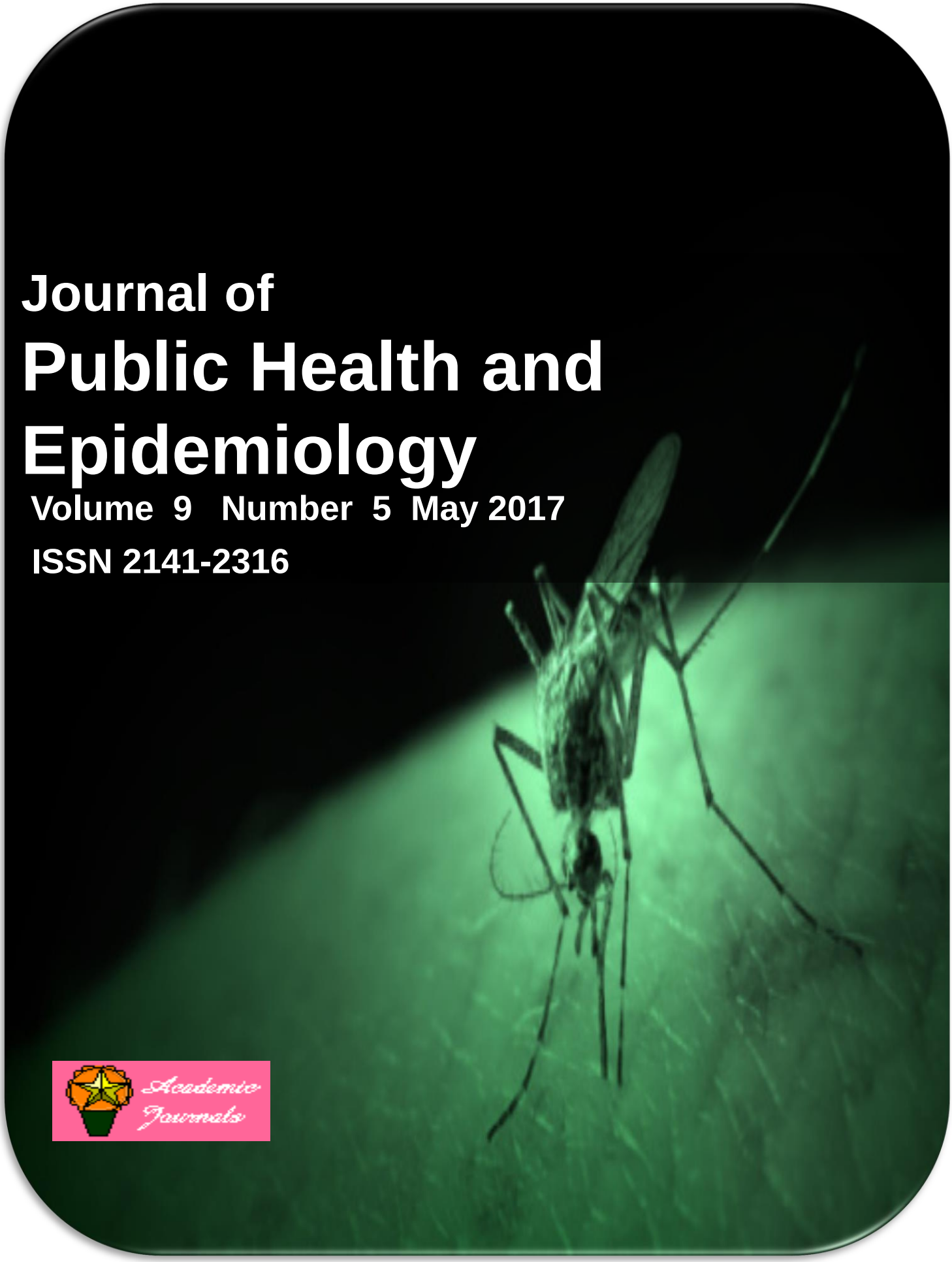

Journal of Public Health and Epidemiology

Volume 9 Number 5 May 2017

ISSN 2141-2316

Academic Journals

ABOUT JPHE

The **Journal of Public Health and Epidemiology (JPHE)** is published monthly (one volume per year) by Academic Journals.

Journal of Public Health and Epidemiology (JPHE) is an open access journal that provides rapid publication (monthly) of articles in all areas of the subject such as health observatory, biostatistics, occupational health, behavioral medicine etc. The Journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence. Papers will be published shortly after acceptance. All articles published in JPHE are peer-reviewed.

Contact Us

Editorial Office: jphe@academicjournals.org

Help Desk: helpdesk@academicjournals.org

Website: http://www.academicjournals.org/journal/JPHE

Submit manuscript online http://ms.academicjournals.me/

Editors

Professor Mostafa A. Abolfotouh
Professor of Family & Community Medicine
Head of Medical Team - Biobanking Section.
King Abdullah International Medical Research CEnter, King Saud Bin-Abdulaziz University for Health Sciences, National Guard Health Affairs, Saudi Arabia

Editorial Board

Journal of Public Health and Epidemiology

Table of Content: Volume 9 Number 5 May 2017

ARTICLES

academicJournals

Vol. 9(5), pp. 99-105, May 2017
DOI: 10.5897/JPHE2016.0882
Article Number: 990EF4E63787
ISSN 2141-2316

http://www.academicjournals.org/JPHE

Journal of Public Health and Epidemiology

Full Length Research Paper

A 14 year review of neonatal tetanus at Ahmadu Bello University Teaching Hospital, Zaria, Northwest Nigeria

Alhaji A. Aliyu*, Isa Abdulkadir, Lawal Amadu and Tukur Dahiru.

Department of Community Medicine and Paediatrics, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.

Received 8 October, 2016; Accepted 20 February, 2017

Neonatal tetanus (NNT) is still one of the major preventable causes of neonatal death in Nigeria. It is a disease of poverty, adverse social and environmental conditions. The aim of the study was to review neonatal tetanus cases, determine the prevalence, disease outcome and what possible interventions can be done in the study area to reduce its prevalence. This was a retrospective study of cases of NNT seen in Special Care Baby Unit of Ahmadu Bello University Teaching Hospital, Zaria, Nigeria from 2001 to 2014. Case notes of neonates with clinical diagnosis of tetanus who were admitted into the unit were retrieved for analysis. Data extracted included: socio-demographic characteristics, antenatal clinic (ANC) history, TT immunization, place of delivery and disease outcome. There were a total of 60 cases of NNT during the period; this gave an annual prevalence of 4.3 per year. Mean age of neonates was 9.3 ± 5.1 days, M: F ratio was 4.0:1.0. Mean age of mothers was 23.2 ± 4.0 years, majority (55%) had no formal education, 48% had ≤ 2 ANC visits, and more than 70% had no TT immunization and delivered at home. Commonest probable portal of entry of infection was umbilicus (70%) and major presenting symptoms/signs were: spasms (81.7%), poor suckling (81.7%), inability to open mouth (45%) and fever 45%, respectively. Site of infection and presence of fever were associated poor outcome. Mortality among neonates who had short incubation period (≤ 6 days), umbilicus as probable site of infection (P=0.006) and presence of fever (P=0.014) were significantly higher for non-survivors than survivors. Overall, case fatality rate (CFR) was 56.7%. The review revealed that CFR is still unacceptably high for a disease that can be prevented and eventually eliminated with cost effective and affordable public health interventions. All the 3 tiers of government need to re-focus the National Immunization Policy together with sustained immunization programmes throughout all the communities in Nigeria. There is urgent need for health education at community level on the importance of ANC and mass immunization regardless of age in order to achieve the goal of NNT elimination.

Key words: Neonatal tetanus (NNT), immunization, prevention, tertiary hospital, Nigeria.

INTRODUCTION

Tetanus is a disease characterised by muscle rigidity and spasms and was first described in Egypt over 3000 years ago. *Clostridium tetani* that causes tetanus is a ubiquitous strictly anaerobic Gram positive bacillus that is

*Corresponding author. E-mail: alhajimph@gmail.com. Tel: +234 80 237315 66.

present in the soil and in human and animal faeces. It is a disease that is largely now confined to developing countries. Efforts by World Health Organization (WHO) to eradicate the disease by 1995 has not yielded any remarkable success as tetanus still remains one of the world's major preventable causes of mortality with an estimated incidence of 700,000 to 1 million cases a year, causing an estimated 213, 000 death (World Health Organization, 2006; Thwaites and Farrar, 2003). In 1890, Faber discovered tetanus toxin and in the same year, von Berhring and Kitasario produced the first antitoxin. In 1926, Raman performed the first successful vaccination in humans (Catherine and Lam, 2009). Tetanus is a positive environmental hazard and its occurrence depends upon man's physical and ecological surroundings [soil, Agriculture and animal husbandry] and not on the presence or absence of infection in the population. Thus, *C. tetani* will never be eradicated from the soil and so wherever vaccination programmes are ineffective and or inadequate, tetanus will continue to occur. In 2004, an estimated 27 million children did not complete their immunization (World Health Organization, 2006). Neonatal tetanus (NNT) usually arises from contamination of umbilical cord, unhygienic delivery practices, traditional midwifery practices (cutting the umbilical cord with dirty blade, bamboo, applying soil, cow dung, hot fermentation and charcoal or even engine oil to the umbilical stump). Gitta et al. (2006) and Alhaji et al. (2013) Ritual surgery (ear piercing) or circumcision, uvelectomy may also cause infection (Charles, 2004). Another source of infection is otitis media (Catherine and Lam, 2009; Charles, 2004).

Neonatal tetanus [NNT] can be prevented by maternal immunization, yet in 2004, WHO estimated that about 40 million pregnant women were unimmunized (World Health Organization (WHO) (2006). Tetanus elimination needs continuing vaccination programmes because the tetanus spores are widespread in soil and faeces throughout the world. Vaccination is started at two months of age with 3 injections performed at monthly intervals (Cook et al., 2001) and a second injection confers immunity (Ruben et al., 1973) with a third prolonging its duration. A booster dose is given before the age of five years. Immunity is not life long, so revaccination is recommended at 10 year intervals in adulthood. Neonatal immunity is provided by maternal vaccination and transplacental transfer of immunoglobulins. It has been reported that even after maternal immunization, the infant is still at risk of infection as malaria and HIV infections reduce placental transfer of protective antibodies (Brair et al., 1994; de Moraes-Pinto et al., 1996) In Africa, neonates account for up to 40% of the patients admitted to hospital with tetanus in some areas and they tend to have the highest mortality rates. Furthermore, it was reported that mortality rates varied between 0.3/1000 live births in Egypt to 15.0/1000 live births in Somalia (Charles, 2004). The incidence of neonatal tetanus in Nigeria ranges between 14.6 and 20.0 per 1000 live births (Federal Ministry of Health and Human Services (FMOH & HS), Nigeria (1992), it contributes 16% to the global neonatal deaths UNICEF/WHO/UNFPA (2005). Without medical care, mortality from NNT is close to 100% and often exceeding 50% with hospital care (Louise et al., 2014; Roper et al., 2007; Black et al., 2010). Thus, the elimination of maternal and neonatal tetanus is a key area in global public health policy as maternal immunization has resulted in 82% of today's newborn babies being protected from tetanus UNICEF (2013) Most countries in sub-Saharan Africa (SSA) including Nigeria are undergoing demographic transition with a very young population and with more women in reproductive age group Cincotta (2010). Nigeria is still among the countries that is yet to achieve the WHO goal to eliminate neonatal tetanus (defined as; less than one case per 1000 live births in every district of every country) UNICEF/WHO/UNFPA (2005) The study aimed to review neonatal tetanus cases, determine the prevalence, disease outcome and what possible interventions can be done in the study area to decrease its prevalence. The paucity of literature on NNT in the study area also prompted this review.

METHODS

Retrospective study of NNT patients admitted to the Special Baby Care Unit (SBCU), Ahmadu Bello University Teaching Hospital (ABUTH), Zaria over a period of 14 years (2001-2014) was conducted. The teaching hospital was established in 1967 to serve as a referral centre for the former Northern region, located in North western part of Nigeria. Currently, it has 21 clinical departments as well as being centre of excellence in oncology. The medical records (case notes/folders) of all the cases during the period were retrieved and reviewed. Relevant data extracted for this study came from the case notes (folders) of the patients and included socio-demographic characteristics of mothers of patients, age of neonate at the time of admission, focus/site of infection, clinical signs and symptoms at presentation, antenatal care history of mothers, history of tetanus toxoid [TT] immunization of mothers and place of delivery. The criteria for diagnosis was based on clinical findings; muscle spasms, inability to suck, trismus and has been used in previous studies (Bunyamin et al., 2008; Barlow et al., 2001).Data was first entered into Excel then imported into Stata13 for statistical analysis. The data was analysed by generating frequencies of cases against socio-demographic and clinical characteristics and then comparison between survivors and non-survivors. Therefore, we generated frequencies, means, standard deviations, Student's t-test, X^2-test and probit regression model since the sample size is small. This strategy avoids inflated standard errors associated with odds ratio when applying logistic regression. Furthermore, both models provide similar results but the estimates are much inflated in logistic regression as compared to probit regression (Hahn Soyer, 2005). Results are presented using appropriate tables and test of significance was done with p- value at <0.05 taken as significant.

RESULTS

During the period under review, there were a total of 60

Table 1. Socio-demographic characteristics of neonatal tetanus cases in ABUTH from 2001 – 2014 (n = 60).

Socio-demographic profile	Frequency (%)
Age of patient (week)	
1 week	33 (55.0)
2 weeks	21 (35.7)
3 weeks	4 (6.7)
4 weeks	2(3.3)
Mean age: 9.32 ± 5.1 days	
Sex	
Male	48 (80.0)
Female	12 (20.0)
Mother's age (years)	
15 - 19	9 (15.0)
20 - 24	26 (43.3)
25 - 29	19 (31.7)
30-34	5 (8.3)
35 - 39	1 (1.7)
Mean age:	23.2 ±4.0 years
Mother's educational status	
None	33 (55.0)
Primary	10 (16.7)
Secondary	17 (28.3)
Mother's ANC visit	
0	18 (30.0)
2	11 (18.3)
3	10 (16.7)
4	3 (5.0)
5+	18 (30.0)
Mother's tetanus vaccination	
0 dose	43 (71.7)
1 dose	13 (21.7)
3 doses	4 (6.7)
Place of delivery	
Home	46 (76.7)
Health facility	14 (23.3)
Mortality (Case Fatality Rate)	34 (56.7)

Table 2. Distribution of site of infection of neonatal tetanus cases.

Focus of infection	Frequency (%)
Umbilicus	42(70.0)
Uvula	12 (20.0
Genital	2 (3.3)
None	4 (6.7)

Table 3. Distribution of symptoms of neonatal tetanus cases.

Presenting signs	Frequency (%)
Spasm	49 (81.7)
Inability to open mouth	27 (45.0)
Excessive crying	23 (38.3)
Fever	27 (45.0)
Poor sucking	49 81.7)

Multiple responses.

of NNT cases, this gave an annual prevalence of 4.3 per year. Mean age of cases was 9.3 ± 5.1 days, majority (80%) were males with M : F ratio of 4.0:1.0. Mean age of mothers was 23.2 ± 4 years, majority had no formal education (55.0%), 48.0% had ≤ 2 ANC visits, more than 70% had no TT immunization and also delivered at home assisted by relatives in unhygienic environment or traditional birth attendants (TBAs) and only 23.3% delivered at health facility respectively (Table 1). The commonest probable sites of infection among cases were umbilicus 70.0%, uvula 20% and genitals 3.3%, while in 6.7%, no site was identifiable (Table 2). Major presenting symptoms/signs were respectively spasms (81.7%), poor suckling (81.7%), inability to open mouth (45%), fever (45.0%) and excessive crying (38.3%) (Table 3). Table 4 shows comparison of the values of selected variables for survivors and non-survivors; mortality among neonates who had short incubation period (≤ 6 days), umbilicus as probable site of infection (P=0.006) and presence of fever (P=0.014) were significantly higher for non-survivors than survivors. Mortality was not significantly higher with age, mothers' TT status and ANC attendance. Probit regression model was used to determine the effects of mothers' age, age of neonate, ANC attendance, TT immunization status of mothers, etc on mortality (Table 5). The result revealed that route of infection (umbilicus) significantly increases the risk of mortality several folds (six times) while TT immunization was protective. Finally, from a total of 60 cases, 26 (43.3%) survived while 34 cases died, giving an overall case fatality rate (CFR) of 56.7%.

DISCUSSION

The neonatal period is only 28 days, yet accounts for 38% of all deaths in children younger than 5 years of age and globally some three-quarter of neonatal deaths occur in the first week after birth Joy et al., 2005; Zupan and Aahman, 2005). Mortality from NNT still remains high, despite being preventable using affordable and accessible public health measures. There were a total of

Table 4. Clinical and socio-demographic characteristics of survivors and non-survivors.

Variables	Survivors	Deaths	P
Mean age, days (SD)	10.8 (6.3)	8.2 (3.8)	0.973
Males, n (%)	23 (88.5)	25 (73.5)	0.152
Age≤6days, n (%)	4 (15.4)	13 (38.2)	0.052†
TT of mother, n (%)	6 (23.1)	11 (32.4)	0.429
ANC, n (%)	18 (69.2)	21 (61.8)	0.548
Umbilical cord as route of infection, n (%)	23 (88.5)	19 (55.9)	0.006*
Fever, n (%)	7 (26.9)	20 (58.8)	0.014*

†Marginally significant at p≤0.05; * significant at p≤0.05; ^Values are given in percentages and numbers.

Table 5. Probit regression model predicting death from NNT.

Variable	Coefficient	(95%CI)	P
Age of mother			
15-19	1.00	Reference	
20-24	1.91	(-0.28-4.11)	0.088
25-29	3.02	(-0.05-6.09)	0.054
30-39	2.41	(0.18-4.63)	0.034
Age of neonate			
1-6days	1.00	Reference	
7-20days	2.31	(0.07-4.55)	0.043
21days+	1.97	0.10-3.84)	0.038
Sex of neonate			
Male	1.00	Reference	
Female	0.26	(-1.75-2.28)	0.797
Spasms			
No	1.00	Reference	
Yes	-1.42	(-3.72-0.88)	0.225
Can open mouth			
No	1.00	Reference	
Yes	0.07	(-1.46-1.60)	0.930
Excess crying			
No	1.00	Reference	
Yes	-0.67	(-2.39-1.04)	0.441
Fever			
No	1.00	Reference	
Yes	-4.64	(-8.39-0.89)	0.015
Poor sucking			
No	1.00	Reference	
Yes	-0.62	(-3.06-1.82)	0.617
ANC attendance			
No	1.00	Reference	

Table 5. Contd.

Yes	4.20	(0.00-8.39)	0.050
TT immunization of mother			
No	1.00	Reference	
Yes	-3.57	(-7.00-0.14)	0.041
Rout of infection			
Other route	1.00	Reference	
Umbilicus	5.98	(1.10-10.85)	0.016

60 cases over the review period with an annual prevalence of 4.3 per year. This prevalence is still unacceptably high particularly in the 21st century as Nigeria has all the resources needed to meet the WHO maternal and neonatal tetanus elimination by 2005, almost a decade ago.

The results of univariate analyses shows that survival is significantly associated with site of infection (cord) and presence of fever, but is not associated with age, infant's sex, TT immunization of mothers or ANC attendance. The findings relating to ANC and place of delivery (home) are well known and widely accepted. But these factors were not significant in regression model which again showed route of infection (umbilicus) as the most consistent and strongest predictor for non-survival. The most probable explanation for these are that poor home delivery environment as well as harmful traditional cord care practices are all conditions that predispose to cord sepsis and fever. This is consistent with earlier studies (Alhaji et al., 2013; Ambe et al., 2009; Abhulimenhen-Ihoha et al., 2011). The fever may be as a result of sepsis from the infected site and or secondary bacterial infection arising from unhygienic practices which will further worsen the clinical condition of the patients and resulting in high mortality. It is important therefore, for policy makers to promote and encourage hygienic midwifery, umbilical cord care and delivery services.

TT immunization status of mothers was found not to be significant in this study in agreement with previous study (Anita et al., 1998) but in contrast to many local and international studies (Anita et al., 1998; Onalo et al., 2011; Mbarie and Abhulimhen-Iyoha, 2015; Bunyamin et al., 2008). Studies have shown that many factors can potentially confound the protective efficacy of TT which include; ineffective immune response, defective transfer of protective antibodies across the placenta especially among African women (Hlady et al., 1992) and quality problems associated with vaccine production (Anita et al. 1998). Importantly, the erratic power supply coupled with incessant power outrages resulting in inefficient cold chains which is common in Nigeria can reduce the efficacy and potency of vaccine. Thus, to ensure efficiency of vaccines, health care facilities need to be provided with alternative source of power/electricity such as the use of solar panels.

In this study, the umbilicus was identified as the probable portal of entry in two-thirds of cases followed by uvula in a third of cases. This is consistent with report of other studies with local practices of cutting the cord with potentially infectious instruments (Alhaji et al., 2013; Onalo et al., 2011; Mbarie and Abhulimhen-Iyoha, 2015). It is also a traditional practice to perform uvulectomy conducted by "local surgeons" using unsterile tools in the study area (Onalo et al., 2011) on the new born within the first seven days of birth. The continued persistence of these practices will mean persistence of NNT in the study community and indeed Nigeria and thus require urgent sustained public health interventions (health education, community mobilization) on hygienic delivery and post delivery cord care to prevent these practices.

A recent report in Nigeria (National Population Commission (NPC) Nigeria and ICF International 2014) revealed that 61% of pregnant women had ANC, 51% had at least 4 ANC visits, 53% of them had protection against neonatal tetanus and only 36% had health facility delivery respectively. In this study, more than 70% of mothers had no TT immunization and only 48% had at least 2 ANC visits. Added to these factors is the fact that majority of the mothers (70.6%) delivered at home which is in agreement with the report of an earlier study (Joy et al. 2005). Again, the need to make health care accessible and affordable in order to encourage utilization of health care services cannot be over emphasized. This will go along way in reducing neonatal tetanus incidence and mortality not only in the study area but Nigeria as a whole.

The case fatality rate (CFR) of 56.7% reported in this study is comparable to the findings of several studies in Nigeria and elsewhere (Alhaji et al., 2013; Onalo et al., 2011; Ogunlesi et al., 2007; Yaramis and Tas, 2000). Eliminating NNT is possible and achievable in our communities using cost effective public health measures. That is why it is regarded as one of the simplest and most cost effective way to reduce neonatal mortality rate (Joy et al., 2005; Ertem et al., 2004). Immunization of pregnant women or women of childbearing age with 2

doses of TT was estimated to reduce mortality from NNT by 94.0% (Biencave et al., 2010). Thus, all tiers of government need to re-focus the implementation of National Immunization Policy which recommends five doses of TT for women of childbearing age (National Immunization Policy, 2009). Furthermore, there is need for community-wide publicity campaigns on the importance and benefits of ANC for pregnant mothers in order to increase its acceptance and utilization. Health education to TBAs, elderly women who care for pregnant women during delivery and their babies on hygienic practices is of utmost importance.

CONCLUSION AND RECOMMENDATION

Prevention and eventual elimination of NNT in our community is possible if there is political will to harness the resources to use public health measures- intensive, sustained, periodic health education through the mass media on cord care and health facility delivery, mass immunization campaigns starting at the grassroots regardless of age and community mobilization.

Study limitation

There was slightly higher percentage of males than females which may be due to gender bias in care seeking. The findings may also not reflect the true prevalence of the disease in the study area because of “iceberg phenomenon” whereby only the most serious cases are brought to the health facility. As reported by WHO, there is the issue of under-reporting of neonatal tetanus cases which are influenced by performance and reporting artefacts (WHO, 2004). The problem of proper record keeping in this part of the world has to be borne in mind, it is possible some case notes/folders were not captured by us and thus not included in the study.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENT

The authors are grateful to the staff of HMIS Department for their untiring efforts in retrieving the case note/files for data collection.

REFERENCES

Abhulimenhen-Ihoha BI, Ofili A, Ibadin MO (2011). Cord care practices among mothers attending immunization clinic at University of Benin Teaching Hospital, Benin City. Niger. J. Paediatr. 38:104-108.

Anita A, Davies-Adetugbo, Torimoro SEA, Ako-Nai KA (1998). Prognostic factors in neonatal tetanus. Trop. Med. Int. Health 3(1):9-13.

Ambe JP, Bello M, Yahya SJ, Omotara BA (2009). Umbilical cord care practices in Konduga LGA of Borno state, North east Nigeria. Int. J. Trop. Med. P 5.

Alhaji MA, Bello MA, Elechi HA, Akuhwa RT, Bukar FL, Ibrahim HA (2013). A review of Neonatal tetanus in University of Maiduguri Teaching Hospital, North eastern Nigeria. Niger. Med. J. 54(6):398-401.

Barlow JL, Mung’ala-Odera V, Gona J, Newton CRJC (2001). Brain damage after neonatal tetanus in rural Kenyan hospital. Trop. Med. Int. Health 6(4):305-308.

Biencave H, Lawn J, Vandelaer J, Roper M, Cousens S (2010). Tetanus toxoid immunization to reduce mortality from Neonatal tetanus. Int. J. Epidemiol. 39(sppl 1):1102-1109.

Black RE, Cousens S, Johnson HL, Lawn JE, Rudan I, Bassani DG, Eisele T (2010). Global, Regional and National causes of child mortality in 2008: a systematic analysis-The Child Health Epidemiology Reference Group of WHO and UNICEF. Lancet 375(9730):1969-1987.

Brair ME, Brabin BJ, Milligan P, Maxwell S, Hart CA (1994). Reduced transfer of tetanus antibodies with placental Malaria. Lancet 343:208-209.

Bunyamin D, Hakan U, Ebru YK, Taskin T, Ali G, Halal K, Tas MA (2008). Neonatal tetanus in Turkey: what has changed in the last decade. BMC Infect. Dis. 8(1):112.

Catherine LT, Lam MY (2009). Tetanus, In: Gordon C Cook and Alimuddin I Zumla (Eds). Manson’s Tropical Diseases 22nd Edition, China, Saunders Elsevier. pp 1113-1118.

Charles RJC (2004). Tetanus, In Principles of Medicine in Africa (Eldryd Parry, Richard Godfrey, David Mabey and Geoffrey Gill, eds). Cambridge University press UK.

Cincotta R (2010). The future of SSA’s tentative fertility decline. Available at: http://www.newsecuritybeat.org/2010/08/future-of-sub-sahara-africa-tentative:25html.

Cook TM, Protheroe RT, Handel JM (2001). Tetanus: a review of literature. Br. J. Anaesth. 87:477-487

Cvetanovic B (1978). Dynamics of acute bacterial diseases: epidemiological models and their applications in Public Health: part II. Epidemiological models of bacterial diseases. Bull. World Health Org. 1:29.

de Moraes-Pinto MI, Almeida AC, Kenj G (1996). Placental transfer of maternal acquired neonatal IgG immunity in human immunodeficiency virus infection. J. Infect. Dis. 173(5):1077-1084.

Ertem M, Cakmak A, Saka G, Ceylan A (2004). Neonatal tetanus in the South-Eastern region of Turkey: changes in prognostic aspects by better health care. J. Trop. Pediatr. 50:297-300.

Federal Ministry of Health and Human Services (FMOH & HS), Nigeria (1992). Neonatal tetanus. Niger. Bull. Epidemiol. 2:13-16.

Fetuga BM, Ogunlesi TA, Adekanmbi FA (2010). Risk factors for mortality in neonatal tetanus: A 15 year experience in Sagamu, Nigeria. World J. Pediatr. 6:71-75.

Gitta, Sheba N, Wabwire-Mangen F, Kitimbo D, Pariyo G (2006). "Risk factors for neonatal tetanus--Busoga region, Uganda, 2002-2003." MMWR Morb Mortal Wkly Rep. 55(Suppl 1):25-30.

Hahn ED, Soyer R (2005). Probit and Logit Models: differences in Multivariate Realm. J. Royal Stat. Soc. pp. 1-12.

Hlady WG, Bennett JV, Samadi AR, Begum J, Hafez A, Tafdar AI, Boring JR (1992). Neonatal tetanus in Bangladesh: Risk factors and toxoid efficacy. Am. J. Publ. Health 82:1365-1369

Joy EL, Simon C, Jelka Z (2005). 4 million deaths: When? Where? Why? Lancet 365:891-900.

Louise TC, Nicholas JB, Charles RN (2014). Maternal and neonatal tetanus. Lancet 385(9965):662-670.

Mbarie IA, Abhulimhen-Iyoha BI (2015). A 6 year review of Neonatal tetanus at the Stella Obasanjo hospital, Benin City, South south Nigeria. Afr. J. Med. Health Sci.14:52-55.

National Population Commission (NPC) Nigeria and ICF International (2014). Nigeria Demographic and Health Survey 2013, Abuja-Nigeria and R M, USA, NPC and ICF International.

National Immunization Policy (2009). National Primary Health Care Development Agency. Available at:

http://www.thephss.org/ppep/resource/National_immunization_Policy_with_frwd_and_acknwldg.pdf. (Accessed on 3/04/2016) FMOH, Nigeria.
Ogunlesi TA, Okeniyi JA, Owa JA, Oyedeji GA (2007). Neonatal tetanus at the close of 20th century in Nigeria. Trop. Doct. 37:165-167.
Onalo R, Ishiaku HM, Ogala WN (2011). Prevalence and outcome of Neonatal tetanus in Zaria, North western Nigeria. J. Info. Dev. Countries 5(4):255-259.
Roper MH, Vandelaer JH, Gasse FL (2007). Maternal and Neonatal tetanus (2007). Lancet 370:1947-1959.
Ruben FL, Smith EA, Foster SO, Casey HL, Pifer JM, Wallace RB, Atta AI, Jones WL, Arnold RB, Teller BE, Shaikh ZQ (1973). Simultaneous administration of smallpox, measles, yellow fever, and diphtheria—pertussis-tetanus antigens to Nigerian children. Bull. World Health Org. 48(2):175.
Thwaites CL, Farrar JJ (2003). Preventing tetanus. Br. Med J. 326(7381):117-118.
UNICEF/WHO/UNFPA (2005). Maternal and neonatal tetanus elimination by 2005. Strategies to achieving and maintaining elimination. Available at: http://www.unicef.org/health/files/MNTE (Accessed 3/5/016). WHO, Geneva. WHO.
UNICEF (2013). The state of world's children 2013. Available at: http://www.unicef.org/sowe2013.
WHO (2004). WHO Vaccine preventable diseases (2004): Monitoring system- 2004 global summary, WHO, Geneva.
World Health Organization (WHO) (2006). Tetanus vaccination Weekly. Epidemiol. Rec. 81(20):198-208.
Yaramis A, Tas MA (2000). Neonatal tetanus in the south east Turkey:
Risk factors and clinical and prognostic aspects. Review of 73 cases, 1990-1999. Turk. J. Pediatr. 42:272-274.
Zupan J, Aahman E (2005). Perinatal mortality for the year 2000, estimates developed by WHO Geneva. World Health Organization.

academicJournals

Vol. 9(5), pp. 106-113, May 2017
DOI: 10.5897/JPHE2017.0926
Article Number: 890857663789
ISSN 2141-2316

http://www.academicjournals.org/JPHE

Journal of Public Health and Epidemiology

Full Length Research Paper

Knowledge, attitude and practice of self-medication among health science students at Debre Markos University, Northwest Ethiopia

Abebe Dilie*, Tenaw Gualu, Dessalegn Haile and Franelee Alay Zuleta

Department of Nursing, College of Health Sciences, Debre Markos University, Debre Markos, Ethiopia.

Received 14 February, 2017; Accepted 7 March, 2017

Self-medication is defined as obtaining and consuming drugs without the advice of a physician either for diagnosis, prescription or surveillance of treatment. Self-medication can lead to wasteful expenditure, increase in morbidities due to adverse events and resistance to antibiotics. So enhancing the knowledge and attitude of consumers is very important to reduce practice of self-medication. The objective of the study was to assess the knowledge, attitude and practice of self-medication among health science students at Debre Markos University in 2016. An institutional based cross-sectional study design was conducted. A total of 276 eligible participants were selected using simple random sampling after participants were proportionally allocated to size from each department in health Science College. Data was collected using pretested structured self-administered questionnaire. When queried, 64.6% of the respondents had good level of knowledge on self-medication, while 49.1% had favorable attitudes towards self-medication practice. Moreover, 58.4% of participants practiced self-medication. This study shows that self-medication is widely practiced among health sciences students in Debre Markos University(DMU), more than half of the respondents were found to have good knowledge about self-medication however, their outlook towards it remain majorly unfavorable. Therefore, concerned bodies need to enhance the level of knowledge and attitude towards the impacts of self-medication.

Key words: Knowledge, attitude, practice, self-medication, Ethiopia.

INTRODUCTION

Self-medication is defined as the selection and use of non-prescription medicines by individuals' own initiatives to treat self-recognized illnesses or symptoms. It is also obtaining and consuming medication without professional supervision regarding indication, dosage, and duration of treatment (Gutema et al., 2011).

Inadequate knowledge of medication use may directly lead to misuse by community and/or patients,

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

noncompliance with a drug regimen and results in serious outcomes like adverse drug reaction and reduction of the quality of treatment (Atsbeha and Suleyman, 2008).

Previous studies conducted in different areas suggested that people had a poor knowledge about the pros and cons of self-medication, as a result their outlook toward self-medication practice were majorly favorable for any perceived illness (Suleman et al., 2009). The misuse of nonprescription drugs amongst students has become a serious problem. The youth is especially exposed to the media and the increased advertising of pharmaceuticals poses a larger threat to the young population. This raises concerns of incorrect self-diagnosis, drug interaction, and use other than for the original indication (Zafar et al., 2008). In economically deprived communities, most episodes of illnesses are treated by self-medication (Shankar et al., 2002). However, it resulted in wastage of resources, increases in resistance of pathogens, and causes health hazards such as adverse drug reactions, prolonged suffering and drug dependence. Despite this fact, studies indicated that health science students continued to practice and recommend self-medication (Pan et al., 2012; Bekele et al., 2016).

Therefore, the purpose of this study was to assess the knowledge, attitude and practice of self-medication among health science students in Debre Markos University.

MATERIALS AND METHODS

Study area and period

The study was conducted in Debre Markos University among health science students. There are a total of 725 health science students in the campus. The study was conducted from June to September, 2016.

Study design

An institutional based cross-sectional study design was conducted to assess the knowledge, attitude and practice of self-medication among health science students at Debre Markos University.

Source of population

The source populations were all health science students in Debre Markos University at 2016 academic year.

Study population

The study subjects were all randomly selected health science students after proportionally allocated to size in nursing, public health and midwifery departments.

Eligibility criteria

Inclusion criteria

All health science students who were willing to participate and available during study period were included in the study.

Exclusion criteria

Students who were in annual leave and seriously ill during data collection period were excluded from the study.

Sample size determination

The sample size was determined by using a single population proportion formula and considering the following assumptions: Prevalence (p) KAP of self-medication 50%, (Z) = standard normal distribution value at 95% confidence level of Zα/2 = 1.96 and margin of error (d) = 5%.

$$N = \frac{(Z\alpha/2)^2 P (1-P)}{d^2}$$

$$n = \frac{(1.96)^2 \times 0.5 (1-0.5)}{(0.05)^2}$$

n=384. The final sample size was determined as follows using correction formula:

nf = no/[1 + no/N]

Where: nf = the final sample size; no = initial sample size which is 384 and N = number of health science students in Debre Markos university

$$nf = \frac{no}{1+\frac{no}{N}} = \frac{384}{1+\frac{384}{725}} = 251$$

Considering a 10 % non-response rate, the total sample size was:

$\frac{10}{100} \times 251 = 25$, 25+ 251 = 276

Hence, 276 health science students were included in this study.

Sampling procedure

After allocating students from the 3 departments by proportional allocation to size (PAS), the participants were selected by using simple random sampling (Figure 1).

Variables of the study

Dependent variable

Knowledge about self-medication, attitude towards self-medication and practice of self-medication.

Independent variables

Socio-demographic characteristics (sex, age, ethnicity, educational level, occupation, marital status), prior experience.

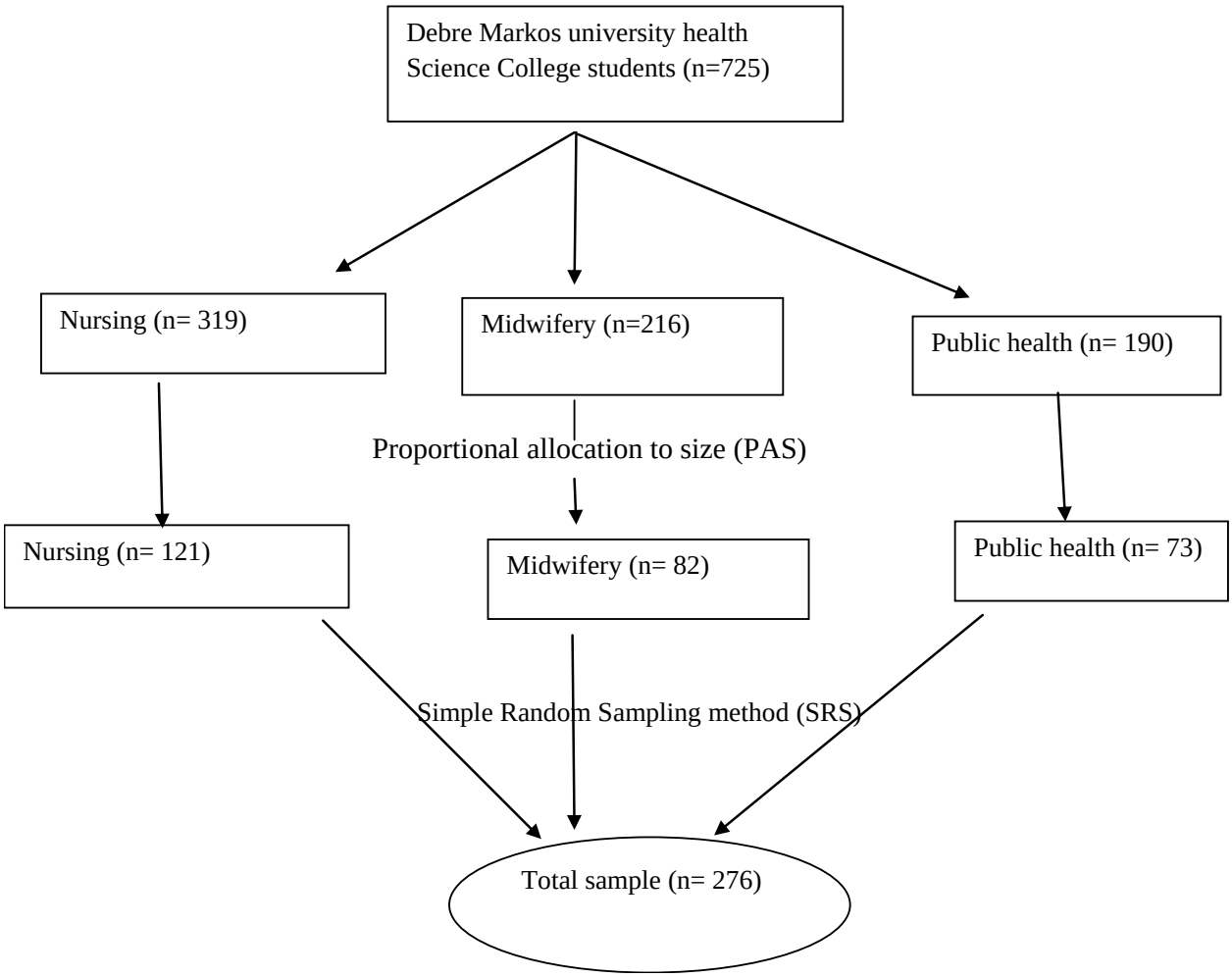

Figure 1. the schematic presentation of the sampling procedure to select study participants from Debre Markos university health science college students.

Data collection tool

Data was collected using structured self-administered questionnaire having four parts. The first, second, third and fourth parts of the questionnaires were about socio demographic information, knowledge, attitude and self-medication practices respectively. The questionnaire was adapted by reviewing literatures of similar studies on KAP of self-medication (Gutema et al., 2011; Patel et al., 2013).

Data collection procedure

The data were collected by five trained diploma nurses and were supervised by two nurses having previous experience in data collection. Continuous follow-up and supervision were also made by principal investigator throughout the data collection period.

Data quality assurance

In order to maintain quality of the data, data collectors and supervisors were trained in data collection procedures by the principal investigator. The questionnaire has also been carefully designed and English version was used for data collection. Before actual data collection time, the questionnaire (tool) was checked for clarity, comprehensiveness, and content validity by an expert and pretested for reliability on 10% of the total sample at Tropical College of Medicine, at Bahir Dar campus among under graduate health science students. Then, based on the finding of the pretest, the questions were modified for wording and clarity. The collected data were then reviewed and checked for completeness and consistency by the principal investigator on a daily basis.

Data processing and analysis

The collected data was checked, reviewed and organized daily for its completeness and consistency. Then data were coded, entered, and analyzed using the statistical package for social sciences program (SPSS) version 21.0 and interpreted in terms of descriptive statistics (frequency, percentage, mean). The results were presented in absolute figures (percentages) as depicted in tables.

Table 1. Socio-demographic characteristics of health science students at DMU, 2016 (n=250).

Variable		Frequency	Percentage
Age	20-25	205	82.0
	26-30	39	15.6
	>30	6	2.4
Sex	Female	91	36.4
	Male	159	63.6
Department	Nursing	121	51.2
	Midwifery	82	26.8
	Public Health	93	22.0
Studying year	1st year	71	28.4
	2nd year	75	30.0
	3rdyear	52	20.8
	4th year	52	20.8
Marital status	Single	224	89.6
	Married	19	7.6
	Divorced	7	2.8
Religion	Orthodox	237	94.8
	Muslim	5	2.0
	Protestant	8	3.2
Educational background	Diploma	56	22.4
	12 complete	185	74.0
	Others	9	3.6

Ethical consideration

Ethical clearance was obtained from Debre Markos University (DMU), College of Health Sciences. The study participants were informed about the objective, rationale and expected outcomes of the study and written consent were provided for guaranteeing their choice of participation or refusal. All the information was recorded anonymously and confidentiality was assured throughout the study.

RESULTS

Socio-demographic characteristics

A total of 276 health science students were included in the study. Of these, only 250 students voluntarily agreed to participate in this study, and 26 either refused or submitted incomplete questionnaires. This resulted in a response rate of 90.3%.

Out of 250 respondents, 159(63.6%) were males and 224 (89.6%) were single. Moreover, the mean age of study participants were 22.75 years (SD= ± 1.8). The majority of the respondents 237 (94.8%) were orthodox Christian by religion (Table 1).

Knowledge about self-medication

The majority, 220 (88.8%), of the participants were aware that medication administration requires basic knowledge about drug action. About 40(16%) of respondents did not know that changing of times when taking the drugs as having hazard (Table 2).

Based on the correct and incorrect responses each respondent gave, a count was made for each respondent. Then the aggregate scores of each of the 250 respondents were used to calculate mean, median and other descriptive statistics. Based on these results, respondents who have correctly answered more than the mean among the questions that were aimed at assessing knowledge towards self-medication were to be considered as knowledgeable. The study showed that, 64.6% of respondents had good level of knowledge regarding self-medication (Figure 2).

Table 2. Distribution of right and wrong responses about knowledge of self-medication among Health Science students in Debre Markos University, 2016.

S/N	Knowledge question	Right		Wrong	
		Frequency	%	Frequency	%
1	Medication administration requires basic knowledge about drug action	220	88.0	30	12.0
2	Changing of times when taking the drugs has no hazard	210	84	40	16.0
3	Antihypertensive drugs could be discontinued when blood pressure returns to a normal range	139	55.6	111	44.4
4	You can discontinue the use of antibiotics by yourself when the symptoms of fever or sore throat are relieved	180	72.0	70	28.0
5	Overuse of Paracetamol will cause liver toxicity	189	75.6	61	24.4
6	Antacids should be chewed before swallowing to achieve a better effect	146	58.4	104	41.6
7	Antacids should be added into all prescriptions to avoid GI upset	130	52	120	48
8	Taking all medicines with empty stomach helps to achieve optimum effect	197	78.8	53	21.2
9	Taking medicines three time a day means: taking at breakfast, lunch and dinner time.	127	50.8	123	49.2
10	Not taking full dose of medication does not have any effect.	192	76.8	58	23.2
11	Vitamins are a health food, so overusing it will not cause negative effects to human body	159	63.6	91	36.4
12	Storing ointment or gel in the refrigerator could extend the expiration date	164	65.6	86	34.4
13	Storing syrup in the refrigerator could extend the expiration date	129	51.6	121	48.4
14	Dosage of cough syrup is one bottle per use	156	62.4	94	37.6
15	Taking medicine with food, drink, tea or alcohol can interfere with the effect of medicine	175	70.0	75	30.0

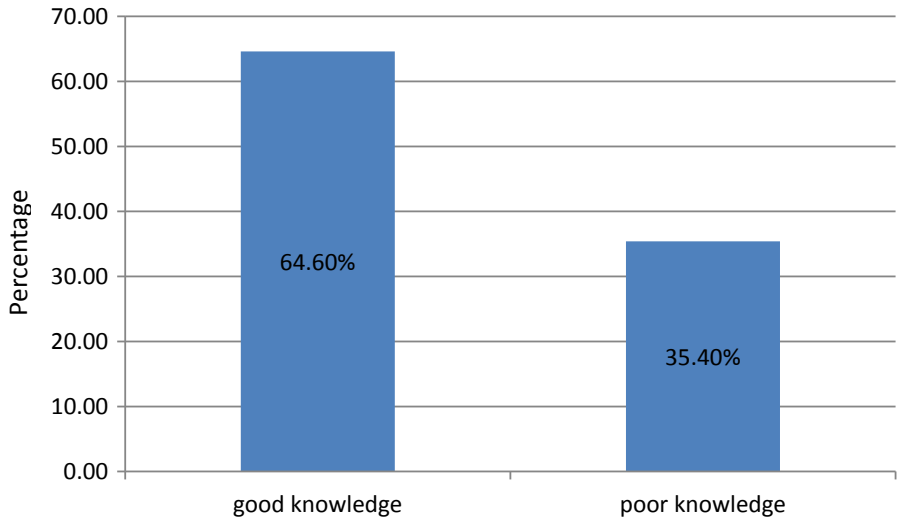

Figure 2. Respondents' level of knowledge regarding self-medication in DMU health science students, 2016.

Attitude towards self-medication

Scores for each attitude related question were summarized and the responses were then categorized into two variables, namely, favorable attitude and unfavorable attitude. Students who were positively worded for each attitude related question were categorized as having favorable attitude whereas respondents who were negatively worded for each attitude related questions were classified in the

Table 3. Attitude towards self-medication among health science students in Debre Markos University, 2016.

S/N	Statement	Strongly agree (%)	Agree (%)	Disagree (%)	Strongly disagree (%)
1	Self-medication is acceptable for medical students.	72(28.8%)	92(36.8%)	68(27.2%)	18(7.2%)
2	Medical students have good ability to diagnose the symptoms	85(34.0%)	133(53.2%)	29(11.6%)	3(1.2%)
3	Medical students have good ability to treat symptoms	62(24.8%)	152(60.8%)	27(10.8%)	9(3.6%)
4	Self-medication would be harmful if they are taken without proper knowledge of drugs and disease	124(49.6%)	97(38.8%)	25(10.0%)	4(1.6%)
5	Medical license would be essential for better administration of drugs	94(37.6%)	125(50%)	24(9.6%)	7 (2.8%)
6	The course of medicines should be complete although the symptoms subside	79(31.6%)	144(57.6%)	23(9.2%)	4(1.6%)
7	The pharmacist is a good source of advice/information about minor medical problems	33(44%)	136(54.4%)	40(16.0%)	10(4.0%)
8	Medical students are likely to bother their doctors with minor problems always.	15(6.0%)	161(64.4%)	55(22.0%)	19(7.6%)
9	We should be careful with non-prescribed over the counter medicines	74(29.6%)	136(54.4%)	37(14.8%)	3(1.2%)
10	Medical students should check the accompanied medication leaflet contain	106(42.4%)	114(45.6%)	25(10.0%)	5(2.0%)

unfavorable attitude category. Finally, overall attitude score of the respondents were calculated. Those students who score above the median were considered as having favorable attitude while those who scored below the median were labeled as having unfavorable attitude. Accordingly, 49% of students had favorable attitude while 51% had unfavorable attitude toward self-medication.

Majority 144(57.6%)) of the respondents agreed that medicines should be completed although the symptoms subside and 18 (7.2%) of the respondents strongly disagree towards acceptance of self-medication (Table 3).

Practice of self-medication

From the respondents, 146 (58.4%) took self-medication, but only 4.8% went to traditional healers when they fall sick due to different reasons (Figure 3).

Moreover, among the respondents who took self-medication, 60(41%), 24(16.4%), 17(11.6%), 14(9.6%), 11(7.5%), 10(6.8%) and 10(6.8%) identified pain (head, body, tooth), diarrhea, fever, nausea and vomiting, dysmenorrhea, cough and itching respectively as reasons to took self-medication.

Similarly, Analgesics (52.7%) are the most common type of drugs used for self-medication whereas antifungals (2.1%) are least used for self-medication among Debre Markos university health science students (Figure 4).

Among the respondents, who practiced self-medication 66.8% replied improved condition, 24% replied no change and 9.2 % replied worsened health condition after practicing self-medication.

Among the respondents who did not practice self-medication when they fall sick, 66(63.4%), 15(14.4%), 12(11.5%) and 11(10.57%) reasoned due to fear of adverse drug reaction, risk of missing actual diagnosis, risk of using wrong diagnosis and risk of drug dependence respectively.

DISCUSSION

The main purpose of this study was to assess the knowledge, attitude and practice of Debre Markos university health science students to self-medication.

This study showed that 64.6% of the students had good level of knowledge regarding self-medication. This was relatively analogues with a study done in Chitwan Medical College, Nepal, where more than half of the respondents had good knowledge about self-medication (Mehta and Sharma, 2015).

In this study, 58.4% of respondents practice self-medication in the last one year which is almost similar to a study done in Ain Shams university of Egypt, where prevalence of self-medication was 55% (El Ezz and Ez-Elarab, 2011). However, it was slightly higher than a study done in Kerman Iran, where 50.2% practiced self-

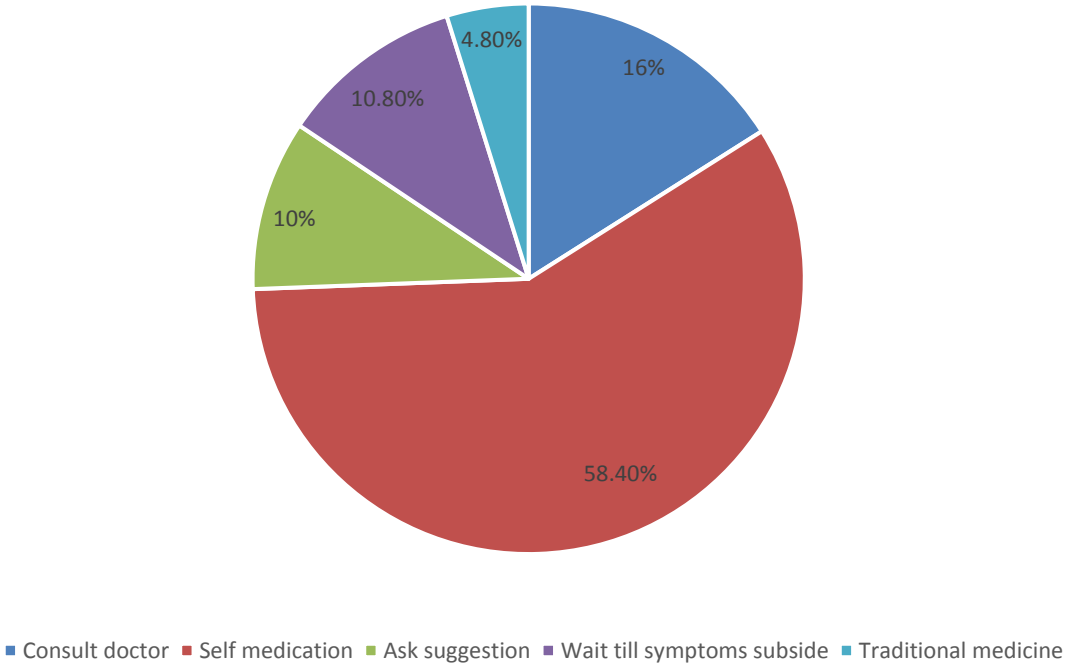

Figure 3. Immediate actions taken when they fall sick among Debere Markos university health science students, 2016.

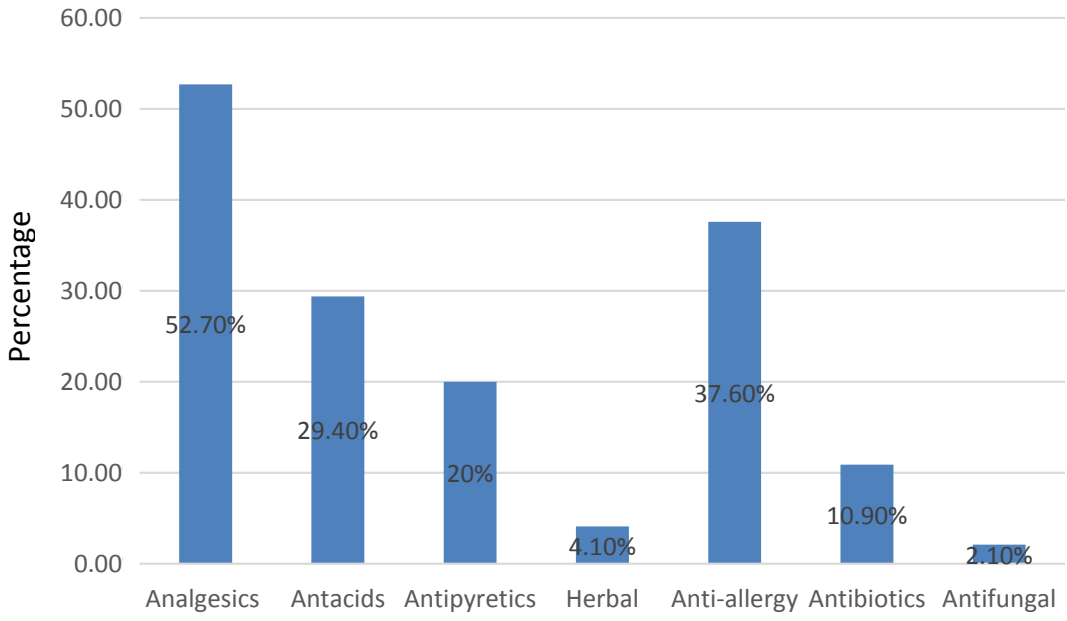

Figure 4. Types of drugs used for self-medication practice among Debre Markos university health science students, 2016.

medication (Zardosht et al., 2016). On the contrary it is much lower than a descriptive study done in Palestinian university, where 98% reported self-medication practice and Rio Grande, Brazil, where 86.4% practiced self-medication (Sawalha, 2008; da Silva et al., 2012). The finding of this study revealed that, 49.12% of the respondents had favorable attitude towards self-medication. This was relatively lower than a study done

by college of medicine and medical sciences of Arabian Gulf University in Kingdom of Bahrain, where 76.9% of the respondents had positive attitude favoring self-medication (James et al., 2006).

The study revealed that analgesics (52.7%) are the most common drugs used for self-medication. This finding was relatively lower than a study done in Ain Shams university of Egypt, where 87.2% of the participants took analgesics without physicians' prescription (El Ezz and Ez-Elarab, 2011).

The most common reason for self-medication was pain (head, body and tooth (41%). This was also similar to a study done in among university students in Karachi, Pakistan, where headache (72.4%) was the most common symptoms leading to self-medication (Zafar et al., 2008).

CONCLUSION AND RECOMMENDATIONS

Majority of the respondents practiced self-medication. Besides this, more than half of the respondents were found to have good knowledge about self-medication however, their outlook towards it remain majorly unfavorable. Pain and diarrhea were the two most commonly reported conditions for self-medication practice. Analgesics, anti-allergies and antacids were the most commonly reported types of medications consumed in self-medication. Raising the issue of awareness and further improve the attitude of students about self-medications in order to build up new generations combating unregulated self-medication is very important.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENT

The authors would like to thank Debre Markos University for financial support; the authors would also like to extend their gratitude to all the study participants and data collector.

REFERENCES

Atsbeha BW, Suleyman SA (2008). Medication knowledge, attitude and practice (kap) among university of gondar freshman students, north western ethiopia. Pharmacologyonline 1:4-12.

Bekele SA, Argaw MD, Yalew AW (2016). Magnitude and Factors Associated with Self-Medication Practices among University Students: The Case of Arsi University, College of Health Science, Asella, Ethiopia: Cross-Sectional Survey Based Study. Open Access Lib. J. 3(06):1.

da Silva MGC, Soares MCF, Muccillo-Baisch AL (2012). Self-medication in university students from the city of Rio Grande, Brazil. BMC Publ. Health 12(1):1.

El Ezz N, Ez-Elarab H (2011). Knowledge, attitude and practice of medical students towards self-medication at Ain Shams University, Egypt. J. Prev. Med. Hyg. 52(4).

Gutema GB, Gadisa DA, Kidanemariam ZA, Berhe DF, Berhe AH, Hadera MG (2011). Self-medication practices among health sciences students: The case of Mekelle University. J. Appl. Pharm. Sci. 1(10):183.

James H, Handu SS, Al Khaja KA, Otoom S, Sequeira RP (2006). Evaluation of the knowledge, attitude and practice of self-medication among first-year medical students. Med. Principles Pract. 15(4):270-275.

Mehta RK, Sharma S (2015). Knowledge, attitude and practice of self-medication among medical students. IOSR J. Nurs. Health Sci. 4(1):89-96.

Pan H, Cui B, Zhang D, Farrar J, Law F, Ba-Thein W (2012). Prior knowledge, older age, and higher allowance are risk factors for self-medication with antibiotics among university students in southern China. PloS one 7(7):e41314.

Patel P, Prajapati A, Ganguly B, Gajjar B (2013). Study on impact of pharmacology teaching on knowledge, attitude and practice on self-medication among medical students.

Sawalha AF (2008). A descriptive study of self-medication practices among Palestinian medical and nonmedical university students. Res. Soc. Admin. Pharm. 4(2):164-172.

Shankar P, Partha P, Shenoy N (2002). Self-medication and non-doctor prescription practices in Pokhara valley, Western Nepal: a questionnaire-based study. BMC family Pract. 3(1):17.

Suleman S, Ketsela A, Mekonnen Z (2009). Assessment of self-medication practices in Assendabo town, Jimma zone, southwestern Ethiopia. Res. Soc. Admin. Pharm. 5(1):76-81.

Zafar SN, Syed R, Waqar S, Zubairi AJ, Vaqar T, Shaikh M (2008). Self-medication amongst university students of Karachi: prevalence, knowledge and attitudes. J. Pak. Med. Assoc. 58(4):214.

Zardosht M, Dastoorpoor M, Hashemi FB, Estebsari F, Jamshidi E, Abbasi-Ghahramanloo A (2016). Prevalence and Causes of Self Medication among Medical Students of Kerman University of Medical Sciences, Kerman, Iran. Global J. Health Sci. 8(11):150.

academicJournals

Vol. 9(5), pp. 114-121, May 2017
DOI: 10.5897/JPHE2016.0906
Article Number: E8018E863791
ISSN 2141-2316

http://www.academicjournals.org/JPHE

Journal of Public Health and Epidemiology

Full Length Research Paper

Descriptive epidemiology of orofacial clefts in Africa using data from 46,502 Smile Train surgeries

Azeez Butali[1*], Keyla Pagán-Rivera[2], Deborah V. Dawson[2], Ronald Munger[3], Mekonen A. Eshete[4], Wasiu L. Adeyemo[5] and Peter A. Mossey[6]

[1]Department of Oral Pathology, Radiology and Medicine, College of Dentistry, University of Iowa, Iowa City, IA, USA.
[2]Division of Biostatistics and Research Design, Dows Research Institute, College of Dentistry, University of Iowa, Iowa City, IA, USA.
[3]School of Public Health, Utah State University, United States.
[4]Department of Burns and Plastic Surgery, Addis Ababa University, Addis Ababa, Ethiopia.
[5]Department of Oral and Maxillofacial Surgery, University of Lagos, Lagos, Nigeria.
[6]Department of Orthodontics, University of Dundee, Scotland, UK.

Received 19 December, 2016; Accepted 16 February, 2017

The descriptive epidemiology of orofacial clefts (OFC) is an essential prerequisite towards improved care, investigations into the etiology, and eventually prevention. In the present study the distribution of OFC in sub-Saharan Africa using post-surgical data from the Smile Train organization, was examined. Data from 46,502 individuals from Ethiopia (16,049), Nigeria (8,209), Uganda (5,138), Kenya (4,084), Tanzania (2,750), Congo DR (1,371), Zambia (1,319), Somalia (1,039), and a total of 6,543 individuals from another 26 African countries were available for analysis. Individuals without a cleft diagnosis and those who indicated non-black African as their racial group were excluded, and a total of 46,502 individuals were available for analysis. There was a significant difference in frequency between unilateral cleft lip and palate (70.24%) versus bilateral cleft lip and palate (29.76%; $p < 0.0001$), and these were also significant within each sex ($p < 0.0001$). In the database, there were more females (53.50%) with cleft palate only than males (46.50%) ($p = 0.0002$). Data reported here did not take into account infant mortality during the perinatal period. Nonetheless, this study provides estimates from the largest recorded body of data for clefts in the continent, therefore providing valuable information on the need for comprehensive cleft registries in Africa.

Key words: Clefts, Africa, epidemiology.

INTRODUCTION

Africa is the second most populous continent in the world, with a population of over 1 billion people as of 2012 and estimated by the United Nations to reach 2.4 billion by 2050 (United Nations report World population prospects,

*Corresponding author. E-mail: Azeez-butali@uiowa.edu. Tel: 319-335-8980. Fax: 319-384-1169.

2012). Broadly, Africa can be divided into North Africa and sub-Saharan Africa. There are 54 countries in Africa according to the United Nations, and most of these countries are classified as developing (International Monetary Fund, 2014). Sub-Saharan Africa has a population of over 900 million people, with a growth rate of 2.7% per annum (David and Murray, 2013). The gender distribution in sub-Saharan Africa is equal (50% male and 50% female), and over 65% of the entire population is rural. The rural population correlates with over 50% of births delivered outside the hospital (Ahmed et al., 2004; Bukar and Jauro, 2013), as most hospitals and delivery centers are located in urban centers.

Infant mortality rates in African countries are among the highest in the world as a result of health, political, and economic challenges (United Nations Inter-agency Group for Child Mortality Estimation, 2013). The health challenges include infectious diseases like HIV/AIDS, tuberculosis, and malaria. However, infant mortality due to infectious diseases is reducing and being controlled successfully worldwide. Nonetheless, infant mortality is increasing globally due to the rising tide of birth defects such as orofacial clefts (OFCs) (WHO, 2005). Infant mortality as a result of birth defects in Africa could be due lack of infrastructure, limited number of trained personnel and cultural beliefs. Cultural beliefs such as witchcrafts, evil spirits and the devil have been reported to contribute to infanticides. In some instances, children have been deliberately ignored to starve to death or allowed to aspirate during breast feeding (Akinmoladun et al., 2007; Oginni et al., 2010). Therefore, it is a matter of life and death for children with birth defects in a resource low setting in Africa. This is because majority of the population have limited knowledge on the causes of the defects and availability of support for individuals and families (Awoyale et al., 2016).

OFCs are the most visible and most common congenital birth defects in the head and neck region. OFC affects 1 in 700 live births worldwide (Mossey and Modell, 2012). However, there are variations in reported prevalence across geographical and ethnic regions. In Asia, the rates are as high as 1.4/1000 (Dai et al., 2010); in Europe around 0.7/1000 (Calzolari et al., 2004), and in Africa 0.5/1000 (Butali et al., 2014). The difference in prevalence across the world provides support for the role of multiple genetics and environmental factors that increases the risk for OFCs. OFCs occur following disturbances of the normal genomic architecture during palatal development in the embryonic (primary palate) and fetal (secondary palate) phases of development. An environmental insult around this time increases the risk for OFCs.

In Africa, there have been various attempts to examine the incidence, prevalence, and distribution of OFCs in different countries (Butali et al., 2014; Spritz et al., 2007;Carneiro and Massawe, 2009; Agbenorku et al., 2011; Eshete et al., 2011; Manyama et al., 2011). Here, a descriptive report of 46,502 cleft cases in the Smile Train database from all countries in sub-Saharan Africa was presented. To our knowledge, this is the largest descriptive study for clefts in the African continent. This study provides valuable information on the need for holistic care. It also renders an opportunity for proper surveillance and for the establishment of registries in order to provide accurate estimates of prevalence rates. Finally, it is hoped that this report will attract the attention of governmental and non-governmental organizations in Africa and other parts of the world to the plight of individuals with this condition and the need for team care.

METHODOLOGY

Data

An application form to the Smile Train Organization requesting for data from sub-Saharan Africa was completed. This form was submitted in May 2013 and approval was received in June 2013. The data requested did not contain identifiable data and qualifies as a non-human subject research according to the University of Iowa IRB. The data was stratified into countries. All the cleft types based on the clinical information provided in the database were also classified.

Statistical analysis

Study design

This is a retrospective study using the Smile Train data for clefts treated in Africa.

Study population

All cleft cases treated at Smile Train centers in Africa. Only Africans with racial indication as “Black” and individuals with a cleft diagnosis in the database in the final analysis (N = 46,502) were included.

Data collection and classification

Data collected from June, 2007 to December, 2013 was used for analyses. The cleft types was classified into the various broad categories: Bilateral cleft lip and palate (BCLP), left cleft lip and palate (LCLP), right cleft lip and palate (RCLP), bilateral cleft lip only (BCLO), left cleft lip only (LCLO), right cleft lip only (RCLO), and cleft palate only (CPO). Each of these cleft types was divided into males and females.

Data analysis

Frequency data was generated and a frequency distribution table with the observed and expected data was constructed. Estimated prevalence for each country was not conducted due to the lack of live births data (denominator data) in the current data set. Test for differences in proportions were performed to see if there was a significant difference in the proportion of BCLP and unilateral cleft lip and palate (UCLP; LCLP and RCLP was combined). The test was done for all individuals first and then for each gender. Cleft lip only categories (BCLO, LCLO, and RCLO) were combined under

Table 1. The distribution into the various cleft types.

Frequency	BCLP	BCLO	CPO	LCLO	LCLP	RCLO	RCLP
Female	1541	2672	1538	6784	2060	2403	2001
Female expected	1761.3	2520	1174.6	6852.8	2119.2	2532.7	2038.3
Male	2770	3496	1337	9989	3127	3796	2988
Male expected	2549.7	3648	1700.4	9920.2	3067.8	3666.3	2950.7
Total	4311	6168	2875	16773	5187	6199	4989
Percent	9.27	13.26	6.18	36.07	11.15	13.33	10.73

Table 2. Distribution and comparison between individuals with unilateral and bilateral cleft lip and palate and cleft lip only.

Cleft lip and palate				
	Frequency	**Percent**	**Frequency of females**	**Frequency of males**
Bilateral	4311	29.76	1541	2770
Unilateral	10176	70.24	4061	6115
Total	14487	100	5602	8885
	BCLP percent		**Confidence Interval**	**Exact p-value**
Bilateral vs Unilateral	29.76		(29.01, 30.51)	<0.0001
Cleft lip only				
Bilateral	6168	21.17	2672	3496
Unilateral	22972	78.83	9187	13785
Total	29140	100	11859	17281
	BCLP percent		**Confidence Interval**	**Exact p-value**
Bilateral vs Unilateral	21.17		(20.70, 21.64)	<0.0001

unilateral and bilateral in a similar way and the analogous tests were performed (Table 2). The types of clefts alone was also compared, that is, RCLO versus LCLO, BCLO versus LCLO, BCLO versus RCLO, RCLP versus LCLP, BCLP versus LCLP, and BCLP versus RCLP. All these categories were stratified by gender, and laterality tests were performed within each gender. Chi square statistics was used to compare the equality of frequencies of laterality, and $p < 0.002$ was considered significant (Bonferroni corrected p-value for 25 different tests where 0.05 is significant for each test). A distribution of clefts in first degree and second degree relatives was also analyzed. A breakdown of the frequency of clefts and distribution of cleft types in eight of the countries with highest number of treated cases and 26 others was also conducted.

RESULTS

Table 1 shows the distribution of clefts into the different types observed in the database and an estimate of the expected frequency for males and female under the null hypothesis.

Overall test for equality

Unilateral vs bilateral

Table 2 presents the frequencies for the unilateral and bilateral cleft lip and palate (CLP), and cleft lip only (CLO), followed by the test results. The binomial test showed that the proportion of BCLP cases was not the same as the proportion of UCLP ($p < 0.0001$). In fact, the proportion of unilateral cases was greater than the proportion of bilateral cases. A similar result was found for the cleft lip (CL) cases ($p < 0.0001$).

Binomial test comparing pairs of classifications based on gender and laterality

For each pair of categories based upon laterality (among bilateral, left or right) the exact binomial test was used to test the hypothesis that the proportions in each pair of categories are 0.5. That is, considering individuals with CLP, with frequencies given below, a test was carried out to determine significant differences in the proportion of CLP based on the location (bilateral, left, and right). Then, these evaluations were repeated among patients with CL.

The test for differences in proportions showed that there were more LCLP than BCLP ($p < 0.0001$; Table 3). There was also more RCLP than BCLP (p-value <0.0001; Table 3). However, proportion of left vs right CLP was not too different from 0.5, there was no significant difference ($p = 0.05$; Table 3). The test for differences in proportions showed that there was more LCL than BCL ($p < 0.0001$;

Table 3. Classifications based on laterality.

Distribution and comparison between left versus right and between each side versus bilateral cleft lip and palate				
	Frequency	**Percent**	**Frequency of females**	**Frequency of males**
Bilateral	4311	29.76	1541	2770
Left	5187	35.80	2060	3127
Right	4989	34.44	2001	2988
Total	14487	100	5602	8885
	Percent of first category		**Confidence interval**	**Exact p-value**
Bilateral vs Left	45.39		(44.38, 46.40)	<0.0001
Bilateral vs Right	46.35		(45.34, 47.37)	<0.0001
Left vs Right	50.97		(50, 51.95)	0.05
Distribution and comparison between left versus right and between each side versus bilateral cleft lip only				
	Frequency	**Percent**	**Frequency of females**	**Frequency of males**
Bilateral	6168	21.17	2672	3496
Left	16773	57.56	6784	9989
Right	6199	21.27	2403	3796
Total	29140	100	11859	17281
	Percent of first category		**Confidence interval**	**Exact p-value**
Bilateral vs Left	26.89		(26.31, 27.47)	<0.0001
Bilateral vs Right	49.87		(48.99, 50.76)	0.78
Left vs Right	73.01		(72.44, 73.59)	<0.0001

Table 3). There was more LCL than RCL ($p < 0.0001$; Table 3). However, the proportion of BCL was not different from the proportion of RCL ($p = 0.78$; Table 3).

By gender

The test for differences in proportions was used to determine if the proportion of cleft was greater in one category than in another category. Among females, the proportion of BCLP was lesser than the proportion of LCLP and RCLP ($p < 0.0001$ in both cases; Table 4). The proportions of CLP among males were similar to those for females (Table 4).

Among females, the proportion of BCL was less than the proportion of UCL ($p < 0.0001$; Table 4). However, the proportion of BCL was slightly greater than the proportion of RCL ($p = 0.0002$). Also, the proportion of LCL was greater than the proportion of RCL ($p < 0.0001$; Table 4).

In males, the proportion of BCL was smaller than the proportion of LCL (p-value <0.0001; Table 4). The proportion of BCL was lesser than the proportion of RCL (p-value 0.0005; Table 4). The proportion of LCL was greater than the proportion of RCL (p-value <0.0001; Table 4). There was a significant difference between males and females with CPO (p-value 0.0002).

Affected relatives

Table 5 shows the distribution and percentages of first and second degree relatives with a cleft diagnosis recorded in the database. Frequency of clefts and distribution of cleft types in eight of the countries with highest number of treated cases and 26 others are presented in supplementary Table 1.

DISCUSSION

Epidemiology

In the absence of established population based birth defects registries in most countries in sub-Saharan Africa, hospital based registries supported by non-governmental organizations provide a reliable estimate of birth defects including OFCs. In this study, post-surgical data from the Smile Train organization was obtained and these data by cleft type, gender and countries in SSA was analyzed. In the overall distribution of OFCs, it was observed that in major cleft types such as CLP, CLO and CPO is similar to what has been reported in some populations around the world (Butali et al., 2014; Eshete et al., 2011; Doray et al., 2012; Yáñez-Vico et al., 2012; Bell et al., 2013; McDonnell et al., 2014). Our observation for UCLP versus BCLP is not different from other studies (Yáñez-Vico et al., 2012; Lithovius et al., 2014). Nonetheless, there was no significant difference between RCLP and LCLP.

Gender difference for CPO has been consistently reported in the literature (Butali et al., 2014; Lithovius et al., 2014; Matthews et al., 2014). A statistically significant difference for CPO in our cohort even after applying the

Table 4. Distribution and comparison between females and males with left versus right and between each side versus bilateral cleft lip and palate and cleft lip only.

Females (cleft lip and palate)			
	Frequency		**Percent**
Bilateral	1541		27.51
Left	2060		36.77
Right	2001		35.72
Total	5602		100
	Percent of first category	**Confidence interval**	**Exact p-value**
Bilateral vs Left	42.79	(41.17, 44.43)	<0.0001
Bilateral vs Right	43.51	(41.87, 45.16)	<0.0001
Left vs Right	50.73	(49.18, 52.28)	0.36
Males (cleft lip and palate)			
	Frequency		**Percent**
Bilateral	2770		31.18
Left	3127		35.19
Right	2988		33.63
Total	8885		100
	Percent of first category	**Confidence interval**	**Exact p-value**
Bilateral vs Left	46.97	(45.69, 48.26)	<0.0001
Bilateral vs Right	48.11	(46.81, 49.41)	0.004
Left vs Right	51.14	(49.88, 52.40)	0.08
Females (cleft lip only)			
	Frequency		**Percent**
Bilateral	2672		22.53
Left	6784		57.21
Right	2403		20.26
Total	11859		100
	Percent of first category	**Confidence interval**	**Exact p-value**
Bilateral vs Left	28.26	(27.35, 29.18)	<0.0001
Bilateral vs Right	52.65	(51.27, 54.03)	0.0002
Left vs Right	73.84	(72.93, 74.74)	<0.0001
Males (cleft lip only)			
	Frequency		**Percent**
Bilateral	3496		20.23
Left	9989		57.80
Right	3796		21.97
Total	17281		100
	Percent of first category	**Confidence interval**	**Exact p-value**
Bilateral vs Left	25.93	(25.19, 26.67)	<0.0001
Bilateral vs Right	47.94	(46.79, 49.10)	0.0005
Left vs Right	72.46	(71.71, 73.21)	<0.0001
CPO			
Males	1337	44.67, 48.35	0.0002
Females	1538		

Table 5. Frequencies for the relatives with a diagnosis of cleft reported in the database.

Response	Immediate relative with clefts	Distant relative with clefts
Do not know	734	846
No	44,587	44,307
Yes	1,181	1,349
Total	46502	46502

Bonferroni correction was observed. An interesting finding was the gender difference in CL. It was observed that more females had BCL than RCL. The opposite was observed in males.

In the present study, 2.5% reported clefting in first degree relatives (that is, siblings and 2.9% in second degree relatives (uncles, cousins and aunties). These rates are lower than reported rates for positive family history of 10.4% reported in Nigeria (Butali et al., 2014), and in other population groups where rates as high as 17 to 35% have been reported (Peterka et al., 1996; Jaruratanasirikul et al., 2008; Martelli et al., 2010).

Furthermore, data for cleft types in affected relatives were not available for analysis. This is a limitation because it is now known that recurrent risk varies in families according to cleft types. There is a genetic risk for having another child with cleft in a family with a positive history of clefting. A family with a particular cleft phenotype will likely give birth to offspring with the same phenotype compared to a family with no history of clefting in the general population, BCLP to BCLP: Recurrent risk is 4.6% (95% CI: 3.2-6.1%); CP to CP: recurrent risk is 3.9% (95% CI: 2.5-5.6%) (Grosen et al., 2010). This information will be valuable during genetic counselling for affected families. Recurrent risks also provide evidence supporting the role of genetic underpinnings for the different type of phenotypes. Therefore, future genetic studies investigating these phenotypes in separate cohorts will provide opportunities for novel and sophisticated strategies for prevention.

Limitations

The data is very limited and the study was unable to estimate the prevalence for each country since the birth rates for these countries from Smile Train were not available. A survival curve which will provide information on the survival of individuals with clefts in this population could not be plotted. This is a limitation since the data was cross-sectional. The estimates provided in this study are not exact prevalence data for the cleft types, as they were obtained in only hospitals supported by Smile Train. In addition, they are prone to bias and may not represent the true rates. Furthermore, the data do not include infant mortality data, and it is difficult to estimate the number of stillbirths with clefts or infants with clefts who died during the perinatal period prior to surgery. Nonetheless, this database can be developed further into a hospital birth defect registry for records of all births (live and stillbirths). Population-based surveillance and record of all births should then be linked to the hospital registry. It is only when this is done that accurate estimates of birth defects rates including OFCs can be estimated.

Conclusion

Data reported here provides estimates from the largest recorded body of data for clefts in the African continent, therefore providing a rationale for the establishment of a population based registry. These registries when established will support studies on cleft treatment outcomes, etiology and prevention.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

We are grateful to the Smile Train for providing the data for analysis and supporting free cleft surgeries in Africa through local man-power. This project was supported by grants from the NIDCR grant R00 DE022378, Robert Wood Johnson Foundation Grant number 72429 (AB).

REFERENCES

Agbenorku P, Ansah S, Acheampong A, Sabbah D, Bankas D, Adu E, Plange-Rhule G, Adiyiah Y, Donkor P (2011). Komfo Anokye Teaching Hospital Multidisciplinary Cleft Clinic. J. Craniofac Surg. 22(2):532-536.

Ahmed O, Odunukwe N, Raheem Y, Efienemokwu C, Junaid M, Adesesan S, Ogedengbe O, Harry T, Salako L (2004). Knowledge, attitudes and perceptions of HIV/AIDS among traditional birth attendants and herbal practitioners in Lagos State, Nigeria. Afr. J. AIDS Res. 3(2):191-196.

Akinmoladun VI, Owotade FJ, Afolabi AO (2007). Bilateral transverse facial cleft as an isolated deformity: Case report. Ann. Afr. Med. 6(1):39-40.

Awoyale T, Onajole AT, Ogunnowo BE, Adeyemo WL, Wanyonyi KL, Butali A (2016). Quality of Life of Family Caregivers of Children with Orofacial Clefts in Nigeria: A mixed methods study. Oral Dis. 22(2):116-122.

Bell JC, Raynes-Greenow C, Bower C, Turner RM, Roberts CL, Nassar N (2013). Descriptive epidemiology of cleft lip and cleft palate in

Western Australia. Birth Defects Res. A Clin. Mol. Teratol. 97(2):101-108.
Bukar M, Jauro YS (2013). Home births and postnatal practices in Madagali, North-Eastern Nigeria. Niger J Clin. Pract. 16(2):232-237.
Butali A, Adeyemo WL, Mossey PA, Olasoji HO, Onah II, Adebola A, Efunkoya, Akintububo A, James O, Adeosun OO, Ogunlewe MO, Ladeinde AL, Mofikoya BO, Adeyemi MO, Ekhaguere OA, Emeka C, Awoyale TA, The Nigeriacran Collaboration (2014). Prevalence of orofacial clefts in Nigeria. Cleft Palate Craniofac J. 51(3):320-325.
Calzolari E, Bianchi F, Rubini M, Ritvanen A, Neville AJ (2004). Epidemiology of cleft palate in Europe: implications for genetic research. Cleft Palate Craniofac J. 41(3):244-249.
Carneiro PM, Massawe ER (2009). Pattern of cleft lip and palate in Dar-es-Salaam. Cent. Afr. J. Med. 55(1-4):10-14.
Dai L, Zhu J, Mao M, Li Y, Deng Y, Wang Y, Liang J, Tang L, Wang H, Kilfoy BA, Zheng T, Zhang Y (2010). Time trends in oral clefts in Chinese newborns: data from the Chinese National Birth Defects Monitoring Network. Birth Defects Res. A Clin. Mol. Teratol. 88(1):41-47.
David L, Murray L (2013). Global Demographic Trends and Their Implications for Employment. Post-2015 UN MDG Development Agenda Employment and Economic Growth. 2013. http://www.post2015hlp.org/wp-content/uploads/2013/05/Lam-Leibbrandt_Global-Demographic-Trends-and-their-Implications-for-Employment.pdf
Doray B, Badila-Timbolschi D, Schaefer E, Fattori D, Monga B, Dott B, Favre R, Kohler M, Nisand I, Viville B, Kauffmann I, Bruant-Rodier C, Grollemund B, Rinkenbach R, Astruc D, Gasser B, Lindner V, Marcellin L, Flori E, Girard-Lemaire F, Dollfus H (2012). Epidemiology of orofacial clefts (1995-2006) in France (Congenital Malformations of Alsace Registry). Arch. Pediatr. 19(10):1021-1029.
Eshete M, Gravenm PE, Topstad T, Befikadu S (2011). The incidence of cleft lip and palate in Addis Ababa, Ethiopia. Ethiop. Med. J. 49(1):1-5.
Grosen D, Chevrier C, Skytthe A, Bille C, Mølsted K, Sivertsen A, Murray JC, Christensen K (2010). A cohort study of recurrence patterns among more than 54,000 relatives of oral cleft cases in Denmark: support for the multifactorial threshold model of inheritance. J. Med. Genet. 47(3):162-168.
International Monetary Fund (2014). "Standard country or area codes for statistical use" (ST/ESA/STAT/SER.M/49/Rev. 4).
Jaruratanasirikul S, Chichareon V, Pattanapreechawong N, Sangsupavanich P (2008). Cleft lip and/or palate: 10 years experience at a pediatric cleft center in Southern Thailand. Cleft Palate Craniofac J. 45(6):597-602.
Lithovius RH, Ylikontiola LP, Harila V, Sándor GK (2014). A descriptive epidemiology study of cleft lip and palate in Northern Finland. Acta Odontol. Scand. 72(5):372-375.
Manyama M, Rolian C, Gilyoma J, Magori C.C, Mjema K, Mazyala E, Kimwaga E, Hallgrimsson B (2011). An assessment of orofacial clefts in Tanzania. BMC Oral Health 11:15.
Martelli D, Bonan P , Soares M, Paranaíba L, Martelli-Júnior H (2010). Analysis of familial incidence of non-syndromic cleft lip and palate in a Brazilian population. Med. Oral Patol. Oral Cir. Bucal. 15(6):e898-901.
Matthews JL, Oddone-Paolucci E, Harrop RA (2014). The Epidemiology of Cleft Lip and Palate in Canada, 1998 to 2007. Cleft Palate Craniofac J. 52(4):417-424.
McDonnell R, Owens M, Delany C, Earley M, McGillivary A, Orr DJ, Duggan L (2014). Epidemiology of orofacial clefts in the East of Ireland in the 25-year period 1984-2008. Cleft Palate Craniofac J. 51(4):e63-69.
Mossey PA, Modell B (2012). Epidemiology of oral clefts: an international perspective. Front Oral Biol. 16:1-18.
Oginni F, Asuku M, Oladele A, Obuekwe O, Nnabuko R (2010). Knowledge and Cultural Beliefs About The Etiology And Management Of Orofacial Clefts In Nigeria's Major Ethnic Groups. Cleft Palate-Craniofacial J. 47(4):327-334.
Peterka M, Peterková R, Halasková M, Tvrdek M, Fára M, Likovský Z (1996). Sex differences in the incidence of cleft and question of primary prevention in families with genetic risk. Acta Chir Plast. 38(2):57-60.
Spritz RA, Arnold TD, Buonocore S, Carter D, Fingerlin T, Odero WW, Wambani JO, Tenge RK, Weatherley-White RC (2007). Distribution of orofacial clefts and frequent occurrence of an unusual cleft variant in the Rift Valley of Kenya. Cleft Palate Craniofac J. 44(4):374-377.
United Nations Inter-agency Group for Child Mortality Estimation (2013). Under-Five Mortality Estimates: Rates. Available at: http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/health/under_five_mortality.pdf
United Nations report World population prospects (2012). Revision (2014). World Development Indicators. Washington, DC.
World Health Organization (WHO) (2005). 2nd International Conference on Birth Defects and Disabilities in the Developing World. Hospital-based registries for monitoring birth defects: The National Collaborative Perinatal Neonatal Network; 11–15 September; Beijing, China.
Yáñez-Vico RM, Iglesias-Linares A, Gómez-Mendo I, Torres-Lagares D, González-Moles MÁ, Gutierrez-Pérez JL, Solano-Reina E (2012). A descriptive epidemiologic study of cleft lip and palate in Spain. Oral Surg. Oral Med. Oral Pathol. Oral Radiol. 114(5 Suppl):S1-4.

Table S1. Frequency of clefts in 8 countries with the highest number of treated cases and 26 others.

Hospital country	Frequency	Percent	Cumulative frequency	Cumulative percent
Congo DR	1371	2.95	1371	2.95
Ethiopia	16049	34.51	17420	37.46
Kenya	4084	8.78	21504	46.24
Nigeria	8209	17.65	29713	63.90
Somalia	1039	2.23	30752	66.13
Tanzania	2750	5.91	33502	72.04
Uganda	5138	11.05	38640	83.09
Zambia	1319	2.84	39959	85.93
Other	6543	14.07	46502	100.00

academicJournals

Vol. 9(5), pp. 122-132, May 2017
DOI: 10.5897/JPHE2016.0853
Article Number: F9CFDDB63793
ISSN 2141-2316

http://www.academicjournals.org/JPHE

Journal of Public Health and Epidemiology

Full Length Research Paper

Sero-epidemiological investigation and risk factors for contagious bovine pleuro pneumonia infection of cattle in Dello Mena and Sawena Districts of Bale Zone, South Eastern Ethiopia

Minda Asfaw Geresu[1]*, Kemal Kedir[2], Dagim Birhanu[2] and Aynalem Teshome[2]

[1]College of Agriculture and Veterinary Medicine, School of Veterinary Medicine, Jimma University, Jimma, Ethiopia
[2]College of Agriculture and Natural Resources, Department of Animal and Range Sciences, Madda Walabu University, Bale-Robe, Ethiopia.

Received 29 July, 2016; Accepted 15 March, 2017

Contagious bovine pleuropneumonia (CBPP) is a highly infectious cattle disease, which is widespread in pastoral areas of Africa and it is a major problem for Ethiopian livestock. A cross-sectional study on sero-epidemiology and risk factors for contagious bovine pleuropneumonia infection of cattle in Dello Mena and Sawena districts of Bale Zone was conducted from February, 2016 to May, 2016. Competitive Enzyme Linked Immunosorbent Assay test was used to analyze 384 cattle sera for contagious bovine pleuropneumonia antibodies and the overall sero-prevalence rate was determined to be 6.51%. A higher sero-prevalence rate of 8.26% was observed in Dello Mena district when compared to Sawena (3.89%) district. The prevalence in each kebele ranged from 0 to 15.91% and the highest prevalence (15.91%) was found at Hi-Oda, located in Dello Mena district. A Chi-square computed statistical analysis indicated that age (χ^2=5.738; p<0.017), sex (χ^2=11.105; p<0.001), breed (χ^2=13.29; p<0.014), body condition score (χ^2=6.063; p<0.048) and purpose of rearing cattle (χ^2=14.877; p<0.001) were the major putative risk factors associated with the occurrence of contagious bovine pleuropneumonia in the study districts. The difference, however, was not statistically significant (p>0.05) for origin (Dello Mena/Sawena), contact with other herds (yes/no) and herd size (small/medium/large). Multivariable logistic regression statistical analysis revealed that age (adult/young), body condition score (good/medium/poor) and purpose of rearing cattle (beef/draft power/milk) were significantly associated with contagious bovine pleuropneumonia sero-positivity (p<0.05). Consequently, cattle rearing purpose (for beef/draft power/milk) was statistically identified as the major risk factor for contagious bovine pleuropneumonia occurrence in relation to other factors and cattle(oxen/bull) used for the purpose of draft power were more likely to be infected by CBPP(Adjusted Odds Ratio=49.052). This study showed that the overall sero-epidemiology of contagious bovine pleuropneumonia in Bale Zone of Oromia Regional State was relatively high. This warrants the implementation of appropriate preventive and control measures to minimize the economic losses arising from the disease.

Key words: Cattle, contagious bovine pleuropneumonia, Dello Mena, risk factors, Sawena, seroepidemiology

INTRODUCTION

Contagious bovine pleuropneumonia (CBPP) is a highly contagious disease of cattle that is caused by *Mycoplasma mycoides subsp.mycoides* (*Mmm*) (Yaya et al., 2008; Billy et al., 2105).The disease is endemic in many African countries, and the Sahara region is under constant threat due to the carrier status of its host. The disease spread alarmingly during the 1990s, infecting several countries previously free from the disease, causing greater losses in cattle than any other diseases, including rinderpest (OIE, 2001). Due to high economic losses caused by CBPP in endemic regions, OIE declared CBPP as one of the most serious contagious animal disease and listed it in the group of notifiable animal diseases of high socio-economic impact and is regarded as one of the major transboundary animal diseases (TADs) (FAO, 2002; Wade et al., 2015).

M. mycoides is mainly transmitted from animal to animal in aerosols. This organism also occurs in saliva, urine, fetal membranes and uterine discharges. Carrier animals, including sub-clinically infected cattle that can retain viable organisms in encapsulated lung lesions (sequestra) for up to two years. These animals may shed organisms, particularly when stressed (Rovid, 2008). The disease is manifested by anorexia, fever and respiratory signs such as dyspnoea, polypnoea, cough and nasal discharges in cattle (OIE, 2014; Wade et al., 2015).

Although CBPP was once found worldwide, it was eradicated from most continents, by the mid-20th century. Its incidence also began to decline in Africa by the 1970s. However, because of the economic and financial difficulties that affected the ability of governments to adequately fund Veterinary Services, the disease came back in the late 1980s and early 1990s (Tambi et al., 2006; Rovid, 2008). Major CBPP epidemics have been experienced in Eastern, Southern, and West Africa over the last few years. It currently affects 27 countries in Africa at an estimated annual cost of US $ 2 billion (Otte et al., 2004). A total of 2,719 outbreaks were reported in Africa between 1995 and 2002. Countries in East Africa reported 66% of the total outbreaks (58% in Ethiopia and Tanzania, and 8% in other countries in the region) (Tambi et al., 2006; Alemayehu et al., 2014).

The livestock subsector currently supports and sustains livelihoods for 80% of all rural population in Ethiopia. However, transboundary animal diseases such as CBPP constrain the livestock sector of the country and affect livelihoods via their impact on animal health, animal food production, availability and quality. Furthermore, CBPP is one of the major diseases in Ethiopia that hampers the export of livestock and livestock products to the international markets (Gedlu, 2004; Alemayehu et al., 2014). Pastoral areas output underpins almost all of Ethiopia's live animal and meat exports. Generally, CBPP is a threat for Ethiopian livestock export market and a well-established disease in Oromia Regional State especially in pastoral areas of Borana and Bale where the animals originated (Kassaye and Molla, 2013).

Contagious bovine pleuropneumonia (CBPP) is both an epidemic and endemic disease of cattle that affects production through mortality and reduction in productivity. It also retards genetic improvement and limits working ability of cattle. The economic impacts of CBPP in a number of African countries, including Ethiopia were studied (Tambi and Maina, 2004). Accordingly, cattle in CBPP-infected areas (epidemic and endemic) are divided into three classes namely, calves and yearlings below 3 years, adult males, and reproductive females. The losses due to CBPP (epidemic and endemic) are measured as the number of deaths that occur per class of animal, the quantity of beef lost for each class of animal, the quantity of milk lost from reproductive females and the loss in draft power from oxen (Gedlu, 2004).

In Ethiopia, the average physical losses from CBPP in terms of cattle deaths are 25,115 heads (8,372 in endemic and 16,743 in epidemic), 1,852 and 13,396 metric tons of beef and milk, respectively. In terms of animal power, averages of 3,135,000 ox days are lost. The country experiences the largest number of cattle deaths, and reduction in cattle products under both endemic and epidemic conditions compared to the other African countries, due probably to its large cattle population (Tambi and Maina, 2004). Although vaccination has been considered as a strategy for the control of CBPP in Ethiopia for the last 30 years, the disease still persists in several regions of the country, with its incidence increasing from year to year (Gedlu, 2004). This is, mainly due to lack of effective vaccine, irregular and low rate/coverage of vaccination, lack of livestock movement control, and absence of systematic disease surveillance and reliable data. For the time being, therefore, mass vaccination and where possible control of animal movement remains the most practical option in sub-Saharan Africa (Litamoi, 2000).

The vaccines are exclusively monovalent live attenuated freeze-dried products derived from broth culture of *T1SR* (streptomycin resistant variant) or *T1/44* seed strains of *M. mycoides* subspecies *mycoides* that gives protection for 6 months up to one year. The other vaccines are *V5, KH3J* that gives protection for 2 and 6 months (Bamhare, 2000).

Various studies have been conducted to determine the sero epidemiology of CBPP in various regions of

*Corresponding author. E-mail: minda.asfaw@gmail.com.

Ethiopia. Studies conducted by Beyene (1997) in Western Ethiopia, Takele (1998) in North West Ethiopia, Wondimu (1996) in Southern Ethiopia, NAHRC (2000) in different regions of the country, Issa (2004) in Borena zone, Gedlu (2004) in Somali Region and Regassa (2001) in West Wollega zone revealed that the disease was prevalent in different region of the country for over a decade. Recently, study conducted by Kassaye and Molla (2013), and Alemayehu et al. (2014) at export quarantine centers in and around Adama and bulls' originated from Borena pastoral area, respectively, revealed that CBPP is posing a major threat to cattle in many parts of the country thereby causing considerable economic losses through morbidity and mortality and warranting serious attention.

Although all the above study revealed that CBPP was seriously devastating the cattle production industry in Ethiopia, there is no published data (information) about the sero epidemiology of this disease in cattle production system in Bale Zone in general and in Dello Mena and Sawena districts in particular. This scarcity of information on the presence and sero epidemiology of CBPP in livestock production may reflect a lack of resources for disease surveillance and control in the cattle production system. In addition, most livestock disease outbreaks, particularly in more remote parts of the country, remain undiagnosed and therefore, information on the sero epidemiology and significance of CBPP can only readily be obtained through serological studies in order to apply control measures based on mass vaccination or effective movement control.

Hence, this study was conducted: (i) To determine the sero-epidemiology of CBPP and putative risk factors exposing to CBPP that potentially affects the cattle production system in the selected pastoral districts of Bale Zone, and (ii) To assess knowledge, attitude and practices (KAP) of the households HHs (pastoralists/herdsmen) about the disease. Therefore, our study could be a foil for the paucity of information about the sero-epidemiology of CBPP, putative risk factors exposing to the disease, and knowledge, attitudes and practices of the pastoralists/herdsmen in the cattle production system of the two selected districts of the study areas.

MATERIALS AND METHODS

Description of the study area

The study was conducted in two selected districts of Bale Zone namely, Dello Mena and Sawena districts of Bale Zone, Oromia Regional State, south east of Ethiopia. The two study districts were selected purposely to represent the cattle rearing districts of the zone based on their agricultural vocational activities and ecological conditions.

Dello Mena is located in the south western part of Bale zone and is 555 km south east of Addis Ababa. It shares borders with Madda Walabu district in the south, Goba district in the north, Harena Buluk district in the west and south west, Berbere district in north east and Guradhamole in the east. It has a total area of 1,339 km^2 ranking it the 14th largest district. The mean annual temperature of the district is 29.5°C with the lowest and highest temperatures being 21 and 38°C, respectively. The mean annual rainfall is 701.5 mm; with the lowest and highest rainfall being 628mm and 775 mm, respectively. The lowland area predominates with a narrow strip of high land area in the northern part of Dello Mena district. From early days, livestock rearing has played an important role in the life of district population. In the rural and lowland areas of the district, rearing and breeding is the main stay of the people. There are about 312, 400 bovines, 5,122 sheep, 61, 626 goats, 11, 436 equines and 31, 644 camels (DMDAO, 2015).

Sawena district is located in the eastern part of Bale zone and is 623 km south east of Addis Ababa. It is bounded by Laga Hida district in the North, Ginir district and Gololcha district in the west, Rayitu district in the south and Somalia National State in the east. It has a total area of 8289 km^2 ranking it the second largest among the districts. The mean annual temperature of the district is 35°C with the lowest and the highest temperatures of 30 and 40°C, respectively. The mean annual rainfall is 375 mm whereas the lowest and highest rainfall is 250 and 500 mm, respectively. Unlike Dello Mena, surface water is a serious problem in Sawena district, where only seasonal streams, ephemeral ponds and shallow temporary wells are sources of water in the rainy season and these usually dry out after a few days during the dry season. Sawena district has a very large livestock resource. It has a pastoral vocation with livestock rearing being the dominant economic activity in the district. In the rural and lowland areas of the district, rearing and breeding is the main stay of the people. There are about 52,740 bovines, 14,645 sheep, 46,450 goats, 4,603 equines and 26,586 camels (SDAO, 2015).

Study population

The target study population comprised cattle above six months of age in the two selected districts. The status of CBPP in Dello Mena and Sawena districts was unknown since no study had been conducted in the two districts before. The study animals consisted of 384 cattle above six months of age with no history of CBPP vaccination. Cattle were selected for sample collection using the simple random method for both districts.

Study design

A cross sectional study supported by questionnaire survey was conducted to determine the sero-epidemiology of CBPP and its associated risk factors in pastoral vocation with livestock rearing being the dominant economic activity of the two selected districts.

Questionnaire survey was conducted to have information on the clinical signs of cattle diseases in the afore-mentioned districts. In the two selected districts cattle owners were interviewed with semi-structured questionnaire. Emphasis was given on the frequent clinical symptoms manifested whenever outbreaks of cattle diseases occurred in the respective study sites. Tentative diagnosis was made based on the classical disease manifestation and treatment was provided for diseased animals accordingly. The questionnaires were prepared, pre-tested and adjusted by translating in to local language (Afan Oromo) and administered by the interviewer. The questionnaire focused on the potential risk factors and was conducted after carefully explaining the purpose of the work to the interviewees.

Sampling method and determination of sample size

The sample size required for the study was calculated according to the formula given by Thrusfield (2007) for simple random sampling.

$$n = \frac{(1.96)^2 P_{exp}(1 - P_{exp})}{d^2}$$

Where n = required sample size, Pexp = expected prevalence, and d = desired absolute precision.

Since there has been no research conducted in this area; the sample size was calculated at 95% CI, 5% desired absolute precision and expected prevalence of 50%. Accordingly, the total numbers of sample required for this study was 384 cattle above six months of ages.

Dello Mena district contains 17 kebeles while Sawena district contains 28 kebeles. Five kebeles from each district were selected purposely by their proximity to roads, accessibility of infrastructure and cattle population holdings of each kebele. Prior to commencement of the study, list of HHs of those kebeles (sampling frame) was obtained from both district Agricultural offices. The sample size of HHs was determined using the formula recommended by Arsham (2007) for survey studies.

$N=0.25/(SE)^2$

Where: N = sample size and SE= standard error of the proportion.

Assuming the standard error of 4.1% at a precision level of 5%, and the confidence interval of 95%, 150 HHs owning cattle were selected by a simple random sampling technique for interview. The numbers of HHs selected per kebeles were fixed based on the proportion of HHs owning cattle in each kebele.

Inclusion criteria

Cattle above six months of ages without a history of vaccination for CBPP were included.

Exclusion criteria

Apparently healthy cattle with history of CBPP vaccination were excluded (Actually no CBPP vaccination had been given in the selected districts).

Sera collection

Animals were restrained by animal handlers and 10 ml of blood sample was collected from the jugular vein using vacutainer tubes with 18 to 20 gauge hypodermic needles. Vacutainer tubes with blood samples were then labeled with tag number of animals set tilted on a table overnight at room temperature to allow clotting and kept protected from direct sun light until the blood clotted and sera were separated. Then serum was filled into serum storage vials (cryovials) with appropriate identification and stored at -20ºC until transported to National Veterinary Institute (NVI) and the C-ELISA was performed. Corresponding to each sample, age, sex, breed of each animal, body condition, geo-reference information and other risk factors contributing to the occurrence of CBPP were collected and registered on a separate case book.

Serological testing

Competitive Enzyme Linked Immunosorbent Assay (C-ELISA) test was conducted as recommended by CIRAD-UMR15 (FAO and OIE World reference centre for CBPP) based on a monoclonal anti-*Mmm* antibody named *Mab* 177/5 as described previously (LeGoff and Thiaucourt, 1998). The test was undertaken at NVI, Bishoftu, Ethiopia. Sera samples were mixed with specific monoclonal antibody (*Mab 117-5*) in a dilution plate and were incubated with gentle agitation at 37°C for one hour, and then it was transferred into the *Mmm* coated microplate. After washing, anti-mouse IgG serum conjugated-horse radish perioxidase (HRP) was added. After series of washings the HRP substrate (TMB) was added forming a blue compound that was turned yellow when the reaction stopped. The optical density (OD) was read in an ELISA reader at 450 nm and the cut off points were calculated to validate the results. All sera with Percentage Inhibition (PI) > 50% was considered as positive. Sera with PI between 40 and 50% were considered doubtful and those sera with PI less than 40% were considered negative.

Data storage and analysis

Data generated from questionnaire survey and laboratory investigations were recorded and coded using Microsoft Excel spreadsheet (Microsoft Corporation) and analyzed using STATA version 11.0 for Windows (Stata Corp. College Station, TX, USA). The sero-epidemiology of CBPP was calculated as the number of sero-positive samples divided by the total number of samples tested. Association of sero-positivity with the potential risk factors (origin, age, sex, body condition, breed type, herd size, vaccination history, contact with other herds and etc.) was computed by Chi-square test and logistic regression (both simple and multiple). Regression models are used to explore the relationships between a dependent or response variable (CBPP in this case) and one or more independent or predictor variables of interest (risk factors in this case). A P-value <0.05 was considered statistically significant.

RESULTS

Knowledge, attitudes and practices of the respondents about contagious bovine pleuropneumonia

The educational level of the respondents involved in cattle production system in the two selected pastoral districts of Bale Zone were diverse from literate to illiterate people in that they had degree (4.67%), diploma (10.67%), grade 9 to 12 (32.67%), grade 1 to 8 (35.33%) and no formal education training (16.67%). Of the 150 HHs (herdsmen/pastoralists) that responded, 125 (83.33%) could at least read and write in English language. The study finding, astonishingly, revealed that as the disease was the only culling criteria for cattle from the rest herds than feeding system in the study settings. The study illustrated that only about 21.33% of the HHs (pastoralists/herdsmen) in the study area had knowledge about CBPP threat while about 74% of the respondents stated that the disease was the main cause of meat and milk reduction in the cattle production of the study area. All the HHs included in the study reported uncontrolled movement, and search for feed and water as the main intention for cattle movement in the study districts. In addition to this, all of the respondents (pastoralists/herdsmen) stated that as there was no CBPP test and provision of vaccine for their cattle by the government as illustrated in Table 1.

Table 1. Knowledge, attitudes and practices (KAP) of the risk factors exposing to CBPP of the respondents with their educational level in the study districts.

Variable category	Educational level of the respondents					
	Degree(N=7) n (%)	Diploma(N=16) n (%)	Grade 9-12(N=49) n (%)	Grade 1-8(N=53) n (%)	No educational level(N=25) n (%)	Total n (%)
Culling criteria(problems)						
Disease	7(4.67)	16(10.67)	49(32.67)	53(35.33)	25(16.67)	150(100)
Feed	-	-	-	-	-	-
Both	-	-	-	-	-	-
Meat and milk reduction causes						
Diseases	3(2.7)	11(9.91)	41(36.94)	39(35.13)	17(15.31)	111(74)
Old age	-	-	3(30)	4(40)	3(30)	10(6.67)
Poor production	4(13.79)	5(17.24)	5(17.24)	10(34.48)	5(17.24)	29(19.33)
Knowledge about cattle developing CBPP						
No	-	4(3.27)	36(29.51)	53(46.72)	25(20.49)	118(78.67)
Yes	7(21.88)	12(37.5)	13(40.63)	-	-	32(21.33)
Uncontrolled movement of cattle in the area						
Yes	7(4.67)	16(10.67)	49(32.67)	53(35.33)	25(16.67)	150(100)
No	-	-	-	-	-	-
Uncontrolled movement purpose						
For feed and water	7(4.67)	16(10.67)	49(32.67)	53(35.33)	25(16.67)	150(100)
Draught	-	-	-	-	-	-
Illegal trade	-	-	-	-	-	-
Replacement flock						
Buy in	-	3(21.43)	6(42.86)	5(35.71)	-	14(9.33)
Raise own replacement	7(5.15)	13(9.56)	43(31.62)	48(35.29)	25(18.38)	136(90.67)
Both	-	-	-	-	-	-
Observation of large volume of yellow fluid in the chest after the death of animal						
Yes	3(2.73)	13(11.82)	31(28.18)	47(42.73)	16(14.55)	110(73.33)
No	4(10)	3(7.5)	18(45)	6(15)	9(22.5)	40(26.67)
CBPP Test						
Yes	-	-	-	-	-	-
No	7(4.67)	16(10.67)	49(32.67)	53(35.33)	25(16.67)	150(100)
CBPP Vaccine						
Yes	-	-	-	-	-	-
No	7(4.67)	16(10.67)	49(32.67)	53(35.33)	25(16.67)	150(100)

N, total number of the respondents; n, number of respondents for specific interview.

Table 2. Overall seroprevalence of C-ELISA test result of cattle from the study districts.

C-ELISA test result	Dello Mena	Sawena	Total	Overall seroprevalence (%)	χ^2 (*p*-value)
	No. of animal tested (%)	No. of animal tested (%)			
Positive	19(8.26)	6(3.89)	25	6.51	
Negative	211(91.74)	148(96.1)	359	93.49	2.887(0.089)
Total	230(100)	154(100)	384	100	

Table 3. Seroprevalence of contagious bovine pleuropneumonia in different selected kebeles of Dello Mena and Sawena districts.

Selected kebeles from the two districts	Positive samples (No.)	Negative samples (No.)	Total	Prevalence (%)	df	χ^2 (*p*-value)
Dello Mena						
Burkitu	3	44	47	6.38		
Chiri	6	51	57	10.53		
Gomgoma	0	41	41	0		
Hi-Oda	7	37	44	15.91		
Wabaro	3	38	41	7.32		
Sawena					9	17.134(0.084)
Arele	0	28	28	0		
Gale	0	24	24	0		
Kasho	2	33	35	5.71		
Laku	0	27	27	0		
Shaku	4	36	40	10		

df, Degree of freedom; No., Number; χ^2, Chi-square; *p*, Precision value.

Overall seroprevalence of contagious bovine pleuropneumonia in the study districts

In the present study, an overall sero-prevalence of 6.51% was determined by the C-ELISA test. A higher sero-prevalence of 8.26% was observed in Dello Mena when compared to Sawena (3.89%) but there was no significant association between the study districts and CBPP sero-positivity as depicted in Table 2.

Sero-positivity of contagious bovine pleuropneumonia in selected kebeles of the study districts

Of 5 kebeles selected from Dello Mena district, Hi-Oda had the highest CBPP sero-positivity (15.91%) while Shaku (10%) from Sawena district had the highest sero-positivity among the 5 kebeles selected.

However, no CBPP sero-positive cattle were found in 4 kebeles (one (1) from Dello Mena and three (3) from Sawena) of the study districts. There was no significant association ($p>0.05$) between the selected kebeles of the study pastoral districts and CBPP sero-positivity (Table 3).

Chi-square analysis of association of the putative risk factors with contagious bovine pleuropneumonia sero-positivity

A chi-square analysis revealed age, sex, breed, body condition score and purpose of rearing cattle were significantly associated ($p< 0.05$) with CBPP sero-positivity among the putative risk factors considered during the study as indicated in Table 4.

Multivariable logistic regression analysis of putative risk factors associated with CBPP sero-positivity

The logistic regression analysis of the putative risk factors indicated that cattle used for the purpose of draft power were more likely to be infected (AOR=49.052; 95% CI: (3.836-627.310) by CBPP disease than cattle used for milk and beef as depicted in Table 5.

DISCUSSION

Knowledge, attitudes and practices of the respondents about contagious bovine pleuropneumonia

The study discovered the local name of CBPP to be

Table 4. Chi-square analysis of association of the putative risk factors with CBPP sero-positivity.

Variable	No. of animals tested	No. of animals positive N (%)	df	χ^2 (*p*-value)
Origin			1	2.887(0.089)
Dello Mena	230	19(8.26)		
Sawena	154	6(3.89)		
Age			1	5.738(0.017*)
Adult	293	24(8.19)		
Young	91	1(1.09)		
Sex			1	11.105(0.001**)
Female	215	6(2.79)		
Male	169	19(11.24)		
Breed			1	6.067(0.014*)
Local	371	22(5.93)		
Cross	13	3(23.1)		
Body condition score			2	6.063(0.048*)
Poor	117	13(11.11)		
Medium	181	9(4.97)		
Good	86	3(3.49)		
Contact with other herd			1	1.862 (0.172)
Yes	259	25(6.96)		
No	25	0		
Herd size			2	3.610(0.164)
Small	23	0		
Medium	147	7(4.76)		
Large	214	18(8.41)		
Purpose of rearing cattle			2	14.877(0.001**)
Milk	202	4(1.98)		
Beef	34	3(8.82)		
Draft power	148	18(12.16)		

No., Number; *, Statistically significant;**, Highly statistically significant; df, degree of freedom; χ^2, chi-square; *p*, precision value.

"dhukkuba sombaa" in Dello Mena and Sawena districts of Bale Zone. The high level of literacy among the HHs (pastoralist/herdsmen) in which 83.33% were literate disagrees with the report of Tahir (2001), who stated that pastoralists and their children have little or no access to formal education. The HHs (pastoralists/herdsmen), astonishingly, responded that as the disease was the only culling criteria for cattle from the rest herds than feeding system in the study settings. Communities in this study had a low (21.33%) level of awareness of CBPP when compared with the work of Tambuwal et al. (2011) and Billy et al. (2015) who reported a high level in the two transboundry states of north-western Nigeria (65.0%) and in Kaduna State of Nigeria (88.9%), respectively. This low level of awareness could be attributed to the rare outbreaks of CBPP.

About 111(74%) of the respondents (pastoralists/herdsmen) stated that the disease was the main cause of meat and milk reduction in the cattle production system of the study areas. All of the HHs (pastoralists/herdsmen) included in the study linked uncontrolled movement, and search for feed and water as the main intention for cattle movement in the study districts. In addition to this, all of the respondents (pastoralists/herdsmen) stated that as there was no CBPP test and provision of vaccine for their cattle by the government. In contrast to this finding, Aliyu et al. (2000) in northern Nigeria, Tambuwal et al. (2011) in the two transboundry states of north-western Nigeria and Billy et al. (2015) in Kaduna State of Nigeria reported 14.2, 32.5 and 36.7% vaccination coverage, respectively. The absence of CBPP test and vaccination coverage in the study area is possibly due to decreased awareness of the disease and absence of veterinary services.

Sero-epidemiology and putative risk factors exposing to contagious bovine pleuropneumonia

The present serological study established the presence of antibodies of CBPP among sampled cattle from two pastoral districts, Dello Mena and Sawena, of Bale Zone.

Table 5. Multivariable logistic regression analysis of putative risk factors associated with CBPP sero-positivity.

Variable	No. of animals examined	No.(%) of positive c-ELISA	Crude odds ratio (95%CI)	Adjusted odds ratio (95%CI)
Age				
Young	91	1(1.09)	1	1
Adult	293	24(8.19)	8.030(1.071, 60.203)*	11.005(1.304,92.858)*
Sex				
Female	215	6(2.79)	1	1
Male	169	19(11.24)	0.227(0.088,0.581)*	5.875(0.598,57.741)
Breed				
Local	371	22(5.93)	1	1
Cross	13	3(23.1)	4.759(1.221,18.547)*	2.960(0.636, 13.768)
Body condition				
Poor	117	13(11.11)	1	1
Medium	181	9(4.97)	0.289(0.080,1.048)	0.217(0.055,0.846)*
Good	86	3(3.49)	0.419(0.173,1.013)	0.303(0.116,0.796)*
Purpose of rearing cattle				
Beef	34	3(8.82)	1	1
Milk	202	4(1.98)	4.790(1.023, 22.436)*	13.253(1.920,91.455)*
Draft power	148	18(12.16)	6.854(2.268,20.709)**	49.052(3.836,627.310)*

No., Number; CI, Confidence interval; *, Statistically significant; **, Highly statistically significant; 1, Reference.

An overall sero- prevalence of 6.51% was obtained using c-ELISA from the two districts.

This finding is comparable to 9.4% in Borena (Ahmed 2004), 9.7% in south-western Kenya (Schnier et al., 2006), 9.1% in northwest Ethiopia (Gashaw, 1998) and 4% in and around Adama, central Ethiopia (Kassaye and Molla, 2013). However, the overall sero-prevalence was lower than the work of Daniel et al. (2016) in Western Oromia (28.5%), Gedlu (2004) in Somali Regional State (39%) and Dejene (1996) in North Omo (56%) of Ethiopia. The variation in prevalence reported from different parts of Ethiopia and other countries could be because of differences in agro ecological systems, cattle management and production systems, population density, sample size and the types of tests used to determine the sero-prevalence (Daniel et al., 2016).

The present study revealed that cattle from the two pastoral districts (origin) of Bale Zone was negatively associated with CBPP sero-positivity (p>0.05) and the results showed a relatively higher individual cattle sero-prevalence of CBPP in Dello Mena (8.26%) compared to Sawena (3.89%) district. A relatively higher sero-positivity of CBPP recorded in Dello Mena when compared to that of Sawena district could be attributed to more cattle that were sampled from Dello Mena, the presence of larger herds and communal grazing areas, making contact with infected animals more likely. This justification could be similar with the study conducted in Somali Regional State by Gedlu (2004). Of 10 kebeles selected from the two districts, the highest sero-epidemiology of CBPP was observed in Hi-Oda Kebele (15.91%) while no CBPP sero-positivity was found in four kebeles of the two pastoral districts. In contrast to this finding Daniel et al. (2016) reported the highest sero-positivity of CBPP in Gobbu Sayyo (40.3%) than in Bakko Tibbe (19%) and Horro (5.7%) districts of Western Oromia while Gashaw (1998) reported the highest seroprevalence of CBPP in Banja (66. 3%) than in Dangila (41.7%) and Denbecha (33.3%) districts of Western Gojam and Awi Zone.

Age was considerably associated with the sero-positivity of CBPP as detected by C-ELISA, which corroborates with the finding of Kassaye and Molla (2013) who reported that age was found significantly (p<0.05) associated with the occurrence of CBPP in which a high sero-prevalence was recorded in aged (9.5%) animals than young (3%) at export quarantine centers in and around Adama. In addition to this, the study conducted by Boelaert et al. (2005) revealed that increasing age is a surrogate measure of repeated exposure.

But adult CBPP cattle carriers'(7.2%) showed a relatively higher numerical value over the young (4.4%) this connotes to previous studies conducted by Mtui-Malamsha (2009) and Ikpa et al. (2010). This could be associated to the fact that chronic stages of the disease are usually seen in adult cattle as the age progresses (Olabode et al., 2013).

A relatively higher sero-positivity rate among the male (11.24%) compared to the female animals (2.79%) was significantly associated with the sero-positivity of CBPP (p<0.05). Though our result revealed that as sex of the animal was positively associated with the sero-positivity

of CBPP, the sero-epidemiology of CBPP reported in male and female cattle of the two pastoral districts was lower than that of Daniel et al. (2016) who reported the prevalence of 30.9% in male and 27.04% in female animals in Western Oromia with no significant difference ($p > 0.05$) in the occurrence of CBPP. This could be attributed to lowered immunity following continuous reproductive stress as buttressed by the age frequency of the disease in adult cows (Olabode et al., 2013). Our finding also contradicts the work of Schnier et al. (2006) and Olabode et al. (2013), who reported a significantly higher prevalence in female animals, in the Maasai ecosystem of south-western Kenya and Kwara state of Nigeria, respectively.

A higher seroprevalence was recorded in cross (23.1%) than in local breeds (5.93%) in the present study. The difference was also positively associated with CBPP sero-positivity ($p<0.05$). This finding coincided with that of Daniel et al. (2016) who reported a higher sero-positivity of CBPP in cross (37.2%) than in local breeds (27.4%) but their finding revealed a negative association of breed with sero-positivity of the disease($p>0.05$).

The body condition score of the animals was positively associated ($p<0.05$) with the occurrence of the disease in which a relatively higher sero-positivity was recorded in animals with poor body condition score (11.11%) than in animals with medium (4.97%) and good body condition score (3.49%). This finding is consistent with the study of Atnafie et al. (2015) who reported a significant association of body condition score with the CBPP sero-positivity in abattoirs at Bishoftu and export oriented feedlots around Adama in which a high seroprevalence was recorded in animals with poor body condition (18%) than in medium (12.5%) and good body condition score (6.4%), which was significantly associated with the occurrence of the disease ($p<0.05$). Nevertheless, our finding do not agree with the work of Daniel et al. (2016) who reported no significant association of body condition score with CBPP sero-positivity.

The current study established that CBPP sero-positivity was insignificantly associated with the contact of the animals with other herds (at watering points and animals brought into herds). There was no any suggestion on previous studies that is parallel with this finding in Ethiopia. Though the contact of the animals with other herd was negatively associated with the CBPP sero-positivity, the higher seroprevalence was observed in animals in contact with other herd at watering points and communal grazing (6.96%) than in animals with no contact with the other herds(confined in the feedlots/tied in the garden). This could be explained by the contact structure, herd size and seasonal herding practices influence CBPP disease distribution patterns (Mariner et al., 2006).

Herd size of the animals sampled from the study pastoral districts was found negatively associated ($p>0.05$)) with the occurrence of the disease. However, a relatively higher sero-positivity of CBPP was observed in larger (8.41%) than in medium herd sizes of the cattle sampled (4.76%) while no CBPP sero-positivity was observed in cattle from small herd sizes. This area needs an indebt study to unveil the factors responsible for this difference.

Reductions in the production of beef, milk and draft power were considered as morbidity losses. The present study established the association of the purpose of rearing cattle (beef/milk/draft power) with CBPP sero-positivity. A relatively higher seroprevalence of CBPP was observed in animals (bull/oxen) used for draft power (12.16) than the cattle used for beef (8.82%) and milk (1.98%). This revealed that the animals (bull/oxen) used for draft power was most likely infected by the disease. There was no any hint in previous studies that is parallel with this finding elsewhere and it needs an indebt study to divulge the factors responsible for the variation of CBPP sero-positivity in cattle used for beef, milk and draft power. Tambi et al. (2006) discussed in their review the loss in draft power resulted in economic turn down and was estimated as the product of the number of infected oxen and the number of workdays per year while the loss in beef production by infected animals was used as a surrogate for the absence of weight gain since diseased animals are assumed not to gain weight. They may even lose weight depending upon the severity of the infection. In addition to this, the economic significance of CBPP in animals reared for the purpose of milk (reduction in milk production) was also estimated from the number of infected reproductive females.

These are the animals that show clinical signs, estimated as the product of the number of reproductive females at risk and the transition rate from exposed to the state of infection. The rate of transition from exposed to state of infection was obtained from Mariner et al. (2006).

Conclusion

This study established a relatively high seroprevalence of CBPP in cattle in two pastoral districts of Bale Zone in south eastern part of Ethiopia, suggesting the disease could be causing considerable economic losses through morbidity and mortality. A relatively higher seroprevalence was observed in Dello Mena when compared to Sawena district with insignificant difference. In addition, age, sex, breed, body condition score and purpose of cattle rearing were significantly associated with CBPP sero-positivity. However, origin, contact with other herds and herd size of the cattle were insignificantly associated with CBPP sero-positivity. The occurrence of the disease may cause restriction on the trade of animals and animal products internationally, affecting the export earnings of the country, thereby threatening the livelihood of the farmers and national agricultural economy. In conclusion, the prevailing CBPP sero-positivity in the two

districts indicates the importance of CBPP in the pastoral cattle production system of the study settings.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The author acknowledge Madda Walabu University, Research, Community Engagement and Technology Transfer Vice President office for parental support and encouragement in financial support for purchasing sample collection equipment and good will gesture extended to them during the request for all supports during the research. Their special thanks go to Dello Mena and Sawena districts animal health technicians for their positive collaboration in mobilization of farmers during sample collection. They are grateful to Dr. Bekele, Sawena district livestock health office veterinarian, Mr. Mesele Esatu, animal health technician of Dello Mena district for their collaborative work in sample collection, separation of sera sample from the collected blood and data recording. They sincerely appreciate the support and technical advice from Mr. Mulugeta, Laboratory Technologist at National Veterinary Institute.

REFERENCES

Ahmed I (2004). Epidemiological study of contagious bovine pleuropneumonia in Borana pastoral areas using complement fixation test and competitive enzyme-linked immunosorbent assay. Thesis for degree of Master of Veterinary Epidemiology, Faculty of Veterinary Medicine, University of Addis Ababa, Debrezeit, Ethiopia.

Alemayehu G, Leta S, Hailu B (2014). Low seroprevalence of contagious bovine pleuropneumonia (CBPP) in bulls originated from Borena pastoral area of Southern Ethiopia. Anim. Vet. Sci. 2(6):213-217.

Aliyu MM, Obi TU, Egwu GO (2000). Prevalence of contagious bovine pleuropneumonia (CBPP) in Northern Nigeria. Prev. Vet. Med. J. 47:263-266.

Arsham H (2007). Questionnaire design and survey sampling. http//www.mirror.service. Org/site/ hom. Ubaltedu/ ntsbarsh/Business-stat. Acessed July, 2015.

Atnafie B, Goba H, Sorri H, Kasaye S (2015). Seroprevalence of contagious bovine pleuropneumonia in abattoirs at Bishoftu and export oriented feedlots around Adama. Global Vet. 15(3):321-324.

Bamhare C (2000). Contagious bovine pleuropneumonia surveillance in vaccinated areas: Namibia experience with contagious bovine pleuropneumonia vaccines prepared from the T1-44 and T1-SR Strains. In: Report of second meeting of the FAO/OIE/OAU/IAEA consultative group on Contagious Bovine Pleuropneumonia (CBPP). Rome, Italy. pp. 79-87.

Beyene D (1997). Seroepidemiological investigation of contagious bovine pleuropneumonia in Illubabor and Wellega. DVM Thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

Billy IL, Balami AG, Sackey AKB, Tekdek LB, Sa'idu SNA, Okaiyeto SO (2015). Awareness, knowledge and practices of pastoralists towards contagious bovine pleuropneumonia in Kaduna State, Nigeria. J. Vet. Med. Anim. Health 7(9):296-301.

Boelaert F, Speybroeck N, de Kruif A, Aerts M, Burzykowski T, Molenberghs G, Berkvens, DL (2005). Risk factors for herpesvirus-1 sero-positivity. Prev. Vet. Med. 69:285-295.

Daniel G, Abdurahaman M, Tuli G, Deresa B (2016). Contagious bovine pleuropneumonia: Seroprevalence and risk factors in Western Oromia, Ethiopia. Onderstepoort J. Vet. Res. 83(1):a958.

Dejene W (1996). Contagious bovine pleuropneumonia (CBPP): Prevalence and evaluation of post-vaccination immune response (North Omo, Konso and Dirashe Regions/Ethiopia). Thesis for degree of Doctor of Veterinary Medicine, Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia.

DMDAO (2015). Dello Mena District Agricultural Office.

FAO (2002). Recognizing contagious bovine pleuropneumonia. Food and Agriculture Organization of the United Nations Animal Health Manual, FAO, Rome. 13:3-17.

Gashaw T (1998). Epidemiological survey of CBPP in Awi and Western Gojjam zone of Amhara Region and comparison of CFT and C-ELISA for the diagnosis of CBPP. Thesis for degree of Master of Veterinary Epidemiology, Faculty of Veterinary Medicine, Addis Ababa University and Freie Universität, Berlin.

Gedlu MG (2004). Serological, clinical and participatory epidemiological survey of contagious bovine pleuropneumonia in Somali Region, Ethiopia. MSc Thesis. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Ethiopia. P 3.

Ikpa LT, Ankeli PI, Jambalang AR, Atuman YJ, Akalusi Y, Nwankpa N (2010). Detection of Contagious Bovine Pleuropnuemonia (CBPP) in mixed cattle breed farm in Bauchi state, Nigeria. In: the proceedings of the 47th Nigerian Veterinary Medical Association (NVMA) Conference held in Markurdi, Benue State on Monday 4th-Friday 8th October, 2010. pp. 171-172.

Issa A (2004). Epidemiological study of contagious bovine pleuropneumonia in Borena pastoral area using complement fixation test and competitive enzyme-linked immune sorbent assay (ELISA). MSc Thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.

Kassaye D, Molla W (2013). Seroprevalence of contagious bovine pleuropneumonia at export quarantine centers in and around Adama, Ethiopia. Trop. Anim. Health Prod. 45:275-279.

LeGoff C, Thiaucourt F (1998). A competitive enzyme linked immune sorbent assay for the specific diagnosis of contagious bovine pleuropnuemonia. Vet. Microbiol. 60:179-191.

Litamoi JK (2000). Overview of contagious bovine pleuropneumonia vaccine production and quality in Africa. In: Report of second meeting of the FAO/OIE/OAU/IAEA consultative group on contagious bovine pleuropneumonia (CBPP). Rome, Italy.

Mariner JC, McDermott J, Heesterbeek JAP, Thomson G, Martin SW (2006). A model of contagious bovine pleuropneumonia transmission dynamics in East Africa. Prev. Vet. Med. 73:55-74.

Mtui-Malamsha NJ (2009). Contagious Bovine Pleuropneumonia (CBPP) in the Maasai ecosystem of south-western Kenya: Evaluation of seroprevalence, risk factors and vaccine safety and efficacy. A thesis submitted for the degree of Doctor of Philosophy College of Medicine and Veterinary Medicine. The University of Edinburgh.

NAHRC (2000). Report on contagious bovine pleuropneumonia study in Ethiopia. Sero surveillance results, National Animal Health Research Centre Ethiopian Agricultural Research Organization (EARO), Sebeta, Ethiopia.

OIE (2001). Diagnostic tests for contagious bovine pleuropneumonia (CBPP). Report of the scientific Committee on Animal Health and Animal Welfare. Office International des Épizooties (OIE), Paris. 2-8.4.

OIE (2014). Contagious bovine pleuropneumonia. In: Manual of Diagnostic Tests and Vaccines for Terrestrial Animals. Paris, France: World Organization for Animal Health; Chapter, 2.4.9.

Olabode HOK, Mailafia S, Adah BMJ, Nafarnda WD, Ikpa LT, Jambalang AR, Bello RH (2013). Serological evidence of contagious bovine pleuropneumonia antibodies in trade cattle (*Bos indicus*) sold in Kwara state-Nigeria. Online Int. J. Microbiol. Res. 1(1):14-19.

Otte MJ, Nugent R, Mcleod A (2004). Transboundary animal diseases: Socio-economic impacts and institutional response. FAO Livestock policy discussion paper 9.

Regassa F (2001). Herd prevalence of contagious bovine pleuropneumonia, bovine tuberculosis and dictyocaulosis in Bodji Woreda, West Wellega. DVM Thesis. Addis Ababa University, Faculty

of Veterinary Medicine, Debre zeit, Ethiopia.
Rovid SA (2008). Contagious bovine pleuropneumonia. The center for food security and public health, Iowa State University. College of Veterinary Medicine. http://www.cfsph. A state. Edu. Accessed July, 2015.
Schnier C, Mtui-Malamsha NJ, Cleaveland S, Kiara H, Grace D, McKeever DJ (2006). Contagious bovinepleuropneumonia seroprevalence and associated risk factors in the Maasai ecosystem of south-western Kenya. Proceedings of the 11th International Symposium on Veterinary Epidemiology and Economics, August 6-11, 2006, Cairns, Australia.
SDAO (2015). Sawena District Agricultural Office
Tahir G (2001). Current mandates, activities, achievements, constraints and recommendations. A position paper presented at National Workshop on the strengthening the livestock component of the Unified Agricultural Extension System (UAES). Organized by the National Livestock Projects Division, Department of Livestock and Pest Control Services, Federal Ministry of Agriculture and Natural Resources, held at Arewa House Kaduna, 14th May.
Takele G (1998). Epidemiological survey of contagious bovine pleuropneumonia in Awi and Western Gojam zone of Amhara Region and comparison of CFT and C-ELISA for the diagnosis of contagious bovine pleuropneumonia. MSc Thesis. Addis Ababa University and Free University of Berlin.
Tambi EN, Maina OW (2004). Regional impact of contagious bovine pleuropneumonia in Africa. In: Regional Workshop on Validation of Strategies to Control CBPP in Participative PACE countries. Conakry, Guinea.
Tambi NE, Maina WO, Ndi C (2006). An estimation of the economic impact of contagious bovine pleuropneumonia in Africa. Rev. Sci. Technol. Off. Int. Epiz. 25(3):999-1012.
Tambuwal FM, Egwu GO, Shittu A, Sharubutu GH, Umaru MA, Umar HU, Mshelia PC, Garba S (2011). Vaccination coverage and prevalence of contagious bovine pleuropnuemonia (1999-2008) in two transboundary states of north-western Nigeria. Nig. Vet. Med. J. 32:169-173.
Thrusfield M (2007). Sample size determination. In: Veterinary Epidemiology. 3rd ed., UK: BlackwellScience Ltd. pp.185-189.
Wade A, Yaya A, El-Yuguda AD, Unger H, Nafarnda Daniel W, Ikechukwu ES, Egwu GO (2015). The Prevalence of Contagious Bovine Pleuropneumonia in Cameroon: A Case Study Garoua Central Abattoir, Cameroun. J. Vet. Med. Res. 2(4):1029.
Wondimu D (1996). Contagious bovine pleuropneumonia: Prevalence and evaluation of post vaccination immune response (North Omo, Konso and Dirashe Regions/Ethiopia). DVM Thesis. Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia.
Yaya A, Manso-Silvan L, Blanchard A, Thiaucourt F (2008). Genotyping of *Mycoplasma mycoides subsp. mycoides* small colony by multilocus sequence analysis allows molecular epidemiology of contagious bovine pleuropneumonia. Vet. Res. 39:14.

academicJournals

Vol. 9(5), pp. 133-144, May 2017
DOI: 10.5897/JPHE2016.0898
Article Number: 05FFC4D63795
ISSN 2141-2316

http://www.academicjournals.org/JPHE

Journal of Public Health and Epidemiology

Full Length Research Paper

Magnitude of maternal complications and associated obstetric factors among women who gave birth by cesarean section at Arba-Minich General Hospital, Southern Ethiopia: Retrospective cohort

Melkamu Biniyam Wae[1], Fanuel Belayneh[2], Niguse Mekonnen[3]* and Feleke Hailemicheal[3]

[1]Arbaminch General Hospital, Gammo Goffa Zone, Ethiopia.
[2]School of Public and Environmental Health, College of medicine and Health Sciences, Hawassa University, Hawassa, Ethiopia.
[3]School of Public Health, College of Health Sciences, Wolaita Sodo University, Wolaita Sodo, Ethiopia.

Received 29 November, 2016; Accepted 14 March, 2017

Cesarean section is the most common major surgical procedure in obstetrics and gynecology in the world. Though advance in cesarean section technique, it still poses higher maternal morbidity and mortality than vaginal delivery. This study aimed to determine the magnitude of maternal complications (Including the presence of one of the intera-operative surgical complication or postoperative maternal complication; postoperative complication-is defined as the existence of one of the following; febrile morbidity, extended antibiotics treatment, extended hospital stay, wound infection (SSI), deep venous thrombosis (DVT), pneumonia, admission to Intensive Care Unit (ICU), drop in hemoglobin/hematocrit (HCT/HGB), blood transfusion, postpartum hemorrhage (PPH) maternal death in the Hospital) and associated obstetric factors among women who delivered by cesarean section at Arba-Minch General Hospital, Sothern Ethiopia Hospital based retrospective cohort study was conducted among women who delivered by cesarean section from July 8, 2013 to August 6, 2014 at Arba-Minch General Hospital. Demographic data, obstetric factors and occurrence of intra-operative and postoperative maternal complication during their hospital stay were collected using a pre-tested data collection format. SPSS version 20.0 was used for data analysis. A total of 416 mothers' charts were reviewed. The mean (±SD) age of the mothers was 25.72 (±5.175 years). Emergency cesarean delivery accounted for 87% of all cesarean deliveries. Fetal distress, Cephalo Pelevic Disproportion (CPD), and obstructed labor accounted half of the indications for cesarean sections. Overall maternal complication rate was 38.2%. Living in rural setting (AOR, 1.4,95%CI:1.0,2.3), maternal age ≥ 30 years, (AOR=2.0,95%CI:1.1,3.8), presence of obstetric complications, (AOR=2.6,95%CI:1.4,4.7), operation done in second stage of labor, (AOR=2.5,95%CI:1.3,4.6), labor≥25 h (AOR=1.4,95%CI:1.0,2.4) and general anesthesia (AOR=2.456,95%CI:1.382,4.356) were found to have significant association with maternal complication. Maternal complication was found to be high. Timely management of labor before a woman develops obstetrics complication and use of appropriate anesthesia will reduce the occurrence of complications.

Key words: Maternal complication, cesarean section (C/S), Ethiopia

INTRODUCTION

Pregnancy and parturition are events of considerable importance in the life cycle of women. Pregnant women may deliver their children via normal spontaneous vaginal delivery or through cesarean section. Parturition or giving birth is physiological; however, it poses a significant risk to the life and well-being of both mother and child. Of all deliveries, approximately 10% are considered as high-risk, some of which require cesarean section (Abebe et al., 2016).

Cesarean section (CS) is the most common surgical procedure performed on women worldwide. It could be performed as an elective procedure when there is a predictable risk to the mother or fetus during labor or in the presence of an identifiable indication for the procedure.

The procedure is however undertaken as an emergency when a complication of pregnancy or labor warrants quick intervention to deliver the fetus (Jaiyesimi and Ojo, 2003).

Cesarean section significantly reduces maternal and prenatal mortality (Osonwa et al., 2016). The World Health Organization considers Cesarean section rates of 5 to 15% to be the optimal range for targeted provision of these life-saving interventions to mothers and infants (Luz, 2010); lower rates suggest unmet need, while higher rates suggest improper selection (Betran et al., 2007; Ronsmans et al., 2006).

The majority of cesarean deliveries are performed for condition that might pose a threat to both the mother and the fetus if vaginal delivery occurred (Abdissa et al., 2013). Cesarean deliveries are potentially morbid procedures with overall infectious morbidity rates as high as 25% (Padmaleela et al., 2013).

In addition to the increased risk for infections with cesarean section, women are exposed to complications such as excessive blood loss and damage to pelvic organs (Phillips and Brankman, 1990; Atombosoba et al., 2015).

There is an increased risk of uterine rupture, placenta accreta, and placenta previa associated with a previous cesarean section (Starr, 2003). Post-operative complications include endomyometritis, wound infection, fascial dehiscence, urinary tract infections, bowel dysfunction, thromboembolic complications, and pelvic thrombophlebitis (Maimoona et al., 2014).

Now a day's caesarean section is safer than it has never been. But, in Africa it is still performed in harmful conditions for saving the mother and fetus (Abubakar et al., 2015, Fesseha et al., 2011).

Although the magnitude of maternal complication following C/S in Ethiopia is high, there are no baseline information regarding maternal complication and associated factors in the study area. Therefore, this study will help in filling the gap of information on magnitude of maternal complication of cesarean delivery and associated obstetric factors contributing to poor maternal outcomes. It can also be used as baseline information for future research.

METHODOLOGY

Study setting

The study was conducted in Arba-Minch General Hospital. The average number of deliveries conducted in this hospital is estimated to be 1800 to 2000 women per year and the average number of cesarean deliveries is estimated to be 450 to 550 women per year

Study design and period

Hospital register based retrospective cohort study design was used. Document of mothers who underwent cesarean section from July 8, 2013 to August 6, 2014 in Arba-Minch General hospital were reviewed. It is a general cohort.

In which all women who underwent cesarean deliveries during the study period have had multiple exposure in the study setting during the study period were considered as exposure variables where as developing maternal complication as outcome variables.

In this the study alternate hypothesis may be stated as multiple factors will have relation with maternal complication for those women who underwent casern section where as the null hypothesis states that there is no any relation of the multiple factors for women underwent casern section so as to develop maternal complication.

Population

Women who delivered by cesarean section in Arba-Minch General Hospital from July 8, 2013 to August 6, 2014 were study population. Records of women with ectopic pregnancy (abdominal pregnancy), whose cesarean section was done in other hospital and referred to Arba-Minch General Hospital due to complications and those with incomplete chart records were excluded.

Variables

1. Outcome variable: Maternal complication.
2. Independent variables (multiple exposures) such as socio demographic factors (age, residence), obstetric factors (parity, gestational age, number of pregnancy, previous CS, indication of CS, status of the labor and membrane), obstetric complication (Pre-eclmpsia/eclampsia APH PROM/chorioamnionitis malpresentations OL suspected ux rupture), operation related factors (type c/s, anesthesia, surgeon, type of incision, duration of operation, facility factors (referral status, ANC follow up).

*Corresponding author. E-mail: nigusemekonnen69@gmail.com. Tel: 0916704274/0949658391.

Sampling procedure

All records of caesarean deliveries done at Arba-Minch General Hospital during the study period were traced using delivery room, operation room and postnatal ward log books. The list of all women who gave birth by caesarean section was prepared and selected based on inclusion criteria.

Data collection, processing and analysis

Checklist adopted from emergency cesarean delivery outcome tracing tools and from WHO research format tool which uses proxy events (antibiotics treatment, prolonged hospital stay, prolonged catheterization) in order to identify maternal complication and associated obstetric factors was used for data collection.

Study participants were identified from delivery and postnatal log books. Using a checklist, socio-demographic data, obstetric profiles which are associated with maternal complication and indicators of intra-operative and post-operative maternal complications were retrieved from patient record and operation log book.

Data were coded, entered, cleaned and analyzed using SPSS version 20.0. Descriptive analysis was carried out to explore the socio-demographic characteristics and magnitude of maternal complication following cesarean section. Bivariate and multivariate logistic regression analysis was carried out to examine the relationship between the outcome variable and the selected obstetric factors. Factors for which there was association in the bivariate analysis at $P<0.25$ were selected for subsequent multivariate analysis using multiple logistic regression.

Quality control measures

To insure quality of data pre-test was done on 10% of the study population and necessary adjustment was incorporated to the questionnaire. In addition, the collected data were checked for completeness, accuracy, and consistency by the supervisor before accepting from the data collectors.

Operational definition

1. Maternal complication: Includes the presence of one of the intera-operative surgical complication or postoperative maternal complication.
2. Postoperative complication-is defined as the existence of one of the following febrile morbidity, extended antibiotics treatment, extended hospital stay, wound infection (SSI), DVT, pneumonia, admission to ICU, drop in HCT/HGB, blood transfusion, PPH maternal death in the Hospital.
3. Severe maternal complication includes one of the following hemorrhage, blood transfusion, hysterectomy, thromboembolism, and intensive care unit admission, postpartum lengths of stay, postpartum antibiotics treatment, adjacent internal organ injury, prolonged catheterization, febrile maternal morbidity and death in hospital.
4. Obstetric complications: Presence of one of the following Antepartum heamorrhage (APH), PROM/chorioamnionities, preeclampsia or eclampsia, obstructed labor, malpresentation, suspected uterine rupture, previous cesarean delivery or gynecology operations.
5. Postpartum hemorrhage: Is defined as estimated blood loss of >= 1000 ml, fall in Hct >10%, post-operative Hct <25%.

Ethical considerations

The study protocol was approved and ethically cleared by the Institutional Review Board of the college of medicine and health science of Hawassa University. Official letter of co-operation was written by school of medicine to the Arba-Minch General Hospital. Information on the studies was given to the hospital officials and team leaders of the respective department about the purposes and procedures. In order to protect the confidentiality of the information, name or ID was not included in written questionnaires.

RESULTS

During the study period from July 8, 2013 to August 6, 2014 a total of 1980 deliveries were attended in Arba-Minch general Hospital, out of which 488 women delivered by cesarean section. The Hospital cesarean section rate was 24.65%. Seventy two patients were excluded from the study because their medical records were either unavailable or incomplete.

Socio-demographic characteristics of the mothers

A total of 416 questionnaires were used for analysis after questionnaires were checked for completeness. Two hundred fifty (66.1%) of the mothers were rural dwellers and 166 (39.9%) of them were urban dwellers.

The mean age of the mother's was 25.72 years with standard division of ±5.175 years. Most of the mothers (51.4%) were in the age group of 25 to 34 years (Table 1).

Maternal obstetric data and medical illness

Written referral papers were used to refer 211(50.7%) of the mothers from other health institutes. Three hundred and thirteen (75.2%) had one or more ANC follow up in the same or other health institution. Majority of the women were nulliparous which accounted for 189(45.4%) followed by 92(22.1%) para-II mothers and the least were 28(6.7%) para-IV and 63(15.1%) grandmultipara women. Operation at gestational age of 37 to 42 weeks or at term were done for 369 (88.9%) of the women. Only 8.7 and 2.6% of mothers were operated at gestational age of <37 weeks and >42 weeks respectively. Of the total mothers who delivered by cesarean section 49 (11.8%) have at least one medical illness during their pregnancy. The leading medical disease were HIV/AIDS among 11(22.44%), diabetes mellitus among 10(20.4%), malaria and Acut Febril illness (AFI) among 25(51.04%) and tuberculosis among 3(6.1%) of the mothers (Table 2). Regarding obstetric complication, 312 (75%) of the mother had one or more obstetric complications during their pregnancy period and 104 (25%) had no obstetric complication (Table 3).

Labor status of mothers

Three hundred twenty three (77.6%) of the women were

Table 1. Socio demographic characteristics of the mothers who delivered by cesarean section in Arba-Minch General Hospital, SNNPR Ethiopia, July 8, 2013 to August 6, 2014.

Variable (n=416)	Frequency	Percentage
Age of the mother at the time of cesarean section		
<20	87	20.9
20-24	73	17.5
25-34	214	51.4
35-44	42	10.1
Place of residence of the mother		
Urban	166	39.9
Rural	250	60.1

Table 2. Obstetrics data of the mothers who delivered by cesarean section in Arba-Minch General Hospital, SNNPR Ethiopia, July 8, 2013 to August 6, 2014.

Variables (n=416)	Frequency	Percentage
Referral status		
Referred from other health institute	211	50.7
Self-referral	205	49.3
ANC follow up		
Had one or more ANC follow up	313	75.2
No ANC follow up	103	24.8
Parity of the mother		
One	189	45.4
Two	92	22.1
Three	44	10.6
Four	28	6.7
Five and above	63	15.1
Number of gestation		
Single	387	93.0
Twins	29	7.0
Gestational age		
<37	36	8.7
37-42	369	88.7
≥42	11	2.6
Medical illness during pregnancy		
No medical illness	367	88.2
Diabetes mellitus	10	20.4
Tuberculosis	3	6.1
HIV/AIDS	11	22.44
Others (acute febrile illness, malaria)	25	51.02

operated after labor started and 153(46.1) of the women were in labor for >12 h before operation. Membrane was ruptured in 287(69%) of mothers before operation. One hundred and eighty (58.8%) of the women have meconium stained amniotic fluid.

One hundred and thirty nine (39.94%) of the women were operated at second stage of labor after fully dilatation of the cervix. Two hundred and forty two (58.2%) of the women were operated at high station of the presenting part (Table 4).

Indications for cesarean section and types of cesarean section

The leading indication for cesarean section was fetal

Table 3. Obstetric complications of mothers who delivered by cesarean section at Arba-Minch General Hospital, SNNPR Ethiopia, July 8, 2013 to August 6, 2014.

Variable (n=416)	Frequency	Percentage
Types of obstetric complications		
No complication	104	25.0
APH*	28	6.7
PROM/Chorioamnionits**	45	10.8
Preeclampsia/ eclampsia	20	4.8
Obstructed labor	55	13.2
Malpresentation	71	17.1
Suspected uterine rupture	5	1.2
Previous cesarean section/gyn operation	54	13.0
Others ***	34	8.2

APH* antpartem hemorrhage; PROM** premature rupture of memberane; Others*** preterm labor, polyhydramnious

Table 4. Labor status of the mothers who delivered by cesarean section in Arba-Minch General Hospital, SNNPR Ethiopia, July 8, 2013 to August 6, 2014.

Variable (n=416)	Frequency	Percentage
Status of membrane		
Ruptured	288	69.0
Not ruptured	128	31.0
Duration of ruptured membrane (h)		
<4	83	28.8
4-12	128	44.4
>12	77	26.8
Status of amniotic fluid N=288		
Clear amniotic fluid	54	18.8
Meconium stained amniotic fluid	234	81.2
Cervical status		
Closed cervix	68	16.3
< 4 cm dilated	46	11.1
4-9 cm dilated	163	39.2
10 cm or fully dilated	139	33.4
Station of the presenting fetal part in relation with maternal pelvis		
High	242	58.2
Zero	54	13.0
Low	120	28.8
Stage of labor (n=384)		
Latent first stage of labor	46	13.2
Active first stage of labor	163	46.9
Second stage of labor	139	39.9

distress 86(20.4%), followed by CPD 67(16.1%), obstructed labor 62(14.9%) and the least was cord prolaps 6(1.4%). Emergency cesarean section was done for most (87%) of the women after labor started or maternal obstetric complications occurred (Table 5).

Intra-operative profile

On-training health officers performed 180 (43.3%) of the cesarean section. Gynecology and obstetrics specialists did 118(28.2%) of cesarean sections and 114(27.4%)

Table 5. Indication and types of cesarean section of the mothers who delivered by cesarean section in Arba-Minch General Hospital, SNNPR Ethiopia, July 8, 2013 to August 6, 2014.

Variable (N=416)	Frequency	Percentage (%)
Indication for cesarean section		
Cephalopelvic disproportion	67	16.1
Twine 1st non vertex	14	3.4
Previous two or more c/s	10	2.4
Malpresentation	18	4.3
Obstructed labor	62	14.9
Fetal distress	86	20.4
Suspected uterine rupture	12	2.9
Antepartum hemorrhage	32	7.7
Failed induction	16	3.8
Cored prolaps	6	1.4
Failure to progress	35	8.4
Others (preeclampsia,eclampsia)	58	13.9
Types of cesarean section		
Emergency cesarean section	362	87
Elective cesarean section	54	13
Number of cesarean section		
Primary	362	87
One previous cesarean section	44	10.6
Two and above previous cesarean section	10	2.4

were done by general practitioners. Three hundred fifty one (84.4%) of the mothers were operated under spinal anesthesia and 406 (97.6%) were delivered by lower uterine segment incision. Time for accomplishing the operations shows 260 (62.5%) was completed within 30 to 60 min (Table 6).

Maternal complications

Intra-operative surgical complications

Overall there were 119(28.6%) of mothers with intra-operative surgical complication. The leading intra-operative surgical complications were hemorrhage 45(10.8%), incision extension 35(8.4%), accidental internal organ injury 23(5.5%) and atone 8(1.9%). Procedures done to manage complications were repair, cesarean hysterectomy, uterine artery ligation and B Lynch compression suture for 33(7.9%), 13(3.1%), 12(2.9%) and 9 (2.2%) of women respectively (Table 7).

Post-operative maternal complication

The overall post-operative maternal complication was 98(23.6%) and 318(76.4%) of the mothers had no post-operative complications. Two of the mothers died either during or immediately after the operation. The major post-operative complications were surgical wound infection among 50 (12%), febrile morbidity among 19(4.6%), PPH among 9(2.2%), DVT among 2(0.5%) and UTI in 1(0.2%) of the mothers.

The average duration of catheterization was 1.75 days and the average duration of therapeutic intravenous antibiotics was 1.89 days. The average duration of hospital stay after the operation was 7.73 days with ±SD of 2.83 days (Table 8).

Overall maternal complication

One hundred and fifty nine of the mothers had at least one of the intra-operative or post-operative maternal complications. This makes the overall rate of complication among mothers who delivered by Caesarean section in Arba Minch General Hospital 38.2% (Figure 1).

Neonatal outcomes following cesarean section

A total of 402 (90.3%) of neonates were born alive. Only 60 (14.9%) of the neonates had poor first minute APGAR score. For 153 (38.06%) of the neonates resuscitation was done soon after delivery. Seventy six (18.9%) of the neonate were transfer to pediatric unit and of these 15 neonates died after born alive (Table 9).

Table 6. Intra-operative profile of the mothers who delivered by cesarean section in Arba-Minch General Hospital, SNNPR Ethiopia, July 8, 2013 to August 6, 2014.

Variable (n=416)	Frequency	Percentage
Surgeon qualification		
Specialist (gyn and obs)	118	28.2
GP*	114	27.4
HO**	180	43.3
Resident	4	1.0
Type of anesthesia		
Spinal anesthesia	351	84.4
General anesthesia	65	15.6
Type uterine incision		
LUST***	406	97.6
Inverted “T”	4	1
Classic	2	05
“J” shaped	4	1
Operation time (min)		
<30	39	9.4
30-60	260	62.5
60-90	103	24.8
>90	14	3.4

GP*, General practitioners; HO**, health officer; LUST***, lower uterine segment transverse incision.

Table 7. Intra-operative surgical complications of the mothers who delivered by cesarean section in Arba-Minch General Hospital, SNNPR Ethiopia, July 8, 2013 to August 6, 2014.

Variables (n=416)	Frequency	Percentage
Intra-operative surgical complications		
Hemorrhage	45	10.8
Accidental adjacent organ injury	23	5.5
Incision extension	35	8.4
Atony	8	1.9
No complication	305	73.3
Additional procedures to manage complications		
Cesarean hysterectomy	13	3.1
B-Lynch compression suture	9	2.2
Uterine artery ligation	12	2.9
Repair	33	7.9
Blood transfused in the OR during operation		
Yes	22	5.3
No	394	94.7
Composite measure of intra-operative surgical complication		
Yes	119	28.6
No	297	71.4

Factors associated with maternal complications

Based on multivariable logistic regression, living in rural setting (AOR= 1.452,95%CI:1.002,2.301), maternal age ≥ 30 years (AOR=2.076,95%CI:1.132,3.8 05) presence of obstetric complications with (AOR=2.617,95%CI:1.437,4.767), operation done in second stage of labor (AOR=2.511,95%CI:1.361,4.631), prolonged labor ≥ 25 h with (AOR=1.442,95%CI:1.041,2.472) operation done under

Table 8. Post-operative maternal complication of the mothers who delivered by cesarean section in Arba-Minch General Hospital, SNNPR, Ethiopia, July 8, 2013 to August 6, 2014.

Variable (n=416)	Frequency	Percentage
Status of women after operation		
Alive	414	99.52
Dead	2	0.48
Post-operative maternal complication		
wound infection	50	12
DVT*	2	0.5
UTI**	1	0.2
Febrile morbidity	19	4.6
PPH***	9	2.2
Post-operative blood transfused		
Yes	32	7.7
No	384	92.3
Blood transfused		
No blood transfusion	384	92.3
One unit	14	3.4
Two units	16	3.8
Three and above	2	0.5
Length of hospital stay after operation (days)		
<5	31	7.5
5-7	219	52.6
>7	166	39.9
Composite measure of Post-operative maternal complication		
Yes	98	23.6
No	318	76.4

DVT*, deep venous thrombosis; UTI**, urinary tract infection; PPH***, postpartum hemorrhage.

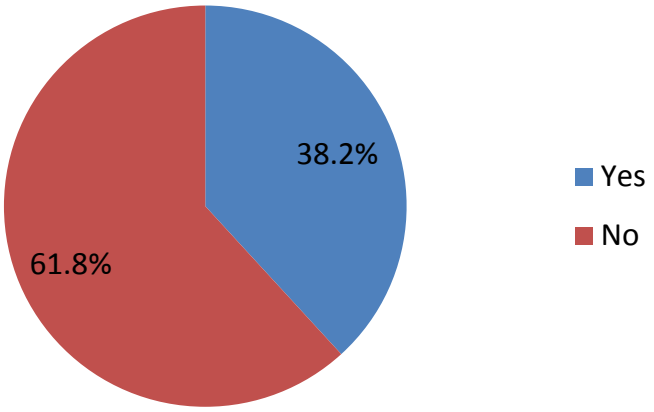

Figure 1. Intra-operative or post-operative maternal complications of women who delivered by cesarean section at Arba-Minch General Hospital, SNNPR, Ethiopia, July 8, 2013 to August 6, 2014.

general anesthesia (AOR=2.456,95%CI:1.382,4.356) were found to be significantly association with maternal complications (Table 10).

Based on multivariate logistic regression, cesarean section done for an indication of mal presentation have high maternal complication than other indication with

Table 9. Neonatal outcomes of mothers' who delivered by cesarean section in Arba-Minch General Hospital, SNNPR, Ethiopia, July 8, 2013 to August 6, 2014.

Variable	Frequency	Percentage
Neonatal outcomes at time of delivery (n=445)		
Alive	402	90.3
Dead	43	9.7
First minute APGAR score (n= 402)		
<4	60	14.9
4-6	153	38.1
≥7	189	47
Five minutes APGAR score (n= 402)		
<4	12	3
4-6	73	18.2
≥7	317	78.8
Neonate resuscitated (n= 402)		
Yes	153	38.06
No	249	61.94
Neonate transferred to neonatology/ pedi units (n=402)		
Yes	76	18.9
No	286	71.1
Died after born alive	15	10
Weight of the neonate (g)		
1500-2499	52	11.7
2500-3999	328	73.7
≥4000	65	14.6

(AOR=14.426, 95%CI: 3.210, 64.842), obstructed labor with (AOR=3.279, 95%CI: 1.787, 6.017) and suspected ruptured uterus (AOR=9.016, 95%CI: 1.914, 42.484) were found to have significant association with maternal complication (Table 11).

DISCUSSION

In this study, 316 (75%) of the mother had at least one obstetric complications during pregnancy or intra-partum. The leading obstetric complications were mal-presentation (17.1%), obstructed labor (13.2%), previous cesarean section or gynecology operation (13%), PROM or chorioamnionits (10.8%), APH (6.7%), preeclampsia and eclampsia (4.8%). In this study, the prevalence of APH and eclampsia/ preeclampsia were found to be less than the Tikur Anbessa hospital study which accounts 11 and 10% respectively (Hussen et al., 2014).

Regarding indications for c/s in this study, fetal distress (20.4%), CPD (16.1%) and obstructed labor (14.9%) account for half of cesarean sections. These findings are consistent with the national c/s review (Fesseha et al., 2011).

Prophylactic antibiotics were given for 93.3% of the mother before operation. This result is consistent with a 94% result from Ethiopian national c/s review (Fesseha et al., 2011). Nevertheless, 50(12.0%) of women developed post-operative wound infection. The rate of wound infection reported in Jimma Hospital was 27.1% of all post-operative maternal complication (Nebreed et al., 2011) which is higher than our findings. The reason could be the difference in sterility technique and choice of prophylaxis antibiotics among the hospitals.

The main intra-operative surgical complications were hemorrhage 45(10.8%), accidental internal organ injury 23(5.5%), incision extension 35(8.4%), and atone 8(1.9%). To manage complication cesarean hysterectomy 13(3.1%), B-Lynch compression suture 9(2.2%), uterine artery ligation 12(2.9%), repair 33(7.9%) were done. In this study, the rate of cesarean hysterectomy is higher than the Tikur Anbessa Hospital 6(2.5%) (London, 2008).

Blood was transfused for 22(5.3%) of women in the operation table. This result is less than the Tikur anbessa hospital study which is 19% (London, 2008). Overall intra-operative surgical complications were 28.6%. This is higher than a 12 and 11.6% results in other studies (Pallasmaa et al., 2008, Ayano et al., 2015).

Among 416 cesarean delivery reviewed, two mothers were died immediately after the operation. This finding is better than the national study finding of 2 deaths out of 267 cesarean deliveries (Fesseha et al., 2011) and 5 deaths out of 318 cesarean deliveries in Tikur Anbessa

Table 10. Bivariate and multivarible analysis for independent variables with maternal complication of women who delivered by cesarean section at Arba-Minch General Hospital, SNNPR, Ethiopia, July 8, 2013 to August 6, 2014.

Variable	Maternal complication		COR 95% CI	AOR 95% CI
	No	Yes		
Residence				
Urban	117	49	1	1
Rural	140	110	1.878(1.237,2.846)	1.452(1.002,2.301)*
Age				
<30 years	234	124	1	1
≥30 years	23	35	2.872(1.625,5.075)	2.076(1.132,3.805)*
Antenatal care				
Yes	205	108	1	1
No	52	51	0.537(0.342,0.843)	1.244(0.734,2.109)
Pregnancy obstetric complication				
Yes	172	140	3.641(2.111,6.281)	2.617(1.437,4.767)*
No	85	19	1	1
Stage of labor				
No labor	41	24	1	1
Latent first stage of labor	32	14	0.486(0.269,0.877)	0.730(0.325,1.643)
Active first stage of labor	125	38	0.323(0.158,0.658)	1.239(0.371,1.357)
Second stage of labor	59	80	0.224(0.137,0.0.368)	2.511(1.361,4.631)*
Types of anesthesia				
Spinal anesthesia	231	120	1	1
General anesthesia	26	39	2.887(1.678,4.970)	2.456(1.382,4.356)*
Duration of labor (h)				
<24	154	83	1	1
≥25	62	50	0.526(0.327,0.844)	1.442(1.041,2.472)*

* P-value < 0.05.

Hospital (Hussen et al., 2014).

Among 98(23.6%) of post-operative maternal complications, the leading were wound infection (12%), febrile morbidity (4.6%) and PPH (2.2%). Study done in Bamako Mali reported an overall post-operative maternal infection among cesarean delivery was 20.1% which is less than our finding (Teguete et al., 2012).

Overall maternal complications of cesarean delivery were found to be 159(38.2%). This finding is higher than the results from the national review (Eyowas et al., 2016). One study done in Jimma Hospital reported an overall cesarean section maternal morbidity of 20%, but they were not included accidental internal organ injury and blood transfusion (Woubishet et al., 2016).

Socio demographic and obstetrics risk factors for maternal complication were found to be living in rural setting, maternal age ≥ 30 years, presence of one or more obstetric complications, operation done in second stage of labor, duration of labor ≥25 h and use of general anesthesia.

Those mothers who came from rural setting have 1.452 times more odds of maternal complication than urban dwellers. This could be mothers who came from rural setting or outside Arba-Minch town after prolonged labor and complicated labor.

Mothers who have obstetrics complication during pregnancy or intrapartum have 2.671 times more odds of maternal complication than those mothers without obstetrics complications. Second stage of labor has 2.511 times more odds of maternal complication than operation without labor. Duration of labor ≥25 h have 1.442 times more odds of maternal complication than duration of labor less than 24 h. Operations done under general anesthesia have 2.456 times more odds of maternal complication than operation done under spinal anesthesia. These factors indicate majority of the cesarean section done after the labor is advanced and complicated. Different study in our country and in other African countries indicates complicated labor and use of general anesthesia increase the risk of accidental internal organs injury and hemorrhage due to atony (Pallasmaa et al., 2008; Ayano et al., 2015, Teguete et al., 2012, Woubishet et al., 2016).

Other risk factors that have association with maternal complications were indications for cesarean sections.

Cesarean section done for an indication of

Table 11. Bivariate and multivariable analysis for indications of cesarean section with maternal complication of mothers who delivered by cesarean section at Arba-Minch General Hospital SNNPR, Ethiopia, July 8, 2013 to August 6, 2014.

Variable	Maternal complication		COR(95% CI)	AOR(95% CI)
	No	Yes		
Fetal distress				
Yes	70	19	3.346(1.864,6.006)	0.412(0.220,0.771)
No	187	143	1	1
Suspected ruptured uterus				
Yes	2	10	8.537(1.850,39,580)	9.016(1.914,42.484)*
No	255	149	1	1
Obstructed labor				
Yes	22	40	3.591(2.041-6.318)	3.279(1.787,6.017)*
No	235	119	1	1
Malpresentation				
Yes	2	16	14.266(3.224,62.930)	14.426(3.21,64.842)*
No	255	143	1	1
Cephalopelvic disproportion				
Yes	51	16	2.213(1.213,4.035)	0.566(0.297,1.076)
No	206	143	1	1

malpresentation have high maternal complication than other indications with (AOR=14.4, 95%CI: 3.2, 64.8) obstructed labor with (AOR=3.2, 95%CI: 1.7, 6.0), suspected ruptured uterus (AOR=9.016, 95%CI: 1.914, 42.484). These indications make operation difficult in fetal extraction, risk of incision extension and hemorrhage are high. Study done in Jimma obstructed labor is associated with high maternal complications (Woubishet et al., 2016).

The average duration of hospital stay after operation was 7.25 days with ±SD 2.865 this finding is higher than the national review of cesarean section in Ethiopia (Hussen. et al., 2014,). Prolonged maternal Hospital stay indicates, there are high maternal complications in Arba-Minch General Hospital.

Generally the magnitude of maternal complications following cesarean section of Arba-Minch General Hospital is high. Factors that have association with high maternal complications were living in rural setting, age of the mothers greater or equal to 30 years, presence of obstetrics complications, operations done in second stage of labor and prolonged labor greater or equal to 25 hours and use of general anesthesia. Indications for cesarean section like obstructed labor, suspected uterine rupture and mal-presentation were other factors that have association with high maternal complications. High obstetric complications and associated factors like obstructed labor, suspected uterine rupture, prolonged and second stage of labor shows laboring mothers were not managed appropriately. Thus, health professionals who are doing caesarean section on second stage of labor, prolonged labor and operation under general anaesthesia should anticipate intra-operative surgical complications and should be prepare to manage complications like, blood preparation.

Strengths and limitations

This study addresses both the intra-operative and post-operative maternal complication. But, maternal complication related factors like body mass index, estimated blood loss, pre-operative and post-operative hematocrit or hemoglobin were not found in the medical records. If they were included in this study, they may affect the outcome. In addition the study could not compare maternal complication of high risk cesarean delivery with low risk cesarean delivery so that, it needs further study.

CONFLICTS OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

Abdissa Z, Awoke T, Belayneh T, Tefera Y (2013). Birth Outcome after Caesarean Section among Mothers who Delivered by Caesarean Section under General and Spinal Anesthesia at Gondar University Teaching Hospital North-West Ethiopia. J. Anesther. Clin. Res. 4:335.

Abubakar IS, Rabiu A, Mohammed AD (2015). Magnitude and Pattern of Caesarean Sections in a Teaching Hospital, Northwest Nigeria: A 5 Year Analysis. J. Obstet. Gynaecol. 3(2):26-28.

Atombosoba AE, Lucky OL, Chukwuemeka AI, Israel J, Isa AI (2015). Review of the Clinical Presentation of Uterine Fibroid and the Effect of therapeutic Intervention on Fertility. Am. J. Clin. Med. Res. 3(1):9-13.

Ayano M, Wondafrash B, Geremew A, Akessa M (2015). Prevalence and Outcome of Caesarean Section in Attat Hospital, Gurage Zone, SNNPR, Ethiopia, IMedPub.J. http://wwwimedpub.com

Betran AP, Merialdi M, Lauer JA, Bing-Shun W, Thomas J (2007). Rates of caesarean section: analysis of global, regional and national estimates. Pediatr. Prenatal Epidemiol. 21:98-113.

Eyowas AF, Worku GA, Negasi KA, Aynalem EG (2016). Factors leading to cesarean section deliveryat Felegehiwot referral hospital, Northwest Ethiopia: a retrospective record review. Reprod. Health 13:6

Fesseha N, Getachew HM, Gebrehiwot Y, Bailey P (2011). A national review of cesarean delivery in Ethiopia. Int. J. Gyn/Obstet 115(1):106-111

Hussen A, Shiferaw N, Lukman Y (2014). Cesarean delivery practices in teaching public and non-government/private MCH hospitals, Addis Ababa. Ethiop. J. Health Dev. 28(1).

London MB (2008). Vaginal birth after cesarean delivery. Clin. Perinatol. 35(3):491-504.

Luz G, José MB, Jeremy AL, Ana PB, Mario M, Fernando A (2010). The Global Numbers and Costs of Additionally Needed and Unnecessary Caesarean Sections Performed per Year: Overuse as a Barrier to Universal Coverage.9World Health Report Background Paper, No 30.

Maimoona H, Asthma Y, Nazia B, Muhammad IP, Nishat A, bushra G (2014). Prevalence and Indications of Caesarean Section in a Teaching Hospital JIMSA 27(1).

Nebreed F, Atnafu G, Mihret H, Yirgu G, Patricia B (2011). A national review of cesarean delivery in Ethiopia. Int. J. Gynecol. Obstetr. 115:106-111

Osonwa OK, Eko JE, Ekeng PE (2016). Trends in caesarean section at Calabar general Hospital, Cross river state, Nigeria. Eur. J. Biol. Med. Sci. Res. 4(1):1-5.

Padmaleela K, Thomas V, Prasad KV (2013). An Analysis of the Institutional Deliveries and Their Outcomes in Government Teaching Hospitals of Andhra Pradesh, India. Int. J. Health Sci. Res. 3(5):76-81

Pallasmaa N, Ekblad U, Gissler M (2008). Severe maternal morbidity and the mode of delivery. Acta Obstet. Gynecol. 87(6):662-668.

Ronsmans C, Holtz S, Stanton C (2006). Socioeconomic differentials in caesarean rates in developing countries: a retrospective analysis. Lancet 368(9546):151-152

Starr C (2003). Elective cesarean section: a new dividing line for OBs Contemporary OB/GYN. Available at: http://obgyn.pdr.net/be_core/MVC?magg&action

Teguete I, Traore Y, Sissoko A, Djire MY, Thera A, Dolo T, Mounkoro N, Traore M, DoloA (2012). Determining Factors of Cesarean Delivery Trends in Developing Countries: Lessons from Point G National Hospital Bamako, Mali Read Salim. 9:161-200.

Woubishet G, Fitsum T, Mirkuzie W (2016). Outcome of induction and associated factors among term and post-term mothers managed at Jimma university specialized hospital: a two years' retrospective analysis. Ethiop. J. Health Dev. 28(1).

academicJournals

Vol. 9(5), pp. 145-150, May 2017
DOI: 10.5897/JPHE2016.0867
Article Number: DE4D0AF63797
ISSN 2141-2316

http://www.academicjournals.org/JPHE

Journal of Public Health and Epidemiology

Full Length Research Paper

Modeling health status using the logarithmic biophysical modulator

Azizur Rahman[1] and Md. Abdul Hakim[2]*

[1]School of Computing and Mathematics, Charles Sturt University, Wagga Wagga, New South Wales, Australia.
[2]Department of Food Technology and Nutritional Science, Mawlana Bhashani Science and Technology University, Santosh, Tangail, Bangladesh.

Received 31 August, 2016; Accepted 30 September, 2016

There are different methods to measure health and nutritional status of samples at different sociodemographic settlements in different communities. Of them, one method can be preferable at a certain topographic condition for specific group of people. Typically, it can then become a common method due to widespread uses by other groups, and hence many researchers often are in doubt to choose the apt method for their studies in dynamic environment of health science. This study aims to design a new modulator of health status for examining the ongoing health and nutritional concerns to the communities including malnutrition, health demography and possible socioeconomic and environmental changes of heath. It uses a wide range of instruments and theories ranging from the Quetelet's index in health science to the Albert Einstein's theory of relativity in physical science. Findings reveal that our proposed logarithmic biophysical modulator of health status [equation (ix)] is a modern and simple tool for health assessment of individuals through statistical modeling. It could be applicable to the study on the worldwide health and nutritional research, geospatial and community health and biostatistics and public health. Also it can be a uniquely functional biophysical model to the discipline of health pedagogy in nutritional epidemiology.

Key words: Health pedagogy, statistical modeling, health status, malnutrition, biophysical modulator

INTRODUCTION

About 2 billion people in the world suffer from various forms of malnutrition (Rahman and Biswas, 2009). Malnutrition is an underlying cause of death of 2.6 million children each year - a third of child deaths globally (Black et al., 2008; Rahman et al., 2008). One in every four of the world's children is stunted, and in developing countries this is as high as one in three (de Onis et al., 2011). This means their bodies fail to develop fully as a result of malnutrition. Undernutrition accounts for 11% of the global burden of disease and is considered the number one risk to health worldwide (Black et al., 2008). Childhood malnutrition leads to stunted growth and influence mortality and morbidity (Rahman and Hakim, 2016a; Rahman, 2006; Megabiaw and Rahman, 2013; Hakim and Kamruzzaman, 2015), which lower the survival opportunities of adults in their later life (Rahman

*Corresponding author. E-mail: info.hakim.bd@gmail.com.

Table 1. Classification of MAC measurements.

Under-nutrition level	MAC in mm
Moderate	160 ≤ MAC <185
Severe	MAC <160

and Chowdhury, 2007). About 4 of each 5 malnourished children live in South-East-Asia, and about 83% of childhood deaths are linked to mild to moderate forms of malnutrition (UNICEF, 1997; Rahman et al., 2009). Malnutrition in developing countries happened due to poverty, household food insecurity, gender bias, population pressure, food taboos, health, hygiene and nutritional negligence, famine and man-made disasters (Hakim et al., 2015; Rahman and Harding, 2013; Ghosh and Shah, 2004; Rahman and Kuddus, 2014a; Fakir and Rahman, 2015; Kuddus et al., 2014; Hakim, 2015). Malnutrition is also caused by intra-family feud, poor socioeconomic status, child abuse, deprivation of schooling opportunity and faulty family planning practices (Rahman and Sapkota, 2014; Kuddus and Rahman, 2015; Kamruzzaman and Hakim, 2016; Rahman, 2004; Kamruzzaman and Hakim, 2015; Hakim and Kamruzzaman, 2016; Hakim, 2016). These nutritional issues are affecting the world's population day by day (Hasan et al., 2016). As a result, typical health issues are in need of identification to overcome such poor health conditions with a view to meet healthy samples of population in different communities.

Some common methods for measuring population health and nutritional status are outlined below. The BMI (Body Mass Index) method is the measure of body fat based on body weight (mass) and height applied to individuals, i.e. BMI = Body weight in kg/(Body height in m)^2. Classification of BMI ranges are: i) Underweight: if BMI < 18 kgm^{-2}; ii) Normal weight: if BMI from 18 to 25 kgm^{-2}; iii) Overweight: if BMI from 25 to 30 kgm^{-2}; and iv) Obese: if BMI > 30 kgm^{-2}. This method is widely used for measuring health status of adult people in the community (Rahman et al., 2008). Another method is called MAC or MUAC or MUAC for age (Mid-Upper Arm Circumference). MAC is the circumference of the left upper arm, measured at the mid-point between the tip of the shoulder and the tip of the elbow. MAC is useful to assess the nutritional status of younger children and it is mostly used in emergency situations to identify nutritional treatment requirements of younger patients. Table 1 provides the typical classification of MAC measurements to assess the moderate and severe form of under-nutrition. An additional measurement based on MAC is known as MUAA (Mid-upper Arm Area) which is estimated as: MUAA = MAC^2/ 4π (Kamruzzaman and Hakim, 2016). Besides this, there are three indices called Height for age (HAZ), Weight for age (WAZ), and Weight for height (WHZ) that are based on the standard ratio measures of the height, weight and age following the WHO's growth charts (Rahman and Chowdhury, 2007). These indices are further standardized using statistical concepts of the *Z-score*. Topically, a Z-score measure tells us whether a particular value for observation is equal to the mean, below the mean or above the mean of a bunch of scores. In the *Z*-scores approach: if the measure of a *Z*-score with the population mean μ has a value of 0, then it is equal to the group mean; if μ is positive then, it is above the group mean; if μ is negative, then it is below the group mean; if μ = +1, then it is 1 standard deviation (SD) above the mean; if μ = +2, then it is 2 SD above the mean, if μ = -1, then it is 1 SD below the mean; and if μ = -2, then it is 2 SD below the mean. However, none of these universal methods can precisely obtain the health and nutritional status at small area communities.

This study aims to design a simple modulator of health status for examining the ongoing health and nutritional concerns in communities including the malnutrition.

METHODOLOGY

This is a methodological review study to design an appropriate technique for modelling health status of samples. A range of instruments have been collected from the Quetelet's index in health science, unit bracket method, SI unit of body mass (Bandini and Dietz, 1987), SI and CGS units of body height in health physics, logarithmic gesture in algebra (Poliyanin and Manzhirov, 2007), ratio and percentages in statistics and Albert Einstein's theory of relativity in the branch of physics (Freedman et al., 2005; Einstein, 1916). These instruments have then used for examining all mathematical and/or statistical modeling in search of a quicker health status modulator in order to measure the health status of the population in the community.

RESULTS

The BMI is the measure of body fat relying on the body mass and body height (Ganong, 2001; Garrow and Webster, 1985; Strain and Zumoff, 1992), derived from the body mass divided by the square of the body height and is universally manifested in unit of kgm^{-2}, resulting from body mass in kilogram (kg) and body height in metre (m) of a sample in a population. So the statistical indicator to assess the BMI yielding to the equation as follows:

$$BMI = m_{kg} / h_m^2 \quad (1)$$

Where,
m_{kg} = Body mass in kg, h_m = Body height in m and BMI = Body mass index in kgm^{-2}

Lambert Alolphe Jacques Quetelet (Eknoyan, 2008), a Belgian astronomer, mathematician, statistician and sociologist invented the BMI philosophy during the period of his pioneering social physics. The BMI concept was named the Quetelet index pointing at the BMI invertor's surname Quetelet. So the BMI is equivalent to the

Quelelet index and the mathematical music in the connection is as follows:

$$BMI = QI \quad (2)$$

Where,
QI = Quetelet index
Inserting the Equation 2 value in the Equation 1.

$$QI = m_{kg} / h_m^2 \quad (3)$$

Body mass measuring in the SI base unit kg is the easiest trick in biophysics while body height measuring in the SI base unit m is harder and so the biophysics laureates are in vast use of the CGS base unit centimeter (cm) in order to measure body height of a sample in a population which is then converted into the SI base unit m with a view to bring to light the QI value in the SI derived unit kgm^{-2}. The following rule is applicable glancing at the unity bracket method (Bela, 2013) to convert the CGS unit cm into the SI unit m,

$$100 \text{ cm} = 1 \text{ m}$$
$$\text{Or, } 10^2 \text{ cm} = 1 \text{ m}$$
$$\text{Or, } 1 \text{ cm} = 1 / 10^2 \text{ m}$$
$$\text{Or, } 1 \text{ cm} = 10^{-2} \text{ m} \quad (4)$$

Inserting the Equation 4 value in the Equation 3,

$$QI = m_{kg} / (10^{-2} h_{cm})^2$$
$$= m_{kg} / 10^{-4} h_{cm}^2$$
$$= 10^4 m_{kg} / h_{cm}^2 \quad (5)$$

QI is a parameter used to determine health status of a sample in a population (Norgan and Ferro-Luzzi, 1982; Freedman, 2005; Davies and Lucas, 1989) and health status is imposed to the symbol H as rule as the myth of considering the initial alphabet of a word having massive influx in the scientific branch of physics.

$$\text{So, } QI = H; \quad (6)$$

Where,
H = Modulator of health status

The Equation 5 turned into the following icon as the Equation 6 stealing into the Equation 5,

$$H = 10^4 m_{kg} / h_{cm}^2 \quad (7)$$

Taking log (Shirali, 2002) in both side of the Equation 7,

$$\log H = \log (10^4 m_{kg} / h_{cm}^2)$$
$$= \log (10^4 m_{kg}) - \log h_{cm}^2$$
$$= \log 10^4 + \log m_{kg} - \log h_{cm}^2$$
$$= 4\log 10 + \log m_{kg} - 2 \log h_{cm}$$
$$= 4 + \log m_{kg} - 2 \log h_{cm}$$ [As log10=1 in common logarithm] (8)

The health status is replied to the equation below calculating the Equation (8),

$$H = \log^{-1} (4 + \log m_{kg} - 2 \log h_{cm}) \quad (9)$$

The picked up H value within the range of 18 to 25 kgm^{-2} found putting the measured body mass in kg and body height in cm in the Equation 9 is the indicator of healthy (H^+) and 18 to 25 kgm^{-2} deviated value the indicator of non-healthy (H^-) sample in the population (WHO, 2006a).

The number of healthy samples $(H^+)_n$ and non-healthy samples $(H^-)_n$ are found using the Equation 9 within the population of N in a community and then the following five postulates are with distinctive features in statistical modeling (Freeman, 2005; Schervish, 1995; Robertson, 1949):

(i) The ratio of healthy and non-healthy samples = $(H^+)_n : (H^-)_n$,
(ii) % of $(H^+)_n = 100 (H^+)_n / N$,
(iii) % of $(H^-)_n = 100 (H^-)_n / N$,
(iv) The population is relatively healthy[38] if $(H^+)_n > (H^-)_n$ and
(v) The population is relatively non-healthy[39] if $(H^+)_n < (H^-)_n$.

DISCUSSION

Health is the level of function or metabolic capacity of living organisms. In humans it is the ability of individuals or communities to adapt and self-manage when facing physical, mental and social challenges (Hube, 2011). The WHO defined health in its broader sense in its 1948 constitution as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (WHO, 2006b). To determine health and nutritional difficulties of people is generally challenging because different risk factors are associated with health and nutritional state (Rahman, 2016). The people are widely deprived of their country’s constitutional basic health, hygiene nutritional care and shelter. The BMI can measure health and nutritional condition in these circumstances defining as a value derived from mass (weight) and height of an individual in the unit of kgm^{-2} giving a big confliction on using mass and/or weight. The mass is a scalar quantity of unit metre (m) while the weight is a vector quantity containing the unit newton (N). The unit of BMI is kgm^{-2} and/or kgN^{-2} which is totally a false concept as well as unit of mass is a base unit but unit of weight is a derived unit.

According to the BMI definition, mass (weight) is used and hence the researchers are at bay over choosing the surer or surest quantity and its corresponding unit. So a simple apt modulator is essential to determine the prevailing health status in the communities aiming to

resist malnutrition influencing factors and so the Equation 9 can be the easier option to choose in assessing the overall health status. The German chemist Friedrich Wohler, the pioneer of organic chemistry disapproves the vitalism inventing Wohler synthesis in 1828 (Brinkman et al., 2012; Wohler, 1828). The current study findings similarly can overlap the place of the BMI (Wohler, 1828) in health science. The BMI or other methods (Hakim and Rahman, 2016; Alam et al., 2011; Hakim and Talukder, 2016; Rahman and Kuddus, 2014b; Ahmed and Islam, 2009; Chumlea et al., 2007; Petitt and Sidney, 1988) are using to measure the health and nutritional condition of people fighting shy of taking initiatives to invent a new method (Garrow et al., 1979) to explore the health status of population in communities and the present study derived biophysical modulator that is, logarithmic Equation 9 can take place in the path of the prior existing methods. This biophysical modulator can be a microsimulation modeling (Rahman et al., 2010; Rahman et al., 2013; Islam et al., 2015; Rahman and Harding, 2014) constructive to design effective policies and see the governments and NGOs, environmental and spatial effects across different countries (Rahman, 2016b; Rahman and Upadhyay, 2015; Rahman and Harding, 2016; Phill, 2011; Rahman, 2009) to bear up against the health and nutritional perils to make sure for ending malnutrition by 2020: an agenda for change in the millennium (Rahman, 2016a).

This health microsimulation modeling (Equation 9) is for exploring health status in bio-statistical rhythm as rule as five postulates derived from statistical analyzing of the respective logarithmic modulator. The current study can be a super active tool in health pedagogy (Poole et al., 2016; Karsten, 2012; Glickman and Mitchell, 1948) to resist nutritional victimization through using nutrition counseling with the help of modified mass energy equivalence in nutritional epidemiology in the branch of health science and biostatistics (Rahman and Hakim, 2016b; Chowdhury et al., 2016; Rahman and Hakim, 2016c).

Conclusion

Malnutrition is one of the splendid public health panics in both the developing and developed countries in the world. The current study findings are the five galore popular bio-statistical postulates on existing health status based on the logarithmic biophysical Equation 9. This equation can help to take immediate bid to shirk the malnutrition intensity identifying the health confounding trails and therefore the equation $H = \log^{-1}(4+ \log m_{kg} – 2 \log h_{cm})$ is the logarithmic biophysical modulator of health status in statistical modeling. So the national and international think tank should pave the way to make pinch of salt on this modulator to reduce malnutrition bulk as degree as possible at national as well as international level. Future research should adopt this modulator in designing microsimulation modeling on health pedagogy and nutritional epidemiology. This modulator should also be explored in further study for policy designing, analysis and checking spatial effects for childhood, adulthood and geriatric health status for health and nutritional upgradation.

Conflict of Interests

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The authors would like to thanks the four anonymous reviewers and the editor for their valuable comments that were used to improve the manuscript.

REFERENCES

Ahmed F, Islam MA (2009). Dietary pattern and nutritional status of Bangladeshi manual workers (rickshaw pullers). Int. J. Food Sci. Nutr. 48(5):285-291.

Alam MA, Hakim MA, Rouf MA, Haque MO, Ali ME, Zaidul ISM (2011). Nutritional status of urban slum children below five years: Assessment by anthropometric measurements with special reference to socioeconomic status. J. Food Agric. Environ. 9(2):85-90.

Bandini LG, Dietz WH Jr (1987). Assessment of body fatness in childhood obesity: evaluation of laboratory and anthropometric techniques. J. Am. Diet Assoc. 87(10):1344-1348.

Bela BCJ (2013). Introduction to Soil Mechanics. John Wiley and Sons. P 9.

Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, Mathers C, Rivera J (2008). Maternal and child undernutrition: global and regional exposures and health consequences. Lancet 371(9608):243-260.

Brinkman SA, Gialamas A, Rahman A, Mittinty MN, Gregory TA, Silburn S, Goldfeld S, Zubrick SR, Carr V, Janus M, Hertzman C, Lynch JW (2012). Jurisdictional, socioeconomic and gender inequalities in child health and development: Analysis of a national census of 5 year olds in Australia. BMJ Open 2(5):1-15.

Chowdhury MR, Rahman MS, Khan MM, Mondal MN, Rahman MM, Billah B (2016). Risk factors for child malnutrition in Bangladesh: A multilevel analysis of a nationwide population-based survey. J. Pediatr. 172:194-201.

Chumlea WC, Schubert CM, Sun SS, Demerath E, Towne B, Siervogein RM (2007). A review of body water status and the effects of age and body fatness in children and adults. J. Nutr. Health Aging 11(2):111-118.

Davies PS, Lucas A (1989). Quetelet's index as a measure of body fatness in young infants. Early Hum. Dev. 20(2):153-141.

de Onis M, Blossne M, Eorghi E (2011). Prevalence of stunting among pre-school children 1990-2020', Growth Assessment and Surveillance Unit. Publ. Health Nutr. 14:1-7.

Einstein A (1916). Relativity: the Special and General Theory. New York: H. Holt and Company.

Eknoyan G (2008). Adolphe Quetelet (1796-1874) - the average man and indices of obesity. Nephrol Dial Transplant 23(1):47-51.

Fakir AMS, Rahman MW (2015). Determinants of malnutrition among urban slum children in Bangladesh. Health Educ. Rev. 5:22.

Freedman DS, Ogden CL, Berenson GS, Horlick M (2005). Body mass index and body fatness in childhood. Curr. Opin. Clin. Nutr. Metab. Care 8(6):618-23.

Freeman DA (2005). Statistical Models: Theory and Practice, Cambridge University Press.

Ganong WF (2001). Review of Medical Physiology (12th edn.). P 302.
Garrow JS, Stalley S, Diethelm R, Pittet P, Hesp R, Halliday D (1979). A new method for measuring the body density of obese adults. Br J Nutr. 42(2):173-183.
Garrow JS, Webster J (1985). Quetelet's index (W/H^2) as measure of fatness. Int. J. Obes. 9(2):147-53.
Ghosh S, Shah D (2004). Nutritional problems in urban slum children. Indian Pediatr. 41(7):682-696.
Glickman N, Mitchell HH (1948). The total specific dynamic action of high-protein and high-carbohydrate diets of human subjects. J. Nutr. 36(1):41-57.
Hakim MA (2015). Nutritional Status and Hygiene Practices of Primary School Goers in Gateway to the North Bengal. Int. J. Publ. Health Res. 3(5):271-275.
Hakim MA (2016). Malnutrition prevalence and nutrition counseling in developing countries: A case study. Int. J. Nurs. Health Sci. 3(3):19-22.
Hakim MA, Kamruzzaman M (2015). Nutritional status of preschoolers in four selected fisher communities. Am. J. Life Sci. 3(4):332-336.
Hakim MA, Kamruzzaman M (2016). The dance of poverty and education for childhood nutritional victimization in Bangladesh. J. Biol. Environ. Eng. 1(1):6-9.
Hakim MA, Rahman A (2016). Health and Nutritional Condition of Street Children of Dhaka City: An Empirical Study in Bangladesh. Sci. J. Publ. Health 4(1-1):6-9.
Hakim MA, Talukder MJ (2016). An Assessment of Health Status of Street Children in Tangail, Bangladesh. Sci. J. Publ. Health 4(1-1):1-5.
Hakim MA, Talukder MJ, Islam MS (2015). Nutritional status and hygiene behavior of government primary school kids in central Bangladesh. Sci. J. Publ. Health 3(5):638-642.
Hasan N, Ashraf M, Rahman A (2016). Effects of Information Communication Technology (ICT) in the Childhood Developments and Lives of Disabilities: A Multivariate Analysis. Sci. J. Publ. Health 4(1-1):28-37.
Huber M, Knottnerus JA, Green L, van der Horst H, Jadad AR, Kromhout D, Schnabel P (2011). How should we define health? BMJ 343 (d4163).
Islam D, Ashraf M, Rahman A, Hasan R (2015). Quantitative Analysis of Amartya Sen's Theory: An ICT4D Perspective. Int. J. Inform. Commun. Technol. Human Dev. 7(3):13-26.
Kamruzzaman M, Hakim MA (2015). Socio-economic Status of Child Beggars in Dhaka City. J. Social Sci. Humanities 1(5):516-520.
Kamruzzaman M, Hakim MA (2016). Basic Rights on the Wane, Human Rights on Brown Study: A Case Study on Thrown Away Children in Bangladesh. Int. J. Environ. Plan. Manage. 2(4):29-35.
Karsten K (2012). Educational theory as tropical rheotic: The concepts of pedagogy of Johann Freidrich Herbert and Freidrich Schleiermacher. Stud. Phil. Educ. 31(1):265-273.
Kuddus A, Rahman A (2015). Affect of Urbanization on Health and Nutrition. Int. J. Stat. Syst. 10(2):165-174.
Kuddus A, Rahman A, Talukder MR, Hoque A (2014). A modified SIR model to study on physical behaviour among smallpox infective population in Bangladesh. Am. J. Maths. Stat. 4(5):231-239.
Megabiaw B, Rahman A (2013). Prevalence and determinants of chronic malnutrition among under-5 children in Ethiopia. Int. J. Child Health Nutr. 2(3):230-236.
Norgan NG, Ferro-Luzzi A (1982). Weight-height indices as estimators of fatness in men. Hum Nutr. Clin. Nutr. 36(5):363-372.
Petitt DB, Sidney S (1988). Obesity and cholecystectomy among women: implications for prevention. Am. J. Prev. Med. 4(6):326-30.
Phill M (2011). Small area housing stress estimation in Australia: Microsimulation modeling and statistical reliability, University of Canberra, Australia.
Poliyanin AD, Manzhirov AV (2007). Handbook of mathematics for engineers and scientists. CRC Press. P 9.
Poole SA, Hart CN, Jelalian E, Raynor HA (2016). Relationship between dietary energy and dietary quality in overweight young children: a cross-sectional analysis. Pediatr. Obesity 11(2):128-135.
Rahman A (2004). A review of child malnutrition and maternal health in developing countries, Discussion Paper - 04, Department of Statistics, University of Chittagong, pp. 1-37.
Rahman A (2006). Risk Factors for Malnutrition in Bangladeshi Children, Paper presentation at the Showcasing Toowoomba Area Health Research conference (STAHR-06), Centre for Rural and Remote Area Health, University of Southern Queensland, Toowoomba.
Rahman A (2009). Small area estimation through spatial microsimulation models: Some methodological issues, Paper presented at the 2nd General Conference of the International Microsimulation Association, The National Conference Centre Ottawa, Canada, (June 8 to 10) 2009. pp. 1- 45.
Rahman A (2016a). Significant risk factors for childhood malnutrition: Evidence from an Asian developing country. Sci. J. Publ. Health 4(1-1):16-27.
Rahman A (2016b). Small area housing stress estimation in Australia: Calculating confidence intervals for a spatial microsimulation model. Communications in Statistics - Simulation and Computation (forthcoming; http://dx.doi.org/10.1080/03610918.2016.1241406).
Rahman A, Biswas SC (2009). Nutritional status of under-5 children in Bangladesh. South Asian Journal of Population and Health 2(1): 1-11.
Rahman A, Chowdhury S (2007). Determinants of chronic malnutrition among preschool children in Bangladesh. J. Biosoc. Sci. 39(2):161-173.
Rahman A, Chowdhury S, Hossain D (2009). Acute malnutrition in Bangladeshi children: levels and determinants. Asia Pacific J. Publ. Health 21(1):294-302.
Rahman A, Chowdhury S, Karim A, Ahmed S (2008). Factors associated with nutritional status of children in Bangladesh: A multivariate analysis. Demogr. India 37(1):95-109.
Rahman A, Hakim MA (2016a). An epidemiological study on hygiene practice and malnutrition prevalence of beggars children in Bangladesh. Int. J. Nutr. Diet. 4(1):29-46.
Rahman A, Hakim MA (2016b). Malnutrition prevalence and health practices of homeless children: A cross-sectional study in Bangladesh. Science J. Publ. Health 4(1-1):10-15.
Rahman A, Hakim MA (2016c). Measuring modified mass energy equivalence in nutritional epidemiology: A proposal to adapt the biophysical modelling approach. Int. J. Stat. Med. Res. 5(3):219-223.
Rahman A, Harding A (2010). Some health related issues in Australia and methodologies for estimating small area health related characteristics. Online Working Paper Series 2010; WP-15, NATSEM, University of Canberra. pp. 1-59.
Rahman A, Harding A (2013). Prevalence of overweight and obesity epidemic in Australia: some causes and consequences. JP J. Biostat. 10(1):31-48.
Rahman A, Harding A (2014). Spatial analysis of housing stress estimation in Australia with statistical validation. Austr. J. Reg. Stud. 20(3):452-486.
Rahman A, Harding A (2016). Small area estimation and microsimulation modeling. Chapman and Hall/CRC Press, Florida.
Rahman A, Harding A, Tanton R, Liu S (2010). Methodological issues in spatial microsimulation modelling for small area estimations. Int. J. Microsimul. 3(2):3-22.
Rahman A, Harding A, Tanton R, Liu S (2013). Simulating the characteristics of populations at the small area level: New validation techniques for a spatial microsimulation model in Australia. Comput. Stat. Data Anal. 57(1):149-165.
Rahman A, Kuddus A (2014a). A new model to study on physical behaviour among susceptible infective removal population. Far East J. Theo. Stat. 46(2):115-135.
Rahman A, Kuddus A (2014b). Effects of some sociological factors on the outbreak of chickenpox disease. JP J. Biostat. 11(1):37-53.
Rahman A, Sapkota M (2014). Knowledge on vitamin A rich foods among mothers of preschool children in Nepal: impacts on public health and policy concerns. Sci. J. Publ. Health 2(4):316-322.
Rahman A, Upadhyay S (2015). A Bayesian reweighting technique for small area estimation. Current Trends in Bayesian Methodology with Applications, CRC Press, London pp. 503-519.
Robertson HP (1949). Postulate versus Observation in the Special Theory of Relativity. Rev. Modern Phys. 21(3):378-382.
Schervish MJ (1995). Theory of statistics. New York: Springer.
Shirali S (2002). A primer on Logarithms. Hyderabad: University Press,

esp. section 2.
Strain GW, Zumoff B (1992). The relationship of weight-height indices of obesity to body fat content. J. Am. Coll. Nutr. 11(6):715-718.
UNICEF (United Nations International Children's Emergency Fund) (1997). Malnutrition in South Asia; A Regional Profile, UNICEF report, P 8.
Wohler F (1828). Ueber kunstliche Bildung des Harnstoffs. Annalen der Physik und Chemie 88(2):253-256.
WHO (World Health Organization) (2006a). BMI Classification. Global Database on Body Mass Index.
WHO (World Health Organization) (2006b). Constitution of the World Health. WHO, Geneva.

Journal of Public Health and Epidemiology

Related Journals Published by Academic Journals

Journal of Diabetes and Endocrinology
Journal of Medical Genetics and Genomics
Journal of Medical Laboratory and Diagnosis
Journal of Physiology and Pathophysiology
Medical Practice and Reviews
Research in Pharmaceutical Biotechnology

academicJournals