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ORIGINAL PAPER

The Most Important Recommended Times of Hand Washing with Soap and Water in Preventing the Occurrence of Acute Diarrhea Among Children Under Five Years of Age in Slums of Addis Ababa, Ethiopia

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Abstract
Adequate hand washing with soap at five recommended times is particularly important in urban slums in developing countries, but which of the recommended times are the most important in the prevention of diarrhea among children under five years of age living in these areas remains unclear. To address this gap, a community-based cross-sectional study was undertaken in the slums of Addis Ababa, Ethiopia between September and November 2014. Data were collected using a pre-tested structured questionnaire and an observational checklist. Multivariable logistic regression with 95% confidence interval (CI) was used for data analysis. Only 4.4% of the households had hand washing facilities within or near a latrine with soap and water access. The average prevalence of hand washing with soap at the five recommended times was 19.8%. One quarter (24.8%) of caregivers washed their hands with soap before feeding a child, 23.8% before preparing food, and 17.1% after defecation. The most important recommended times in preventing acute diarrhea were before preparing food [adjusted odds ratio (AOR) 0.2; 95% CI 0.1–0.7] and after defecation (AOR 0.3; 95% CI 0.1–0.9). Household size of six or more persons (AOR 2.3; 95% CI 1.4–3.9) and low monthly household income (AOR 2.4; 95% CI 1.4–4.0) were significantly associated with acute diarrhea. Promoting hand washing with soap and advocacy programs at the five recommended times, especially before preparing food and after defecation, and implementation of socioeconomic development programs targeting poor households are essential for increasing the prevalence of hand washing with soap and preventing acute diarrhea in the slums of Addis Ababa.

Keywords Acute diarrhea · Hand washing with soap · Hand washing at recommended times · Most important recommended times · Prevalence of hand washing with soap · Slums of Addis Ababa · Ethiopia

Introduction

Diarrhea is a major cause of mortality in children under five years of age [24]. It has been reported as the cause of death of an estimated 760,000 children under five years of age in 2011 [25]. Good hygiene practices usually reduce episodes of diarrhea by 30–40% [14] and hand washing with soap and water reduces episodes of diarrhea on average by 45% (12–68%) [8]. Hand washing with soap and water is abbreviated herein as hand washing with soap. Daily hand washing with soap at recommended times has been estimated to reduce occurrence of diarrhea by 42–47% [10]. The standard

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public health recommendation for hand washing with soap lists five recommended times: before preparing food, before feeding a child, before eating food, after defecation, and after cleaning a child who had defecated [20]. Although the health benefits of hand washing have been increasingly recognized [11], studies in several countries, including Ethiopia, found the prevalence of hand washing with soap is low, for instance after defecation to be only 2–29% [6, 11, 16, 19].

The prevalence of hand washing with soap is particularly low in sub-Saharan Africa [16], although its prevalence in the slums of this region is not known. Hand washing with soap at the five recommended times can significantly decrease the occurrence of acute diarrhea [8] but it is not clear which of the five recommended times are the most important in preventing the occurrence of acute diarrhea. A recent review recommended that the most important times for hand washing with soap for the prevention of diarrhea be identified [16]. The explicit reference to hygiene in UN Sustainable Development Goal 6, particularly in Target 6.2, emphasizes the importance of hygiene through the indicator of hand washing, namely the proportion of a population with hand washing facilities that include water and soap at home [26]. A lack of rigorous data, particularly on the most important recommended times for hand washing with soap, may be a bottleneck for the appropriate planning and implementation of effective diarrhea prevention programs among children under five years of age in the slums of Addis Ababa.

To address the existing research gaps, we undertook a study of water, sanitation, and hygiene (WASH) and health facility utilization in relation to acute diarrhea among under-five years of age children in slums of Addis Ababa. Some of the results have been published in a series of papers [1–3]. Interrupted water supply [2] and proximity of sanitation facilities [1] were significantly associated with acute diarrhea. To provide comprehensive data on WASH in the slums of Addis Ababa, the current study focused on hand washing with soap at five recommended times with the objective of identifying the most important times in preventing the occurrence of acute diarrhea. The results of this study may inform health policy and decision makers seeking to implement hand washing with soap programs by focusing on the most effective recommended times in the prevention of acute diarrhea among children under five years of age in the slums of Addis Ababa and other cities in developing countries.

Methods

Study Area

This study was conducted in two slum districts of Addis Ababa, a study area described in detail elsewhere [1, 2]. According to a 2015 report by the district administration, there were 1453 legally registered children under the age of five years among a population of 32,000 in District 01 in Gullele Sub-City and 1321 under-five years of age children among a population of 27,500 in District 05 in Lideta Sub-City.

Study Design, Sample Size and Study Participants

A community-based cross-sectional study was conducted between September and November 2014 among children aged 0–50 months. A two-stage sampling method and systematic sampling techniques were employed for the selection of the studied slum districts and the participating households, respectively. Further details on the study design, sample size, study participants, sampling techniques, definition of acute diarrhea, inclusion and exclusion criteria, and ethical approval of this study are described in another study [1].

Data Collection and Data Quality Assurance

Data were collected from the caregivers of the selected children using a pre-tested structured questionnaire about hand washing with soap at the five recommended times. The questionnaire also elicited socio-demographic and child-related information. Each of the five recommended times was coded as a binary variable with a score of 1 indicating washing hands with soap and a score of 0 for not washing hands with soap.

Data were also collected by direct observation of the presence of hand washing facilities within or near latrines, hand washing facilities with water only, and facilities with access to both water and soap. Questionnaires were first prepared in English and then translated into Amharic for data collection. Details about the data collectors and data quality assurance methods are described elsewhere [1].

Statistical Analysis

Data were analyzed using STATA Version 14.0 (StataCorp LP, College Station, TX). Categorical variables were summarized using proportions and continuous variables were summarized using mean [± SD (standard deviations)]. The primary outcome of the study was the prevalence of hand washing with soap at recommended times. Prevalence of hand washing with soap at recommended times was estimated using the proportion of caregivers who washed their hands with soap at recommended times within the 2 weeks prior to data collection.

The second outcome of the study was the presence or absence of acute diarrhea among children aged 0–50 months, coded as yes or no. Using this outcome variable, bivariate and multivariable logistic regression analyses were performed. In bivariate analysis, variables resulting in

a *p*-value of less than 0.20 were included in the multivariable logistic regression analysis. The multivariable analysis [adjusted odds ratio (AOR) with 95% CI] identified which of the recommended times for hand washing with soap were most important to the prevention of acute diarrhea and which variables were significantly associated with acute diarrhea. The Hosmer–Lemeshow statistic was used to test the goodness-of-fit of the model [18].

Results

Characteristics of the Study Participants

A total of 690 households participated in the study (99.0% response rate). The mean household size was 5.0 (± 2.0) persons. The mean age of caregivers was 30.4 (± 6.3) years; mean monthly household income was $62.7 (± 34.5) US. Nearly half (47.0%) of the caregivers did not complete high school. The mean number of children under five years of age per household was 1.3 (± 0.5) and the mean age of children aged 0–50 months was 24.9 (± 13.7) months (Table 1).

Prevalence of Hand Washing with Soap at Recommended Times

Only 29 (4.4%) of the households with hand washing facilities within or near a latrine had access to soap and water (Table 1). However, one-fifth (19.8%) of the caregivers washed their hands with soap at all five recommended times. One quarter of caregivers (24.8%) washed their hands with soap before feeding a child, 23.8% before preparing food, 20.4% after cleaning a child who had defecated, 17.1% after defecation, and 12.7% before eating food (Table 2).

Table 1 Descriptive statistics of socio-demographic and child related factors and hand washing facilities in slums of Addis Ababa, Ethiopia, between September and November, 2014

Variable ($N=690$)	Proportion [n (%)]	Mean	SD
Prevalence of acute diarrhea	82 (11.9)		
Monthly household income ($US)		62.7	34.5
Age of caregivers (years)		30.4	6.3
Caregivers education			
Does not read or write	142 (21.0)		
Incomplete high school or below[a]	327 (47.0)		
Completed high school or higher	221 (32.0)		
Employed caregivers	299 (43.0)		
Household size		5.0	2.0
Marital status			
Currently married	575 (83.0)		
Currently single	115 (17.0)		
House ownership			
Owned	76 (11.0)		
Rented or other	614 (89.0)		
Birth order of children			
First	299 (43.0)		
Second	204 (30.0)		
Third or more	187 (27.0)		
Number of under-five children		1.3	0.5
Child's age (months)		24.9	13.7
Child's sex (male)	378 (55.0)		
Characteristics of hand washing facilities located within or near latrines[b] ($N=654$)			
Presence of hand washing facilities	86 (13.1)		
Hand washing facilities with water only	58 (8.9)		
Hand washing facilities with both water and soap	29 (4.4)		

[a]Includes informal education

[b]Open defecation user households are excluded

Table 2 Prevalence of hand washing with soap by caregivers at recommended times in slums of Addis Ababa, Ethiopia, between September and November, 2014

Hand washing with soap at recommended times ($N=690$)	Number (n)	Prevalence (%)	95% CI (%)
Before feeding a child	171	24.8	21.7–28.1
Before preparing food	164	23.8	20.7–27.1
After cleaning a child who had defecated	141	20.4	17.6–23.6
After defecation	118	17.1	14.5–20.1
Before eating food	88	12.7	10.4–15.5
Average prevalence of hand washing with soap at all five recommended times		19.8	17.0–22.9

Table 3 Factors independently associated with acute diarrhea from the multivariable logistic regression analysis in slums of Addis Ababa, Ethiopia, between September and November, 2014

Variable	AOR (95% CI)[a]
Monthly household income of less than $50 US	2.4 (1.4–4.0)
Household size of six or more persons	2.3 (1.4–3.9)
Child's age 6–11 months	2.3 (1.1–4.6)
Child's age 12–23 months	2.0 (1.1–3.5)
Hand washing with soap after defecation	0.3 (0.1–0.9)
Hand washing with soap before preparing food	0.2 (0.1–0.7)

[a]Socio-demographic factors adjusted in multivariable analysis were monthly household income; caregiver's age, education, employment, and marital status; household size; house ownership; birth order of children; number of under-five children; and child's age and sex

Most Important Recommended Times in Preventing Acute Diarrhea

Of the five recommended times for hand washing with soap, before preparing food (AOR 0.2; 95% CI 0.1–0.7) and after defecation (AOR 0.3; 95% CI 0.1–0.9) were the most important recommended times in preventing the occurrence of acute diarrhea (Table 3).

Factors Associated with Acute Diarrhea in Multivariable Analysis

The factors significantly associated with acute diarrhea were monthly household income of less than $50 US (AOR 2.4; 95% CI 1.4–4.0), household size of six or more persons (AOR 2.3; 95% CI 1.4–3.9), child's age 6–11 months (AOR 2.3; 95% CI 1.1–4.6) and 12–23 months (AOR 2.0; 95% CI 1.1–3.5) (Table 3).

Discussion

We found a low prevalence of hand washing with soap at the five recommended times. Our main findings show that hand washing with soap before preparing food and after defecation are the most important of the recommended times for preventing acute diarrhea. Children's age of 6–11 and 12–13 months, low monthly household income, and household size of six or more persons were significantly associated with acute diarrhea.

Our finding of average prevalence of hand washing with soap at recommended times is consistent with data from several countries: Ethiopia (22%), Kenya (15%), Ghana (13%), Senegal (19%), Uganda (15%), Bangladesh (18%), and China (13%) [16]. In our study area, low prevalence of hand washing with soap may be associated with the lack of promotion of and advocacy for the practice of hand washing with soap. Rabbi and Dey [22] reported a gap between knowledge and self-reported hand washing with soap at recommended times; they also reported that education, access to water, and access to the media were predictive of reporting hand washing with soap.

A study in Ghana found that a mother's education level of secondary school or above, knowledge of the importance of hand washing with soap at recommended times, and high quality of child care were associated with hand washing with soap and without soap after defecation [23]. In other studies, the prevalence of observed hand washing with soap at recommended times was much lower than in the present study: in urban Burkina Faso (1%) [12] and in Ghana (4%) [23] after defecation. In rural Bangladesh, 0.5% of study participants washed at least one hand with soap before food preparation [20]. The higher prevalence of hand washing with soap in our study might be due to self-reporting bias.

Self-reporting of hand washing with soap tends to inflate the reporting due to social desirability bias [9].

A study in Mozambique showed that having hand washing facilities in or near home compounds and in yards and keeping soap or ash at the hand washing areas had a protective effect against moderate to severe diarrhea [5]. The current study found that 4.4% and 8.9% of the households had hand washing facilities with both soap and water access or only water access, respectively, a fact that might have contributed to the failure to wash hands with soap at recommended times. Other factors such as interrupted water supply [2] may also contribute to the low prevalence of hand washing with soap at recommended times in the slums of Addis Ababa.

We found that hand washing with soap before preparing food and after defecation were more effective in preventing acute diarrhea than hand washing at other recommended times, as did researchers in a study in rural Bangladesh [20]. Consistent with our findings, a systematic review indicated that hand washing with soap after defecation reduces diarrhea more than hand washing at other recommended times [13]. The finding in the present study that the prevalence of hand washing with soap before eating food was much lower than at the other recommended times is consistent with the results of Rabbi and Dey [22] and may be due to lack of promotion and advocacy of hand washing with soap before eating.

Our finding that low monthly household income increases the risk of acute diarrhea may be due largely to caregivers being unable to afford soap, a factor that would impede hand washing with soap at any recommended time. A similar study by Hoque [17] revealed that household income was directly linked to good hand washing behavior. Our finding that children aged 6–11 months were at significantly higher risk of contracting acute diarrhea is consistent with a study in eastern Ethiopia [21]. We also found that the age category 12–23 months was significantly associated with acute diarrhea; this finding is consistent with other study in Ethiopia [4]. The introduction of weaning at this age may expose children to unhygienic foods/liquids and environmental contamination.

Limitations of the Study and Gaps for Future Research

The relatively high prevalence of hand washing with soap in this study may be the result of self-reporting bias. Further studies that include observation of hand washing behavior and follow-up study designs, such as cohort studies, may more accurately measure prevalence of hand washing with soap at the five recommended times. However, more precise measurement of the prevalence of hand washing with soap remains a challenge because most methodologies, including newly emerging sensor technologies, were developed and applied in developed countries but not in low-income countries due to their high cost [15]. In addition, our study did not consider the types of soap used. Burton et al. [7] reported that using non-antibacterial soap in hand washing is more effective than using antibacterial soap for the removal of bacteria of potential fecal origin from hands.

Conclusion

The findings of this study indicate that before food preparation and after defecation are the most important recommended times for hand washing with soap in preventing acute diarrhea. In the broader context of increasing hand washing with soap as an important factor in improving global health and achieving UN Sustainable Development Goals by 2030, this study supports the need to address both so-called "hardware" factors such as the availability of soap, water, and appropriate hand washing facilities and "software" factors such as social development, education, and promotion of hand washing with soap at recommended times. Behavior change models that address these factors should be used by those working in WASH and programs related to health, nutrition, education, and poverty reduction.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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