voluntarily recruited to participate in the experiment and were given appropriate training.

Data collection

A questionnaire was designed to collect information needed in the study. It consisted of dependent variables as duration of using repellent, sleeping habits and so on and independent variables such as sex, ages and comfortable in using repellents.

Repellents

The repellent used in this study was commercial lavender lotion which was made from the essential oil extracted from the fresh flowers of the lavender plant by steam distillation and yielded 1.4 to 1.6%. The main chemical composition of lavender oil are a-pinene, limonene, 1, 8-cineole, cis-ocimene, trans-ocimene, 3-octanone, camphor, linalool, linalyl acetate, caryophyllene, terpinen-4-ol and lavendulyl acetate. Two packages consisting of 48 refills were given to each student. The

Table 1. Total of sand flies landed/night/five volunteers.

Time/pm	Total of sand flies landed/night/five volunteers					
	First day	Second day	Third day	Fourth day	Fifth day	Total
18:00–19:00	0	0	0	0	0	0
19:00–20:00	0	0	0	0	0	0
20:00–21:00	0	0	0	0	0	0
21:00–22:00	0	0	0	0	0	0
22:00–23:00	0	1	0	0	0	1
23:00–24:00	0	0	0	0	1	1
24:00–01:00	0	0	0	0	0	0
01:00–02:00	1	0	0	0	0	1
02:00–03:00	0	6	2	3	3	14
03:00–04:00	0	5	1	0	5	11
04:00–05:00	1	13	5	6	1	26
Total sand flies landed/five volunteers	2	25	8	9	10	54

Table 2. Students evaluation for the use of lavender lotion.

Parameter	Duration of using the repellants	Is the use of repellants is comfortable?
Correlation coefficient	1.000	0.719(**)
Sig. (2-tailed)	.	0.001
N	10	10

duration of the study was 5 days then the mean was calculated. The volunteers applied the lotion on arms and legs, then exposed the whole nights (18:00 to 05:00) and collected sand flies landing on the arms and legs (with about 5 to 10 min break each hour) using aspirator and small test tubes.

Night visits

Three night visits to student's settlements were done by the team to ensure that the students were applying the repellents properly and collecting the sand flies.

RESULTS

The results showed full protection for up to 4 h, extended to a mean time of 7 h, and 20 to 40 min with less protection. Most of the members in the study said the use of the lotion was comfortable

DISCUSSION

The repellent activities of lavender lotion evaluated against sand fly in the field conditions show full protection for up to 4 hours, extended to a mean time of 7 h, and 20 to 40 min with less protection (Table 1). In fact there are no much studies conducted to evaluate the effectiveness of lavender lotion or lavender oil as personal protection methods against sand fly, but some studies conducted to evaluate the efficacy of neem (*Azadirachta indica* A. Juss.) and Chinaberry (*Melia azedarach*) linseed oils as repellents against laboratory and field populations of some sand flies in Ethiopia, 2009, provided protection up to a mean time of 7 h and 20 min (Kebede et al., 2010). Another study conducted in town of Ma'ale Adumim situated approximately 10 km east of Jerusalem in the Judean Desert of Palestine in 2008, evaluated the efficacy of geraniol, a natural plant-derived product, as a space repellent and the synthetic pyrethroid prallethrin as a diffusible insecticide to control phlebotomine sandflies (Diptera: Psychodidae), the vectors of Leishmaniasis revealed that geraniol proved ineffective in preventing sandflies from feeding (Sirak-Wizeman et al., 2008). Only one study used lavender oil in compound with eucalyptus oil done as field trial in 2012 in Bundaberg, Queensland in tidal mangrove forest against natural population of sand fly (*Culicoides* spp). The target pest was coastal sand flies in their natural habitat. The time of each landings and bite post-application was recorded for each individual bite up to 10 bites per body part per person. This study demonstrated an effective control against sand fly (Sirak-Wizeman et al., 2008; Ridley et al., 2012). Most of the members in the study said the use of the lotion was comfortable with P value = 0.003 and no itching or unpleasant smell (Table 2).

Our study revealed that there was significant relationship between gender and the use of the lotion that

Table 3. Evaluation for the use of lavender lotion and gender.

Gender	Sum of squares	Difference	F	Significance	95% Confidence interval of the difference	
					Lower	Upper
Male	5	4				
Female	5	4	6.862	0.001	2.6082	3.0220
Total	10	8				

Dependent variable: Duration of using the repellants.

all females were satisfied on the use of the lotion with P value = 0.001 (Table 3).

RECOMMENDATIONS

1. National Fund for the student's welfare in collaboration with National program for Leishmaniasis Eradication must provide repellents and other preventive measures.
2. Establishment of health education program addressing leishmaniasis control and prevention in community base in Gadarif State.

ETHICAL CONSIDERATIONS

Regarding the ethical consideration, agreement was obtained from Gadaref University, Ministry of Health, and National Program for Leishmaniasis Eradication and the Students involved in the study.

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Conflict of interest

Authors have none to declare.

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