BMC Public Health

Main menu

- Home
- About
- Articles
- Submission Guidelines

- Sections
- Supplements

Articles

- Search by keyword
- Search by citation

Search BMC Public Heal Volume 15 (2015) Search
Volume 15 (2015) Article number Search

1322 Result(s) within Volume 15 of BMC Public Health

Sort by
Newest first

Previous Page Page 21 of 53 Next Page

1. Research article

A systematic review and meta-analysis of the effectiveness of food safety education interventions for consumers in developed countries

Foodborne illness has a large public health and economic burden worldwide, and many cases are associated with food handled and prepared at home. Educational interventions are necessary to improve consumer food...

Ian Young, Lisa Waddell, Shannon Harding, Judy Greig, Mariola Mascarenhas, Bhairavi Sivaramalingam, Mai T. Pham and Andrew Papadopoulos

BMC Public Health 2015 15:822

Published on: 26 August 2015

2. Research article

Does a reduction in alcohol use by Dutch high school students relate to higher use of tobacco and cannabis?

Substance use of adolescents was investigated in a region around Amsterdam, the Netherlands, in the period 2005–2009. The study was intended to find out to what extent behaviour related to different substances...

Claudia E. Verhagen, Daan G. Uitenbroek, Emilie J. Schreuders, Sabah El Messaoudi and Marlou L. A. de Kroon

BMC Public Health 2015 15:821

Published on: 26 August 2015

3. Research article

Quantifying disparities in cancer incidence and mortality of Australian residents of New South Wales (NSW) by place of birth: an ecological study

In 2013, about 32 % of the Australian population over 15 years of age was born overseas. Previous cancer-related immigrant health studies identified differences in mortality and incidence between immigrants an...

Eleonora Feletto and Freddy Sitas

BMC Public Health 2015 15:823

Published on: 26 August 2015

4. Research article

Self-efficacy regarding physical activity is superior to self-assessed activity level, in long-term prediction of cardiovascular events in middle-aged men

Self-efficacy has been determined to be a strong predictor of who will engage in physical activity. We aimed to evaluate the associations between self-efficacy to perform physical activity, self-reported leisu...

Göran Bergström, Mats Börjesson and Caroline Schmidt

BMC Public Health 2015 15:820

Published on: 25 August 2015

5. Research article

Associations between intimate partner violence, childcare practices and infant health: findings from Demographic and Health Surveys in Bolivia, Colombia and Peru

Child health is significantly poorer in homes with intimate partner violence (IPV). However, a possible link to parental provision of childcare has been neglected.

Helga Bjørnøy Urke and Maurice B. Mittelmark

BMC Public Health 2015 15:819

Published on: 25 August 2015

6. Research article

Associations between parental chronic pain and self-esteem, social competence, and family cohesion in adolescent girls and boys – family linkage data from the HUNT study

Parental chronic pain has been associated with adverse outcomes in offspring. However, knowledge on individual and family resilience factors in adolescent offspring of chronic pain sufferers is scarce. This st...

Jannike Kaasbøll, Ingunn Ranøyen, Wendy Nilsen, Stian Lydersen and Marit S. Indredavik

BMC Public Health 2015 15:817

Published on: 22 August 2015

7. Research article

Understanding the socio-economic and sexual behavioural correlates of male circumcision across eleven voluntary medical male circumcision priority countries in southeastern Africa

Male circumcision (MC) has been demonstrated to be effective and cost-effective for HIV/AIDS prevention. Global guidance to adopt this intervention was announced in 2007 for countries with high HIV/AIDS preval...

Fiona K. Lau, Sylvia Jayakumar and Sema K. Sgaier

BMC Public Health 2015 15:813

Published on: 22 August 2015

8. Research article

Exploring the influence of context in a community-based facilitation intervention

focusing on neonatal health and survival in Vietnam: a qualitative study

In the Neonatal health – Knowledge into Practice (NeoKIP) trial in Vietnam, local stakeholder groups, supported by trained laywomen acting as facilitators, promoted knowledge translation (KT) resulting in decr...

Duc M. Duong, Anna Bergström, Lars Wallin, Ha TT Bui, Leif Eriksson and Ann Catrine Eldh

BMC Public Health 2015 15:814

Published on: 22 August 2015

9. Research article

Development of a text message intervention aimed at reducing alcohol-related harm in patients admitted to hospital as a result of injury

Screening for alcohol misuse and brief interventions (BIs) for harm in trauma care settings are known to reduce alcohol intake and injury recidivism, but are rarely implemented. We created the content for a mo...

Sarah Sharpe, Matthew Shepherd, Bridget Kool, Robyn Whittaker, Vili Nosa, Enid Dorey, Susanna Galea, Papaarangi Reid and Shanthi Ameratunga

BMC Public Health 2015 15:815

Published on: 22 August 2015

10. Research article

Do consumers 'Get the facts'? A survey of alcohol warning label recognition in Australia

There is limited research on awareness of alcohol warning labels and their effects. The current study examined the awareness of the Australian voluntary warning labels, the 'Get the facts' logo (a component of...

Kerri Coomber, Florentine Martino, I. Robert Barbour, Richelle Mayshak and Peter G. Miller

BMC Public Health 2015 15:816

Published on: 22 August 2015

11. Research article

Implementation of the HealthKick intervention in primary schools in low-income settings in the Western Cape Province, South Africa: a process evaluation

The HealthKick intervention, introduced at eight primary schools in low-income settings in the Western Cape Province, South Africa, aimed to promote healthy lifestyles among learners, their families and school...

Anniza de Villiers, Nelia P. Steyn, Catherine E. Draper, Jillian Hill, Lucinda Dalais, Jean Fourie, Carl Lombard, Gerhard Barkhuizen and Estelle V. Lambert

BMC Public Health 2015 15:818

Published on: 22 August 2015

12. Research article

Acceptance of sexual minorities, discrimination, social capital and health and well-being: a cross-European study among members of same-sex and opposite-sex couples

Awareness of health disparities based on sexual orientation has increased in the past decades, and many official public health agencies throughout Europe call for programs addressing the specific needs of lesb...

Arjan van der Star and Richard Bränström

BMC Public Health 2015 15:812

Published on: 21 August 2015

13. Research article

Risk factors for homicide victimization in post-genocide Rwanda: a population -based case- control study

Homicide is one of the leading causes of mortality in the World. Homicide risk factors vary significantly between countries and regions. In Rwanda, data on homicide victimization is unreliable because no stand...

Wilson Rubanzana, Joseph Ntaganira, Michael D. Freeman and Bethany L. Hedt-Gauthier

BMC Public Health 2015 15:809

Published on: 21 August 2015

14. Research article

Country characteristics and acute diarrhea in children from developing nations: a multilevel study

Each year 2.5 billion cases of diarrheal disease are reported in children under five years, and over 1,000 die. Country characteristics could play a role on this situation. We explored associations between cou...

Ángela María Pinzón-Rondón, Carol Zárate-Ardila, Alfonso Hoyos-Martínez, Ángela María Ruiz-Sternberg and Alberto Vélez-van-Meerbeke

BMC Public Health 2015 15:811

Published on: 21 August 2015

15. Research article

Designing and implementing a socioeconomic intervention to enhance TB control: operational evidence from the CRESIPT project in Peru

Cash transfers are key interventions in the World Health Organisation's post-2015 global TB policy. However, evidence guiding TB-specific cash transfer implementation is limited. We designed, implemented and r...

Tom Wingfield, Delia Boccia, Marco A. Tovar, Doug Huff, Rosario Montoya, James J. Lewis, Robert H. Gilman and Carlton A. Evans

BMC Public Health 2015 15:810

Published on: 21 August 2015

16. Research article

Diagnostic accuracy of different body weight and height-based definitions of childhood obesity in identifying overfat among Chinese children and adolescents: a cross-sectional study

Various body weight and height-based references are used to define obese children and adolescents. However, no study investigating the diagnostic accuracies of the definitions of obesity and overweight in Hong...

Lin Wang and Stanley Sai-chuen Hui

BMC Public Health 2015 15:802

Published on: 20 August 2015

17. Research article

Parents' perception of stroller use in young children: a qualitative study

Despite their wide usage, it has recently been suggested that stroller use may reduce physical activity levels of young children. However, there have been no studies on stroller use as it relates to physical a...

Catherine S. Birken, Bradley Lichtblau, Talia Lenton-Brym, Patricia Tucker, Jonathon L Maguire, Patricia C. Parkin and Sanjay Mahant

BMC Public Health 2015 15:808

Published on: 20 August 2015

18. Research article

Do unfavourable working conditions explain mental health inequalities between ethnic groups?: cross-sectional data of the HELIUS study

Ethnic inequalities in mental health have been found in many high-income countries. The purpose of this study is to test whether mental health inequalities between ethnic groups are mediated by exposure to unf...

Karen Nieuwenhuijsen, Aart H. Schene, Karien Stronks, Marieke B. Snijder, Monique H. W. Frings-Dresen and Judith K Sluiter

BMC Public Health 2015 15:805

Published on: 20 August 2015

19. Research article

Substance use and related problems among U.S. women who identify as mostly heterosexual

We used data from a nationally representative sample to compare substance use outcomes among adult women who identified as mostly heterosexual with those who identified as exclusively (only) heterosexual.

Tonda L. Hughes, Sharon C. Wilsnack and Arlinda F. Kristjanson

BMC Public Health 2015 15:803

Published on: 20 August 2015

20. Research article

Impact of migration origin on individual protection strategies against sexual transmission of HIV in Paris metropolitan area, SIRS cohort study, France

The impact of migration and country or region of origin on sexual behaviours and prevention of the sexual transmission of HIV has been scarcely studied in France. The objective of this study was to evaluate if...

Thomas Kesteman, Annabelle Lapostolle, Dominique Costagliola, Véronique Massari and Pierre Chauvin

BMC Public Health 2015 15:807

Published on: 20 August 2015

21. Research article

The contribution of sport participation to overall health enhancing physical activity levels in Australia: a population-based study

The contribution of sport to overall health-enhancing leisure-time physical activity (HELPA) in adults is not well understood. The aim was to examine this in a national sample of Australians aged 15+ years, an...

RM Eime, JT Harvey, MJ Charity, MM Casey, JGZ van Uffelen and WR Payne

BMC Public Health 2015 15:806

Published on: 20 August 2015

22. Research article

Finding the keys to successful adult-targeted advertisements on obesity prevention: an experimental audience testing study

Mass media communications are an important component of comprehensive interventions to address population levels of overweight and obesity, yet we have little understanding of the effective characteristics of ...

Helen Dixon, Maree Scully, Sarah Durkin, Emily Brennan, Trish Cotter, Sarah Maloney, Blythe J. O'Hara and Melanie Wakefield

BMC Public Health 2015 15:804

Published on: 20 August 2015

23. Research article

Assessment of water, sanitation, and hygiene practices and associated factors in a Buruli ulcer endemic district in Benin (West Africa)

Control of neglected tropical diseases (NTDs) requires multiple strategic approaches including water, sanitation and hygiene services (WASH). Buruli ulcer (BU), one of the 17 NTDs, remains a public health issu...

Roch Christian Johnson, Gratien Boni, Yves Barogui, Ghislain Emmanuel Sopoh, Macaire Houndonougbo, Esai Anagonou, Didier Agossadou, Gabriel Diez and Michel Boko

BMC Public Health 2015 15:801

Published on: 19 August 2015

24. Research article

Evaluation of psychometric properties and differential item functioning of 8-item Child Perceptions Questionnaires using item response theory

Four-factor structure of the two 8-item short forms of Child Perceptions Questionnaire $CPQ_{11–14}$ (RSF:8 and ISF:8) has been confirmed. However, the sum scores are typically reported in practice as a proxy of Oral ...

David TW Yau, May CM Wong, KF Lam and Colman McGrath

BMC Public Health 2015 15:792

Published on: 19 August 2015

25. Research article

Correlates of sitting time in adults with type 2 diabetes

Studies suggest a relationship between sitting time and cardiovascular disease mortality. Our aim was to identify socio-demographic, contextual, and clinical (e.g., body composition, diabetes duration) correla...

Anne-Sophie Brazeau, Samantha Hajna, Lawrence Joseph and Kaberi Dasgupta

BMC Public Health 2015 15:793

Published on: 19 August 2015

Previous Page Page 21 of 53 Next Page
Submit a manuscript

- Editorial Board
- Sign up to article alerts

Follow

- Follow us on Twitter

BMC Public Health

ISSN: 1471-2458

Contact us

- Editorial email: bmcpublichealth@biomedcentral.com

- Support email: info@biomedcentral.com

Publisher main menu

- Explore journals
- Get published
- About BioMed Central

Johnson et al. BMC Public Health (2015) 15:801
DOI 10.1186/s12889-015-2154-y

BMC Public Health

RESEARCH ARTICLE Open Access

Assessment of water, sanitation, and hygiene practices and associated factors in a Buruli ulcer endemic district in Benin (West Africa)

Roch Christian Johnson[1*], Gratien Boni[1], Yves Barogui[2], Ghislain Emmanuel Sopoh[2], Macaire Houndonougbo[1], Esai Anagonou[1], Didier Agossadou[2], Gabriel Diez[3] and Michel Boko[1]

Abstract

Background: Control of neglected tropical diseases (NTDs) requires multiple strategic approaches including water, sanitation and hygiene services (WASH). Buruli ulcer (BU), one of the 17 NTDs, remains a public health issue in Benin particularly in the district of Lalo. The availability of water as well as good hygiene are important for the management of Buruli ulcer particularly in the area of wound care one of the main component of the treatment of BU lesions. Given the growing importance of WASH in controlling NTDs and in order to assess the baseline for future cross-cutting interventions, we report here on the first study evaluating the level of WASH and associated factors in Lalo, one of the most BU-endemic districts in Benin.

Method: A cross-sectional study was carried to assess WASH practices and associated factors in the district of Lalo. Data were collected from 600 heads of household using structured pretested questionnaire and observations triangulated with qualitative information obtained from in-depth interviews of patients, care-givers and community members. Univariate and multivariate analysis were carried to determine the relationships between the potential associated factors and the sanitation as well as hygiene status.

Results: BU is an important conditions in the district of Lalo with 917 new cases detected from 2006 to 2012. More than 49 % of the household surveyed used unimproved water sources for their daily needs. Only 8.7 % of the investigated household had improved sanitation facilities at home and 9.7 % had improved hygiene behavior. The type of housing as an indicator of the socioeconomic status, the permanent availability of soap and improved hygiene practices were identified as the main factors positively associated with improved sanitation status.

Conclusions: In the district of Lalo in Benin, one of the most endemic for BU, the WASH indicators are very low. This study provides baseline informations for future cross-cutting interventions in this district.

Background

Neglected tropical diseases (NTDs) include 17 tropical diseases that are prevalent in Africa, Asia and South America. They mostly affect the poor rural populations, especially in areas with low coverage of hygiene and sanitation. These diseases are important causes of morbidity, and sometimes generate significant disabilities as well as stigmatization of affected populations, perpetuating poverty [1]. Control of NTDs requires multiple strategic approaches such as preventive chemotherapy; intensive case management; surgery and chronic care; transmission control; information, education and communication and water and sanitation [1]. Indeed, sustainable water, sanitation, and hygiene (WASH) services are essential for the prevention, long-term control, and even elimination of five of the NTDs: soil-transmitted helminthiasis, trachoma, schistosomiasis, lymphatic filariasis (LF), and Guinea worm disease [2]. Reducing levels of these WASH-preventable NTDs not only improves health and alleviates suffering, but can also lead to improved educational outcomes for children and increased economic progress for communities and nations. The WASH sector can significantly affect health and development by targeting

* Correspondence: rochjohnson@yahoo.fr
[1]Laboratory of Hygiene, Sanitation,Toxicology and Environmental Health, Interfaculty Center of Training and Research in Environment for the Sustainable Development, University of Abomey-Calavi (UAC), 01, PO Box 1463, Cotonou, Benin
Full list of author information is available at the end of the article

WASH activities where NTDs occur and by incorporating behavioral change messages relevant to specific NTDs into existing hygiene promotion efforts [1].

Buruli ulcer (BU), one of the 17 NTDs, is caused by a germ, *Mycobacterium ulcerans*, that mainly affects the skin but that can also affect the bones. It has been reported in over 30 countries. Most of those affected are children under 15 years of age who live in poor, rural communities. Late diagnosis can result in long and costly hospitalizations with significant morbidity and disability [3]. The disease is endemic in eight departments of southern Benin, with among one of the highest levels seen in the district of Lalo [4]. Whether the relationship between the WASH is clearly demonstrated for the five NTDs cited above [2], the link between WASH and BU is still little studied and the results of different studies on a possible association between BU and WASH need further investigations [5]. There is strong evidence that the endemic foci of BU almost always organized around an aquatic ecosystem [3]. However, the WASH sector is vital for the management of BU: BU patients need water for wound care, scar management after skin grafts, taking medications, and for good personal hygiene to prevent complications and secondary infections. Washing the skin lesions with clean water and soap could be protective for those exposed to BU [6]. Indeed, studies on wound care (an important component of the management of BU) have shown that washing wounds daily with clean water and soap is effective in reducing the risk of contamination by various microorganisms [7]. In addition to the above mentioned observations, Buruli ulcer control strategies as well as the community-led total sanitation (CLTS) strategy recommended for WASH in rural settings require significant community mobilization. Community based activities, as a cross-cutting interventions, can therefore be implemented alongside these for efficient use of resources in BU endemic communities where WASH services are poor. Given the growing importance of WASH in controlling NTDs [1], we report here on the first study in Benin to evaluate the level of WASH and associated factors in one of the most BU-endemic communes, to assess the baseline for future community-based cross-cutting interventions.

Method

Study site

This study was conducted in the district of Lalo, one of the administrative divisions of the Couffo department in Benin. Covering an area of 432 square kilometers, the district of Lalo is divided into 11 sub-districts, with 56 villages and 5 urban neighborhoods, and an estimated population of 119,080 in 2014 (Fig. 1).

Study design

A cross sectional study was conducted from July to December 2013 using a pretested and structured questionnaire completed by qualitative informations obtained from in-depth interviews of patients, care-givers and community members.

Sampling

Within the framework of this study (30) clusters of twenty (20) heads of households were selected in all administrative subdivisions of the commune. The number of cluster per subdistrict depends on the population of each subdistrict. Six hundred (600) heads of households were thereby selected across the 11 sub-districts of the district and interviewed using a questionnaire designed for this purpose. After the development of the questionnaire and other data collection tools by the research team, the validation of the questionnaire was made in several steps. A pre test was conducted in the commune of Lalo. Subsequent corrections and rephrasing were made. The questionnaire and pre-tested tools were then submitted to the ethical review committee and the comments of this committee were taken into account in the final version.

For the qualitative component of this study, 15 participants (one per sub-district, two care-givers and two patients) were selected and related issues were discussed. An experienced social scientist moderated all the in-depth interviews. In addition to handwritten notes during the interview, interviews were tape-recorded and later transcribed and translated into French. The main issues addressed by the in-depth interviews were those affecting the water, sanitation and hygiene status. Privacy and confidentiality of the interviewees, as well as good interaction between individuals and interviewer, was maintained during the data collection and interview time.

Operational definitions

Based on the WHO/UNICEF 2013 report on WASH [8], an unimproved (poor) water source is water from a dam or pool, or stagnant water from a river, stream or rain-water tank. Improved (good) water sources are water piped into the residence, from a human-powered drill or from a water tower. Households with unimproved (poor) sanitation status have no latrine or toilet facility. Households with improved (good) sanitation status have a pour-flush latrine, or ventilated improved pit latrine. Poor hygiene practice includes having no hand-washing and bathing facilities or detergents in the house, or washing hands with water but no soap or other detergents. Good hygiene practices include the use of hand-washing and bathing facilities, with the availability of soap and other detergents in the house.

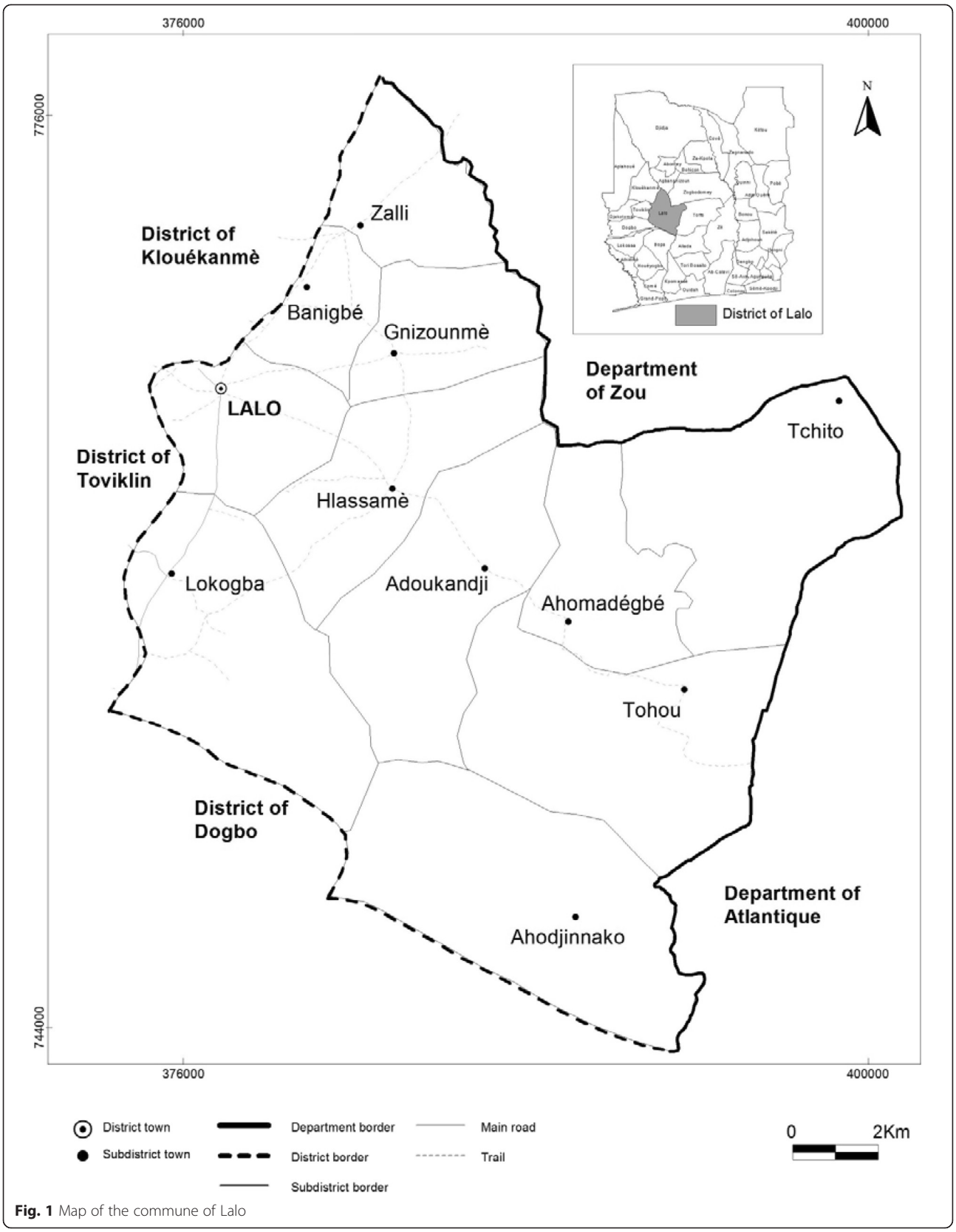

Fig. 1 Map of the commune of Lalo

Variables

Three types of variables were considered in the study: sociodemographic (age, sex, occupation, ethnicity, religion, type of housing); environmental (drinking water sources, presence or absence of latrines at home, wastewater management and domestic waste management, hygiene status), and the prevalence of BU, obtained from the register of the Centre de Dépistage et de Traitement de l'Ulcère de Buruli in Lalo (CDTUB LALO).

Data processing and analysis

The data were checked, coded, and entered in Excel and analyzed using Statistical Package for Social Science (SPSS) version 19.0. Univariate analysis was conducted. Using logistic regression, multivariate analysis was also carried out. The odds ratio, and 95 % confidence interval (CI) were used to determine the effect of potential associated variables on the sanitation and hygiene status considered as outcomes variables and to control confounding factors. The transcripts of the qualitative data were coded using a coding scheme and analyzed across selected themes and triangulated with data from the questionnaire.

Ethical considerations

Ethical clearance was obtained from the National Ethical Review Board of the Ministry of

Health Benin (N°147/MS/DC/SGM/DFRS/CNPERS/SA). The questions from the questionnaire were proven not to affect the morale or personality of study subjects. Written informed consent was obtained from each study subject after they had been given an explanation of the research, and what they were required to do and told that their involvement was voluntary. Confidentiality was assured by using code numbers rather than names and keeping questionnaires locked up. Data collectors also gave health education and advice to the subjects during the data collection process.

Results

Demographic characteristics of respondents

The Table 1 shows the sociodemographic and environmental characteristics of the households. The majorities were farmers and more than 73 % of household heads had received no formal education. Only 7.67 % (46) of households lived in houses built with sustainable materials. The majority of households lived in houses built with flimsy materials, reflecting their economic poverty.

Environmental characteristics of household

The Table 2 shows the environmental characteristics of the households. More than 49 % of households used unimproved sources of water on a daily basis. Only 8.67 % (62) households had improved sanitation facilities at home and 9.7 % (58) households had improved hygiene behavior. 16 % (96) had permanent availability of soap at home.

Table 1 Demographic characteristics of households

	Variables	Frequency	Percent %	95 % CI
Sex	Male	455	75.80 %	[72.2–79.2]
	Female	145	24.20 %	[20.8–27.8]
Total		600	100	
Occupation	Seller	20	3.33	[2.10–5.19]
	Farmer	545	90.83	[88.1–92.9]
	Craftsman	15	2.5	[1.5–4.2]
	Teacher	10	1.67	[0.85–3.15]
	Other	10	1.67	[0.85–3.15]
Total		600	100	
Ethnicity	Adja	363	60.5	[56.4–64.4]
	Fon	209	34.8	[31–38.8]
	Other	28	4.7	[3.2–6.8]
Total		600	100	
Education	Illiterate	439	73.17	[69.40–76.64]
	Able to read and write	161	26.83	[23.36–30.60]
Total		600	100	
Type of housing	Using modern building materials	46	7.67	[5.72–10.17]
	Using flimsy building materials	554	92.33	[89.83–94.28]
Total		600	100	

Cumulative number of cases of BU in the district of Lalo from 2006 to 2012

The Table 3 shows the number of cases of BU detected and treated at the CDTUB LALO from 2006 to 2012. BU appears to be a common condition in this commune with a relatively high detection rate. The sub-districts with the highest levels were Adoukandji, Gnizounmè, Ahomadegbé, and Tchito with 253, 192, 135 and 100 current BU cases respectively. Lokogba, Banigbé and Zalli had lower levels.

Factors associated with sanitation and hygiene status in the district of Lalo

The operational definitions of improved sanitation, good hygiene practices were based on the WHO/UNICEF 2013 report on WASH [8], as describe in the method section.

Based on theses operational definitions, the Tables 4 and 5 show the results of the multivariate analysis of factors associated with sanitation. The type of housing as an indicator of socioeconomic status, the permanent availability of soap and improved hygiene status were

Table 2 Environmental characteristics of households

	Variables	Frequency	Percent %	95 % CI
Water sources	Piped water (improved)	280	46.67	[42.63–50.75]
	Wells	24	4	[2.64–5.98]
	Groundwater	296	49.33	[45.27–53.41]
Total		600	100	
Water status	Improved	280	46.67	[42.6–50.8]
	Unimproved	320	53.3	[4902–57.8]
Total		600	100	
Sanitation	Improved	52	8.67	[6.60–11.28]
	Unimproved	548	91.33	[88.7–93.4]
Total		600	100	
Availability of soap	Yes	96	16.00 %	[13.2–19.20]
	No	504	84.00 %	[80.8–86.8]
Total		600	100	
Handwashing practices	No hand washing	419	69.8	[66.0–73.5]
	With water only	123	20.5	[17.4–24.0]
	With water and soap	58	9.7	[7.5–12.4]
Total		600	100	
Hygiene status	Unimproved	542	90.3	[87.6–92.5]
	Improved	58	9.7	[7.5–12.4]
Total		600	100	

identified as the main factors positively associated with improved sanitation and hygiene.

Results of in-depth interviews

In-depth interviews with key informants were used to gain a better appreciation of their basic knowledge of hygiene and sanitation.

Water uses

Consumption of surface water was recognized by the community as having a health risk, with several making comments like: "The water contains microbes and gives us diseases". The lack of improved water sources forces the households to use this water. It is paradoxical to note that the population generally does not use any disinfection measures, saying, for example: "We have always drunk water like that" or "We do not have disinfectants". Transporting drinking water in non-covered basins was common because "We've always done it like that". The risk associated with the disposal of leaves and plastic bags in drinking water is well known, with comments being made such as: "It's because there was dirt on the leaves that we got sick".

Sanitation

Open defecation is most frequently used by the majority (91, 32 %) of the households. This is explained by the absence of latrines, probably because of the low economic level of most households. The resulting risks are well-known and people are aware that the construction of latrines would be helpful to address the problem. The in-depth interviews did not reveal any cultural barriers to the use of latrines. However a reticence was noted about the use of community latrines, due to infrastructure maintenance problems.

Table 3 Cumulative detection of BU in subdistricts of Lalo

Subdistrict	Cumulative new cases detected (2006–2012)	Mean population (2006–2012)	Cumulative detection Rate
Ahomadégbé	135	4565	30/1000
Adoukandji	253	11035	23/1000
Gnizounmè	192	9571	20/1000
Tchito	100	6155	16/1000
Ahodjinnako	79	6279	13/1000
Tohou	45	6749	07/1000
Hlassamey	72	16924	04/1000
Banigbé	8	6454	01/1000
Lalo Centre	13	14583	01/1000
Lokogba	8	10091	01/1000
Zalli	12	36493	00/1000
Total lalo	917	102298	09/1000

Table 4 Factors associated with hygiene and sanitation status

		Unimproved	Improved	Crude OR	95 % CI	Adjusted OR	95 % CI	P
Education	Illiterate	412	27	2.81	1.57–5.00	1.49	0.75–2.94	0.25
	Read and write	136	25	1.0		1.0		
Type of housing	Modern materials	31	15	0.15	0.07–0.30	0.32	0.14–0.75	0.01
	Flimsy materials	517	37	1.0		1.0		
Availability of soap	Yes	64	32	0.08	0.04–0.15	0.17	0.08–0.34	0.00
	No	484	20	1.0		1.0		
Hygiene status	Improved	37	21	0.11	0.06–0.20	0.32	0.18–0.69	0.00
	Unimproved	511	31	1.0		1.0		
Diarrhea in the last 7 days	No	296	42	0.28	0.14–0.57	0.48	0.22–1.02	0.06
	Yes	252	10	1.0		1.0		

Note: Underlining indicates significance at the 0.05 level

Waste management

Waste is typically discharged into the surrounding environment by almost all of the household. Some of the households incinerate waste periodically. The almost total absence of controlled garbage dumps and the lack of garbage collection systems reflect the lack of attention to this problem, and waste management is a major concern in the municipality.

Hand-washing practices

Washing hands before eating is a common practice. However, it is often not practical for some meals and may be omitted in certain circumstances (for example, on the farm). This washing, however, is not always with soap because of the cost. Hand-washing with soap after defecation is practiced by a little part of households. The non-availability of water influences hand washing, with comments including: "We already have insufficient water for drinking purposes, so it's hard to wash our hands with the little water we have".

According to our results, the minimum requirements of good hygiene and good sanitation are not met. There is a lack of garbage dumps and waste management infrastructure, an almost total lack of latrines in households, and low access to improved water sources.

Discussion

Numerous aspects of the control of NTDs require individuals to have good access to WASH services. This may include water to practice good skin hygiene as well as access to good sanitation for those affected [1]. As far as Buruli ulcer is concerned, contrary to the WASH preventable NTDs [2], there are currently few studies on the WASH and BU. A study conducted in Cameroon show persistence of *M. ulcerans* specific DNA sequences over a period of more than two years at a water contact location of BU patients in an endemic village of Cameroon. At defined positions in a shallow water hole used by the villagers for washing and bathing, detritus remained consistently positive for *M. ulcerans* DNA. The result of real-time PCR indicated *M. ulcerans*, which cause human disease, persisted in this environment after successful treatment of all local patients. Underwater decaying organic matter

Table 5 Factors associated with hygiene status

		Unimproved	Improved	Crude OR	95 % CI	Adjusted OR	95 % CI	P
Education	illetrate	409	30	2.87	1.65–4.98	1.84	0.98–3.43	0.06
	Read and write	133	28	1.0		1.0		
Type of housing	Modern materials	32	14	0.20	0.10–0.40	0.48	0.20–1.11	0.09
	Flimsy materials	510	44	1.0		1.0		
Availability of soap	Yes	63	33	0.10	0.056–0.18	0.19	0.10–0.36	0;00
	No	479	25	1.0		1.0		
Sanitation	Unimproved	511	37	9.36	4.90–17.86	3.23	1.51–6.91	0.00
	Improved	31	21	1		1.0		
Diarrhea in the last 7 days	No	294	44	0.38	0.20–0.71	0.70	0.35–1.40	0.31
	Yes	248	14	1				

Note: Underlining indicates significance at the 0.05 level

may therefore represent a reservoir of *M. ulcerans* for direct infection of skin lesions or vector-associated transmission [9]. In the same line, in a study conducted in Benin, a total of 416 participants were enrolled including 104 cases and 312 controls. BU history in the family ($p < 0.001$), adjusted by daily contact with a natural water source ($p < 0.007$), was significantly associated with higher odds of having BU (OR; 95 % CI = 5.5; 3.0–10.0) [10]. In addition to these considerations, as we explain in the background of our study, the WASH sector is vital for the management of BU patients need water for wound care, scar management after skin grafts, taking medications, and for good personal hygiene to prevent complications and secondary infections. Washing the skin lesions with clean water and soap could be protective for those exposed to BU [6]. Studies on wound care (an important component of the management of BU) have shown that washing wounds daily with clean water and soap is effective in reducing the risk of contamination by various microorganisms [7]. In the fight against HIV/AIDS, good access to WASH services can prevent opportunistic infections and improve patients' lives [11, 12]. Adequate access to WASH services is therefore a challenge for both healthy and non-healthy populations in many countries and communities with high levels of NTDs [1].

This first study in a district in Benin where BU is endemic is very timely, and provides an inventory of WASH indicators in the study area. The average (mean) age of household heads interviewed was 45 years, with a mode of 35 and a standard deviation of 10.42. Heads of households were mostly farmers and their ethnicity is Adja (60.50 %). Other ethnicities (7 %) identified were Yoruba, Fon, Mina and some Bariba. These data are consistent with figures from the municipality showing that the population of the town is dominated by the Adja ethnic group, which together with Fon makes up 95.3 % of the population [13].

The population of Lalo uses three sources of water for drinking purposes: borehole (46.67 %), rainwater tank (4 %); and surface water (49.33 %). Generally, people had experience of using disinfection techniques such as chlorination, but did not implement them, for various reasons, probably the extra work or additional costs required This cross-sectional study was not able to assess the functionality of boreholes throughout the year, nor did it investigate the quality of water from them. However, in many poor countries, studies have shown that the water supplied by the water distribution systems may be poor quality [8]. A study conducted by our team in another municipality of Benin corroborates these findings [14]. Similarly, a study carried out in the municipality of Abomey Calavi in Benin demonstrated that the water from the aquifer was contaminated by various microorganisms including *Escherichia coli*, *Klebsiella pneumoniae*, *Staphylococcus aureus*, *Salmonella spp*, *Clostridium perfringens* and fecal streptococci [15]. In some localities in Lalo, such as the villages of Djibahoun and Assogbahoué, there is no system for supplying improved water for the population. Households there use only unimproved water sources. The results from this study therefore show that 53.33 % of households use unimproved water (surface water and rainwater tank) for drinking purposes. This proportion is higher than that in the WHO and UNICEF report published in 2013 [8] on Benin, which suggested that about 43 % of rural households had access to improved water sources.

There was low latrine coverage for households: only 8.67 % of those surveyed. This low rate is in line with official data from Lalo, which reveal that there are almost no household latrines in the majority of villages in the commune [13]. A study by Reiff et al. for the Global Sanitation Fund and Water Supply and Sanitation Collaborative Council established an evacuation of excreta rate of about 30.21 % in the Atlantique region [16].

As well as the questionnaire survey, which revealed a very low rate of hand-washing, we also made a count of latrines equipped with hand-washing facilities, to obtain an indirect estimate of the frequency of this practice. We found no latrines with hand-washing devices. This exposes people to the risk of disease, because the lack of hand-washing facilitates the transmission of fecal diseases. For example, Judah et al. reported that 28 % of frequent travelers had fecal bacteria on their hands [17].

Observation of maternal practices in handling children's feces shows that often, no precautions are taken. This situation encourages the transmission of fecal diseases. Gil et al. [18] showed that improper disposal and unsanitary handling practices of children's feces were associated with an increase of 23 % in the risk of diarrhea, which may encourage people to increase hand-washing [19, 20]. Despite this, our study showed that systematic hand-washing after defecation remains marginal. This is not without consequences for health, as our field survey found that children had suffered from diarrhea in 11.67 % of households. This could be explained by the behavior of children, who defecate on the floor and frequent uncontrolled garbage dumps. Studies in other African countries have shown a strong link between exposure to solid waste released into the environment and diarrheal diseases. For example, Dikassa et al. [21] demonstrated that in Kinshasa, the children of families living in very poor hygienic and sanitary conditions were at 70 % greater risk of suffering from severe diarrhea.

Wastewater is poorly managed in the district of Lalo. All the households surveyed lacked home cesspools, which are recommended by the Ministry of Health [22]. Wastewater, as well as solid waste, is released untreated

by 98.17 % of households. These practices pose a risk to public health. In some villages, households use garbage as fertilizer on family plantations. These waste management methods should be encouraged in rural areas.

Several factors can influence the sanitation status such as level of education, type of housing, hygiene practices, and water availability [8]. In our multivariate model, the type of housing as an indicator of socioeconomic status was identified as the main factor positively associated with improved sanitation. The lack of soap and the absence of hand-washing were the main factors associated with low sanitation level. We found no link between sanitation and the level of education of the household head, in contrast to a study conducted in Ethiopia, which showed that children's hygiene practices at school were dependent on the parents' level of education [23]. The same observation was made by Schmidt et al. in Kenya, who showed that hand-washing practices were dependent on level of education [24].

Measured as the proportion of people living on less than $ 1 a day, half of the departments in Benin are severely affected by poverty, including Couffo, where this study was conducted. There, the proportion of the population affected by this extreme poverty is estimated to be between 61 % and 75 % [25]. Our results are consistent with those of the Water and Sanitation Program, which also showed a disparity between rich and poor in terms of access to sanitation in Benin [26]. It is therefore clear that the municipality of Lalo lacks individual and collective sanitation, has a shortage of improved water supply infrastructure and poor hygiene practices.

It would be helpful to plan and implement targeted interventions to correct this situation. UNICEF and WHO recommended a strategy called community-led total sanitation, to gradually move villages to zero open defecation [27]. This strategy requires strong community mobilization, but our results suggest that it would be relevant in Lalo. Community programs for early detection of Buruli ulcer and other neglected tropical diseases of the skin could benefit from this social mobilization. Wound care and management of scars after skin grafts can also be taken into account in these WASH programs.

Conclusion

In the commune of Lalo, one of the four districts in Benin where levels of BU are highest, water hygiene and sanitation levels indicators are very low. This has obvious effects on health, especially for children. This study provides baseline information for future interventions in the WASH sector in this municipality. Those treating BU and other NTDs can use the WASH platform to share resources to make interventions more efficient for communities, partners and the health system.

Abbreviations

NTDs: Neglected tropical diseases; WASH: Water sanitation and hygiene; BU: Buruli ulcer.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

RCJ contributed to the data collection, study methodology, analyzed data and wrote the manuscript; YB literature review and analyzed data; GES literature review and analyzed data; GB literature review and analyzed data, MH literature review, analyzed data, EA literature review, analyzed data and mapping DA literature review, GD literature review, MB literature review editing the manuscript. All the authors read and approved the final manuscript.

Acknowledgements

We are very grateful to the populations of the district of Lalo and the health staff of the CDTUB. We are thankful to Anesvad Foundation for supporting the field work.

Author details

[1]Laboratory of Hygiene, Sanitation,Toxicology and Environmental Health, Interfaculty Center of Training and Research in Environment for the Sustainable Development, University of Abomey-Calavi (UAC), 01, PO Box 1463, Cotonou, Benin. [2]National Buruli ulcer Control Program; Ministry of Health, Cotonou, Bénin. [3]Anesvad Foundation, General Concha, 28 - 1°, 48010 Bilbao, Spain.

Received: 12 February 2015 Accepted: 14 August 2015
Published online: 19 August 2015

References

1. Freeman MC, Ogden S, Jacobson J, Abbott D, Addiss DG, Amnie AG, et al. Integration of water, sanitation, and hygiene for the prevention and control of neglected tropical diseases: a rationale for inter-sectoral collaboration. PLoS Negl Trop Dis. 2013;7:e2439. doi:10.1371/journal.pntd.0002439.
2. WHO. Accelerating work to overcome the global impact of neglected tropical disease: a roadmap for implementation. Geneva: World Health Organization; 2012.
3. van der Werf TS, Stienstra Y, Johnson RC, Phillips R, Adjei O, Fleischer B, et al. *Mycobacterium ulcerans* disease. Bull World Health Organ. 2005;83:785–91.
4. Johnson RC, Sopoh GE, Boko M, Zinsou C, Gbovi J, Makoutode M, et al. Distribution of *Mycobacterium ulcerans* (Buruli ulcer) in the district of Lalo in Benin. Trop Med Int Health. 2005;10:863–71 (in French).
5. Merritt RW, Walker ED, Small PLC, Wallace JR, Johnson PDR, et al. Ecology and Transmission of Buruli Ulcer Disease: A Systematic Review. PLoS Negl Trop Dis. 2010;4(12), e911. doi:10.1371/journal.pntd.0000911.
6. Nackers F, Johnson RC, Glynn JR, Zinsou C, Tonglet R, Portaels F. Environmental and health-related risk factors for Mycobacterium ulcerans disease (Buruli ulcer) in Benin. Am J Trop Med Hyg. 2007;77:834–6.
7. Misiakos EP, Bagias G, Patapis P, Sotiropoulos D, Kanavidis P, Machairas A. Current concepts in the management of necrotizing fasciitis. Front Surg. 2014;1:36. doi:10.3389/fsurg.2014.00036.
8. WHO, UNICEF. Progress on sanitation and drinking-water: 2013 update. Geneva: WHO; 2011.
9. Bratschi MW, Ruf M-T, Andreoli A, Minyem JC, Kerber S, et al. *Mycobacterium ulcerans* Persistence at a Village Water Source of Buruli Ulcer Patients. PLoS Negl Trop Dis. 2014;8(3), e2756. doi:10.1371/journal.pntd.0002756.
10. Sopoh GE, Barogui YT, Johnson RC, Dossou AD, Makoutode´ M, et al. Family Relationship, Water Contact and Occurrence of Buruli Ulcer in Benin. PLoS Negl Trop Dis. 2010;4(7), e746. doi:10.1371/journal.pntd.0000746.
11. Yallew WW, Terefe MW, Herchline TE, Sharma HR, Bitew BD, Kifle MW, et al. Assessment of water, sanitation, and hygiene practice and associated factors among people living with HIV/AIDS home based care services in Gondar city Ethiopia. BMC Public Health. 2012;12:1057.

12. Peletz R, Mahin T, Elliott M, Harris MS, Chan KS, Cohen MS, et al. Water, sanitation, and hygiene interventions to improve health among people living with HIV/AIDS: a systematic review. AIDS. 2013;27:2593–601. doi:10.1097/QAD.0b013e3283633a5.
13. Conseil A. Monographie de la commune de Zè. Afrique Conseil: Cotonou; 2006 (in French).
14. Johnson RC, Segla H, Dougnon TV, Boni G, Bankole HS, Houssou C, et al. Situation of water, hygiene and sanitation in a peri-urban area in Benin, West Africa: the case of Sèmè-Podji. J Environ Prot. 2014;5:1277–83. http://dx.doi.org/10.4236/jep.2014.512121.
15. Degbey C, Makoutode M, Agueh V, Dramaix M, de Brouwer C. Facteurs associés à la qualité de l'eau de puits et prévalence des maladies hydriques dans la commune d'Abomey-Calavi (Bénin). Sante. 2011;21:47–55 (in French).
16. Reiff S, Clegbaza G. Rural sanitation: the experience of non-subsidized household latrines through social marketing and the promotion of the small-scale private sector: the case of PADEAR programme in Benin. Washington DC: Water and Sanitation Program; 1999. www.wsp.org. Accessed 29 July 2012.
17. Judah G, Donachie P, Cobb E, Schmidt W, Holland M, Curtis V. Dirty hands: bacteria of faecal origin on commuter's hands. Epidemiol Infect. 2010;138:409–14.
18. Gil A, Lanata C, Kleinau E, Penny M. Children's feces disposal practices in developing countries and interventions to prevent diarrheal diseases: A literature review. Washington DC: Environmental Health Project. U.S. Agency for International Development; 2004.
19. Pittet D, Simon A, Hugonnet S, Pessoa-Silva CL, Sauvan V. Hand hygiene among physicians: performance, beliefs and perceptions. Ann Intern Med. 2004;141:1–8.
20. Drankiewicz D, Dundes L. Handwashing among female college students. Am J Infect Control. 2003;31:67–71.
21. Dikassa L, Mock N, Magnani R, Rice J, Abdoh A, Mercer D, et al. Maternal behavioural risk factors for severe childhood diarrhoeal disease in Kinshasa Zaire. Int J Epidemiol. 1993;22:327–33.
22. de la Santé M. Direction de la Programmation et de la Prospective, Service des statistiques, de la documentation et de la recherche opérationnelle. Annuaire des Statistiques sanitaires. Cotonou: Ministère de la Santé; 2011.
23. Vivas A, Gelaye B, Aboset N, Kumie A, Berhane Y, Williams M. Knowledge, attitude and practices (KAP) of hygiene among school children in Angolela Ethiopia. J Prev Med Hyg. 2010;51:73–9.
24. Schmidt WP, Aunger R, Coombes Y, Maina PM, Berhane Y, Williams MA. Determinants of handwashing practices in Kenya: the role of media exposure, poverty and infrastructure. Trop Med Int Health. 2009;14:1534–41.
25. Institut National de la Statistique et de l'Analyse Économique (INSAE) [Bénin] et Macro International Inc. Enquête Démographique et de Santé (EDSB-III) - Bénin 2006. Calverton, Maryland, USA: Institut National de la Statistique et de l'Analyse Économique et Macro International Inc; 2007. in French.
26. Bénin-WSP. Rapport sur les impacts économiques d'un mauvais assainissement en Afrique. Washington DC: Water and Sanitation Program; 2012. www.wsp.org. Accessed 27 July 2012.
27. Sigler R, Mahmoudi L, Graham JP. Analysis of behavioral change techniques in community-led total sanitation programs. Health Promot Int. 2014 Sep 10. doi: 10.1093/heapro/dau073.