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Hand hygiene status and its associated factors among housemaids working in communal living residences in Jimma city, southwest Ethiopia

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ABSTRACT

Objective: Hand hygiene is a milestone, cost-effective, and convenient strategy to prevent the transfer of pathogenic micro-organisms. However, housemaids operating inside a kitchen can be the source of infection. In addition, hand hygiene among housemaids working in dwellings was underexplored. This study aimed to assess the hand hygiene status and associated factors among housemaids working in communal living residences in Jimma City, Southwest Ethiopia.

Methods: A total of 230 housemaids were included in this cross-sectional study. Total samples were proportionally allocated for each residence and a simple random sampling technique was applied to select the study participants. Hand hygiene status and relevant characteristics were collected through face-to-face interviews and observations. Hand swab samples were collected and tested for bacterial contaminants. Then, it was inoculated aseptically using streak-plating methods on mannitol salt agar (MSA), MacConkey agar (MCA), salmonella-shigella agar (SSA), and eosin methylene blue (EMB) agar and then incubated at 37 °C for 24 h. Data was edited, cleaned, and double-entered into Epidata version 3.1 and then exported to the statistical package for social science statistics version 26 for further analysis. Binary logistic regression was used to identify associated factors. Statistically significant was declared at P value < 0.05.

Results: Two hundred twenty-five housemaids were interviewed with a response rate of 97.8 %. The results showed that the proportion of good hand hygiene status among the housemaids was only 28.0 %. Although the majority of participants reported washing their hands frequently, the prevalence of bacterial contaminants on their hands was high at 72 %. The study identified several factors associated with hand hygiene status, including the occupational status of heads of households (AOR = 0.030, 95 % CI: 0.003, 0.348; $P = 0.0050$), the effectiveness of the heads of household (AOR = 13.955, 95 % CI: 1.442, 13.500; $P = 0.0230$), and the removal of accessories during handwashing (AOR = 20.844, 95 % CI: 2.190, 9.842; $P = 0.0080$).

Conclusion: Overall, the hand hygiene status of housemaids was found to be poor and influenced by demographics and other relevant characteristics. The study emphasizes the need for a multi-modal strategy involving household heads, local and national authorities, and other stakeholders to raise awareness and advocate for hand hygiene to prevent communicable diseases in the wider community, particularly in the study area.

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1. Introduction

Hand hygiene is the mechanism or process of removing debris, soil, and microbes [1]. It also refers to an action taken by an individual for cleansing hands [2]. It is accomplished by washing the hands with water and soap, antimicrobial soap/antiseptic agents, and hand rubbing with alcohol-based hand rub (ABHR) [1,3]. Antibacterial agents are a substance that inactivates microorganisms or inhibits their growth. For instance, 5-methoxybenzimidazolthiomethanol, silver nanoparticles, and its derivatives [4]; nano cadmium (II)-benzyl benzothiazol-2-ylcarbamodithioate complexes [5]; silver nanospheres [6] and synthesized complexes [7] were reported antibacterial agents against bacteria grow.

The public health significance of hand hygiene is not limited to its cost-effectiveness. It has been promoted as an effective preventive measure against various health-related issues, including diarrheal diseases, undernutrition, and neglected tropical diseases [8]. Practicing improved hand hygiene effectively reduces gastrointestinal and respiratory tract infections by up to 50 % [9]. It can also cut diarrhea risk by almost 50 % [10]. Good hand hygiene reduces outbreaks of pathogen transmission and minimizes the spread of antibiotic-resistant bacteria [11,12]. Furthermore, after the confirmation of the COVID-19 pandemic by the World Health Organization (WHO) on March 11, 2020 [13], the insufficiency of vaccines has necessitated basic practices of hand washing to get prevention. WHO, the Centers for Disease Control and Prevention, and the major government authorities recommended consistently and adamantly encouraging people to frequently and thoroughly wash their hands with soap for at least 20 s at a time [14,15]. In sum, hand hygiene continues an extremely important strategy to prevent the spread of pathogens [16].

Since housemaids are domestic workers who handle food or items at home, their hands quickly become contaminated with different pathogens [11,17]. Unclean hands of housemaids could cause contamination through the spread of pathogens between the hands and surfaces, and to food products [18,19]. This contamination of hands might result from contact with feces, body fluids, and inanimate objects; and is a common mode of transmission for gastrointestinal and respiratory infections [20]. As a result, hands could be the major source of disease-causing pathogens such as *Staphylococcus aureus*, *Klebsiella* spp., *Proteus* spp., *Escherichia coli*, *Shigella*, *Salmonella*, *Campylobacter*, *Vibrio cholerae,* and *Streptococcus pneumonia* [21–28].

Bacterial infection continued as a public health risk across the globe. Common types of bacterial infections include food poisoning (gastroenteritis), skin, ear, or sinus infections, sexually transmitted infections, bacterial pneumonia, and urinary tract infections [25,29]. Of those, *Shigella* and *Salmonella* are among the common causes of foodborne diseases worldwide, [25,26,30–32]. The estimated annual incidences of *Shigella* and *Salmonella* spp. were 165 and 25 million respectively [32]. Diarrhoeal diseases are the leading cause of foodborne disease illnesses, particularly norovirus and *Campylobacter* spp [33]. *S. aureus* infection is a major cause of skin, soft tissue, respiratory, bone, joint, and cardiovascular disorders [34]. A variety of pathogens was transmitted by the fecal-oral route [20,35]. Due to this, poor hand hygiene could be recognized as a contributing factor to the occurrence of communicable diseases [36].

Due to this communicable diseases continue to be the major contributor to global morbidity and mortality worldwide. In 2020, WHO indicated that an estimated 600 million people in the world fall ill and 420,000 die after consuming contaminated food of which under-five children carry 40 % of the disease burden with 125,000 deaths [37]. In 2021, the United Nations Children's Fund and WHO reported that half a million people die each year from diarrhea or acute respiratory infections [38]. Accordingly, diarrhea was responsible for 8 % of deaths among under-five taking portion in the countries of South Asia and Sub-Saharan Africa [39]. In developing countries, the consumption of contaminated foods is responsible for a wide range of diseases, including cholera accounts for 70 % of diarrheal diseases [17,40]. In Ethiopia, 60–80 % accounts for communicable diseases of which diarrhea is the leading cause of under-five mortality, accounting for 23 % of all deaths [41]. Therefore, keeping proper hand hygiene via regular and proper handwashing habits is crucial in the prevention of the majority of communicable diseases.

Hand hygiene is an innovative way to cope with those challenges, however, scholars revealed that high magnitudes of problems regarding hand hygiene practice across the globe. Pieces of a study conducted in different countries showed poor hand hygiene practices (49.6 %, 26 %, 34.6 %, 85.1 % & 34 %) [11,42–45]; and improper handwashing practices (77.7 %, 60.9 %, 48.8 %, 65.4 %, 78.5 % & 22.7 %) [46–51]. In the country context, scholars disclosed a need for improvement in hand hygiene in Ethiopia [26,28]. In addition, pieces of evidence indicated that bacterial hand contamination among food handlers due to poor hand hygiene [26,52]. Besides this, no research had been done yet that indicated hand hygiene status, particularly housemaids.

Pieces of evidence from the scientific community indicated that different factors play a crucial role in the lack of good hand hygiene. Demographic characteristics such as education status, marital status, training, income, and occupational status of heads of households could significantly determine hand hygiene [42,53–56]. Relevant characteristics including referent pressure or effectiveness of the head of household to attach the fact to perform optimal hand hygiene, an effort to perform good hand hygiene, and fingernail status were predictors of hand hygiene [46,48,57,58]. Other significant factors include uncleanliness of fingernails, and handwashing practices such as frequent hand washing with soap/other detergents, the removal of a watch, ring, and bracelet during hand washing, and handwashing at critical times like washing hands before preparing meals, after touching their own/others' body parts, after visiting the toilet and the likes [11,21,59–62].

Despite hand hygiene being a cornerstone and simple; there is limited data about the hand hygiene status of housemaids in developing countries including Ethiopia. In addition, there is a high communicable disease burden such as diarrhea and foodborne diseases [28,41,63], in Ethiopia, particularly in the study area, there is no clear report showing the contribution of housemaids to food-borne illnesses and public health concerns. Therefore, showing the level of hand hygiene status among housemaids who are directly involved in domestic work would show their contribution to microbial food contamination, and a study aimed to fill the gap shown in the pieces of literature.

The rationale of this study includes 1st: assessment of hand hygiene status and its associated factors among housemaids in

communal residences can play a crucial role in the early detection problems and would help the responsible body to the wider understanding of potential predicting factors of hand hygiene status to minimize resulting negative effect such as contagious diseases early; 2nd: Besides, the work of housemaids like cleaning and washing activities involves the use of water as well they also use soap in most cases. Thus, the hand hygiene status of housemaids might indicate the real community hand hygiene status and communicable disease burden. 3rd: Moreover, findings from the study would provide basic and essential information for decision-makers such as heads of household, and baseline data for further researchers interested in the topic of study in the larger community settings.

2. Methods and materials

2.1. Study area, design, and period

A cross-sectional study was employed in communal living residences in Jimma City; Southwest Ethiopia from April to June 2022. Jimma City is located 352 km southwest of Addis Ababa. Its geographical coordinates are 7°41′ north latitude and 36°50' east longitude, and also it has an average altitude of 1780 m above sea level. The study area receives a mean annual rainfall of about 1530 mm that comes from the long and short rainy seasons. The mean annual minimum and maximum temperatures were 14.4 °C and 26.7 °C respectively with dominant warm and humid weather conditions [64].

According to information obtained from Jimma City municipality in 2022, the city covers areas of around 11,417 ha and it is also divided into seventeen kebeles with a projected population of 425,816 of which 240,267 males and 185,549 females with total households of 37,878. Kebele is the smallest administrative unit of Ethiopia which is part of a town, woreda, district, City, and Zone that comprise the Federal Democratic Republic of Ethiopia. City administrations built communal living residences on different sites in 2007/2008 with which around 1688 households are there. Communal houses are types of shared houses or condominiums in government built by Jimma city administration to solve the shortage of homes, and now it is providing housing services for different communities such as government employees, merchants, and others within the city. Communal living residences are owned by both Jimma city administration found in different sites [Bossa Addis, Ginjo, Ginjo Guduru, and Bechobore] in which 1355 households are dwelling and Jimma University [residents of Jimma University apartment, Depo condominium, and Kito condominium] in which around 333 households are living. In total, around 455 recorded housemaids were employed in communal living residences in Jimma City.

2.2. Source and study population

All housemaids who have been working in communal living residences in Jimma City were the source population. While housemaids who have been running (engaged in work) in communal dwelling houses in Jimma City, and who could fulfill the eligibility standards and are available in the course of the records or data collection period were the study population.

2.3. Eligibility criteria

All housemaids employed in communal living residences in Jimma City to serve other people or the members of the employer within the household in the last three months were included. Housemaids showing the symptoms of communicable disease specifically fecal-oral disease such as [diarrhea, cholera, shigella, etc.,] and due to this following treatment; and those having pores, skin irritation, inflammation, and eczema or scar on their palms have been excluded.

2.4. Sample size determination

The sample size was determined by applying the general formula for a single population proportion. By considering a 50 % proportion at a 95 % confidence interval:

$$n = (Z\alpha/2)^2\left(\frac{P(1-P)}{d^2}\right) = n = \frac{(1.96)^2 * 0.5(1-0.5)}{(0.05)^2} = 384$$

Where n = sample size, $\mathbf{Z}_{\alpha/2} = 1.96$ standard scores corresponding to a 95 % confidence interval, d = level margin of error tolerated (5 %), p = proportion of hand hygiene status. Since total number of sources population (N) was 455, the sample size to the population size was adjusted by using a correction formula as follows:

$$n = \frac{n}{\left[1 + \frac{n}{N}\right]} = \frac{384}{\left[1 + \frac{384}{455}\right]} = 209$$

After considering 10 % of the sample size or 21 study subjects with a non-response rate, the sample size was 209 + 21 = 230.

2.5. Sampling technique

The number of samples was allocated to each residence proportionately to their population size (total number of housemaids). All

communal residences in Jimma City were included in the study. Information about housemaids employed in each residence was obtained from each household level and local administrations such as Kebele and Idir indicated that 90 housemaids were engaged in the heads of households living in communal residences owned by Jimma University whereas 365 were housemaids working in the heads of households living in communal residences owned by the Jimma city administration). Those housemaids employed in communal residences owned by Jimma city administration were listed as Bossa Addis [29 in Bossa & 117 in Saarsafar], Ginjo [18 in Hostel], 47 in Ginjo Guduru, and Bechobore [76 in Dololo & 78 in Ajip] and Jimma University were 44 in residents of Jimma University apartment, 24 in Depo condominium, and 18 in Kito condominiums.

Each housemaid engaged in communal residences in Jimma City was recorded and listed on documents. Then every housemaid was assigned or coded with an identification number (ID), and we entered each identification number into a database from 1 to 455. A random number generator was used to select two hundred and thirty (230) housemaids. Finally, each study unit was selected randomly. To control sampling bias in the study, we carefully defined the target population (housemaids engaged in communal residences in Jimma City) and our sampling frame (the list of an individual from the heads of household from each residence in which the study subject would be drawn from), made the survey accessible and short, and finally, those non-responders were monitored.

2.6. Variables

2.6.1. Dependent variable

- Hand hygiene status

2.6.2. Independent variables

- Socio-demographic characteristics
- Fingernail status
- Efforts required to perform good hand hygiene
- Effectiveness of the head of household to attach the fact to perform optimal hand hygiene
- Handwashing practices
- Handwashing time in the second
- Handwashing facilities

2.7. Operational definitions

Bacterial hand contaminants: are types of microbes separated or identified through a series of procedures and investigations in the laboratory from hand swab samples that have the potential to cause disease [52,65,66].

Communal living residence: is defined as a modern type of coliving as a means of communal housing or condominium providing housing or accommodation in which people share in either shared or private suites in a communal setting, together with services which may include shared spaces, resources like kitchen/dining facilities, sanitary facilities and a set of values [67,68].

Effectiveness of head of household: is readiness/dedication of head of household to afford hand washing facilities such as [water and soap, ABHR] and accessing reminder posters (signboards) in the working environment to attach the fact to perform optimal hand hygiene [55,58]. Those two conditions stated must be addressed or fulfilled at the same phenomena or time to classify the head of household as very effective unless they are ineffective.

Hand hygiene: refers to any measure or action taken for cleansing hands from extraneous matter by proper hand washing [2,69].

Hand hygiene status (HHS): refers to the current status of keeping hand hygiene for the sake of protecting health [38].

- **Good HHS**: is a state where there is no microbial isolate (bacterial contaminants of hands) on the hands of the study participants [70,71].
- **Poor HHS**: is a condition when there is bacteria isolate (bacterial contaminants of hands) on the hands of the study participants [72,73].

Frequent hand washing: indicates the habit of hygiene with prolonged exposure to water, soap, and ABHR/sanitizer to remove extraneous matter resulting from contact with any dirty matter such as touching hair, door, etc. to protect oneself and his/her family [74].

Housemaids: any persons especially females or women employed by a household living in shared houses, and paid a monthly fee to do housework such as preparing food, washing dishes, and washing clothes at home [75].

2.8. Data collection techniques

Data collection tools were adapted from WHO and published articles [44,76,77]. Data on hand hygiene and related characteristics were collected by face-to-face interviews using pre-tested a semi-structured questionnaire and observational checklist while data on commensal microbial from hand swabs were collected through laboratory investigation via following standard operating procedures that were clearly stated in the laboratory data analysis and interpretation section. Three data collectors with prior experience in data

collection and who were fluent in speaking, writing, and reading Afan Oromo, Amharic, and English language were hired. The data collection survey underwent five-day training sessions from March 20–25, 2022 on the written informed consent and data collection procedures.

2.8.1. Socio-demographic characteristics

Following written informed consent, socio-demographic characteristics including sex, age, religion, educational and marital status, and occupational status of heads of household and monthly income of housemaids were collected through face-to-face interviews using a pre-tested semi-structured questionnaire at communal residences in Jimma City, Southwest Ethiopia.

2.8.2. Hand hygiene and related characteristics

Relevant information on hand hygiene and related characteristics such as fingernail status, training/education about hand hygiene in the last year, the effort required to perform good hand hygiene, the effectiveness of the head of household to attach the fact to perform good hand hygiene, be reminded to do hand hygiene, frequent hand washing, how to wash hands, use of soap and water for frequent hand washing, following five steps to wash hands, pickling under finger dirt, removing watch, ring, and bracelets, hand washing time in seconds, the need of drying after washing hands, use of towel/clothes to dry hands after washing, hand washing before and after a meal, before meal preparation, after cleaning home and washing dishes, after touching garbage and doing laundry, after touching their own or others body parts and after using toilet were collected.

To ensure the validity of the tools, we used standardized questionnaires from published works and the WHO, and it was contextualized carefully and precisely to suit the current study. In addition, we used an appropriate sampling technique to select the study participants by clearly defining the target groups (housemaids). To ensure reliability, we consistently applied the same steps in the same way, and we kept the data collection circumstance consistent.

2.8.3. Sample collections and transport

Hand swab samples are suitable biological samples to culture the presence of commensal (bacterial contaminants) in the hands which is a very important strategy to show hand hygiene. In the laboratory investigation of the commensal microbes from the hands of housemaids, a swab sample was collected following clinical and laboratory standards institute (CLSI), American type culture collection (ATCC), and other guidelines [78–80]. In advance, hand swab samples were collected following sterile conditions for the segregation of commensal microbes.

Sterile cotton swabs and 10 ml saline containing sterile test tubes were prepared to collect and transport the samples. For the bacterial isolates from hand swabs, after handwashing participant's dominant hand was sampled by rubbing all over the surface using sterile-moistened cotton-tipped swabs in the moistened state; and then placed/soaked in labeled 0.85 % saline solution containing sterile test tubes for microbial culturing. However, notification was not delivered in advance and extra hand hygiene was not allowed during sample collection [81]. Swabs samples were collected by three well-trained laboratory personnel in standard aseptic procedures. Soon after collection, hand swab samples were sent to the Microbiology laboratory at the Department of Medical Microbiology at Jimma University. Furthermore, the detection and isolation of bacterial contaminants from the hands can be performed by adding measured volumes of growth or enrichment media to hand swab samples. Then, the samples were inoculated and enriched in nutrient broth (0.1 ml) for 24 h to enhance the recovery of the bacteria isolates in the laboratory because their survival can be affected by hand washing.

2.8.4. Sample culture technique

Culturing bacteria is a very important method that allows the multiplication of bacterial cells in or on a culture medium under controlled laboratory conditions. In addition, is necessary to grow and sustain them under controlled laboratory conditions through supplying growth media. The common method to identify bacteria is through the of use selective media which can hinder or suppress the growth of unwanted commensal microbes or the use of differential media which makes it easier to distinguish colonies of desired micro-organisms from other colonies growing on the same plate [80]. The media used in this study were prepared according to the manufacturer's instructions. A loop full of each hand swab sample enriched on nutrient broth was inoculated aseptically using streak-plating methods on the selective and differential such as mannitol salt agar (MSA); MacConkey agar (MCA); salmonella-shigella agar (SSA) and eosin methylene blue (EMB) agar, and then incubated at 37 °C for 24 h. After an incubation period, the culture plates were examined for the growth of suspected bacteria as positive for those hands of housemaids with poor HHS and no growth as negative for good.

2.9. Data quality management

Questionnaires were prepared in English language and translated into national languages Amharic and Afan Oromo by linguistic professionals, and then back to English for reliability. Data collection tools were adapted from WHO and published articles [44,76,77], and pretested among 10 % of the sample size or 23 study participants engaged in the communal living residences in Mizan-Aman town, Bench Sheko zone before data collection, and state whether any correction or not was made after the pre-test. To control the quality of survey data, orientation was given to data collectors before data collection, and then close supervision was carried out to ensure data correctness, completeness, and consistency during data collection. For the quality of laboratory data, laboratory tests for the investigation of commensal microbes strictly adhered to standard operating procedures as well and the proper functioning of the instruments utilized was checked before processing samples.

2.10. Data processing, analysis, and interpretation

The data was edited, cleaned, and double-entered into Epidata version 3.1 and then exported to the statistical package for social science statistics version 26 for further analysis. Descriptive analyses were summarized using frequency and percentage to present in texts, tables, and figures. Binary logistic regression was analyzed to assess the associated factors. All variables with P value ≤ 0.25 in bivariable logistic regression were fitted to multivariable logistic regression to control the effects of confounders. Hosmer and Lemeshow statistical tests were carried out to check the goodness of fitness. In the model, the Backward Stepwise variable selection method was used. Odds ratios with 95 % CI were computed to measure the strength of the association. Variables with P values < 0.05 were considered statistically significant.

3. Results

3.1. Socio-demographic characteristics

Of the total of 230 housemaids aimed in this study, 225 housemaids were interviewed with a response rate of 97.8 %. All study participants were females with a mean age of 21.41 ± SD of (3.961). About 87 (38.7 %) and 79 (35.1 %) of the study participants were followers of Orthodox Christianity and Muslim respectively. Regarding marital status, more than $^{2}/_{3}$, 70.7 % of study participants were single. More than half (52.4 %) of study participants attended primary school. About 151 (67.1 %) households were government employees. The mean monthly income of respondents was 691.33 ± SD of (141.982) ETB (Table 1).

3.2. Hand hygiene status and related characteristics

According to this study, about 162 (72.0 %) of study participants had poor hand hygiene status. This indicates that the hands of study participants were contaminated by different microbial especially bacteria. More than three-quarters, 176 (78.2 %) of the study participants trimmed their fingernails and 183 (81.3 %) had effective heads of household to attach the fact to perform optimal hand hygiene. About 223 (99.1 %) of the study participants didn't receive education or training for hand hygiene in the last year (Table 2).

Two hundred and seven (92.0 %) of study participants responded that they wash their hands frequently. However, washing hands frequently does not indicate the effectiveness of removal efficiency of microbes from the hands or the absence of microbial contamination on hands. Regarding washing hands with water and soap, 177 (78.7 %) study participants replied that they wash their hands with water and soap. Of these, 172 (76.4 %) of study participants wash their hands frequently with soap/other detergents. However, 136 (60.4 %) and 146 (64.9 %) of study participants didn't follow five steps to wash their hands in the right way and didn't remove their watch, ring, and bracelet during hand washing. Furthermore, about 46.7 % of study participants didn't wash their hands for 20 s every time. The majority, 162 (72.0 %) study participants' hands tested positive for one or more of the microbial contaminants of hands (Table 2).

Accordingly, 224(99.6 %), 221(98.2 %), 221(98.2 %), and 191 (84.9 %) of study participants responded that they wash their hands always while performing different activities at home including before and after meals, before preparing meals, after cleaning home and washing dishes, after touching garbage and doing laundry respectively. The majority, 219 (97.3 %) study participants responded that they wash their hands after visiting the toilet. More than half (62.2 %) of study participants replied that they wash their hands after touching their own or others' body parts (Fig. 1).

Table 1
Socio-demographic characteristics of housemaids (n = 225) working in communal living residences in Jimma City, Southwest Ethiopia.

Study variables	Category	Frequency	Percent
Age category	18–24 Years	182	80.9
	25–30 Years	34	15.1
	31–36 Years	9	4.00
Religion	Orthodox Christianity	87	38.7
	Muslim	79	35.1
	Protestant	58	25.8
	Adventists	1	0.40
Marital status	Single	159	70.7
	Married	64	28.4
	Others such as widowed	2	0.89
Educational status	Cannot read and write	7	3.10
	Followed primary school	118	52.4
	Followed secondary school and above	100	44.4
Occupational status of heads of households of housemaids	Government employees	151	67.1
	Merchant	62	27.6
	Other professional workers	12	5.30
Monthly income	≤1100ETB	224	99.6
	>1100ETB	1	0.40

Other professional workers: drivers, nongovernmental employees, private health care providers

Table 2
Hand hygiene status and related characteristics of housemaids (n = 225) working in communal living residences in Jimma City, Southwest Ethiopia.

Study variables	Category	Frequency	Percent
Hand hygiene status	Poor	162	72.0
	Good	63	28.0
Fingernail status	Not trimmed	49	21.8
	Trimmed	176	78.2
Received education or training for hand hygiene in the last year	No	223	99.1
	Yes	2	0.90
The effort required to perform good hand hygiene	No effort	63	28.0
	A big effort	162	72.0
Effectiveness of heads of a household to attach to the fact to perform optimal hand hygiene	Not effective	42	18.7
	Very effective	183	81.3
Need to be remembered or reminded to do hand hygiene	Not importance	35	15.6
	Very importance	190	84.4
Wash hands frequently	No	18	8.0
	Yes	207	92.0
How to wash hands	Water only	30	13.3
	Water and soap	177	78.7
Wash hands frequently with soap or other detergents	No	5	2.20
	Yes	172	76.4
Wash hands including picking under fingers dirt	No	20	8.90
	Yes	187	83.1
Follow five steps to wash hands the right way	No	136	60.4
	Yes	71	31.6
Remove the watch, ring, and bracelet during hand washing	No	146	64.9
	Yes	61	27.1
Wash hands for 20 s every time	No	105	46.7
	Yes	102	45.3
Need to dry hands after washing	No	81	36.0
	Yes	126	56.0
Use clothes to dry hands after washing	No	14	6.20
	Yes	112	49.8
Hands swab samples tested for bacterial contamination	Negative	63	28.0
	Positive	162	72.0

3.3. Observational survey

3.3.1. Water storage practice-related characteristics at the household level

In this study, all households of the study participants living in the residences use piped water to tap into the yard as the primary source of water for domestic purposes including hand washing. The majority, 219 (97.3 %) condition of containers used to store water were covered barrels within households. Accordingly, 203 (90.2 %) condition of the stored water was visibly clean. Furthermore, 175 (77.8 %) of the households used water and soap to wash the storage container as recorded during the observation (Table 3).

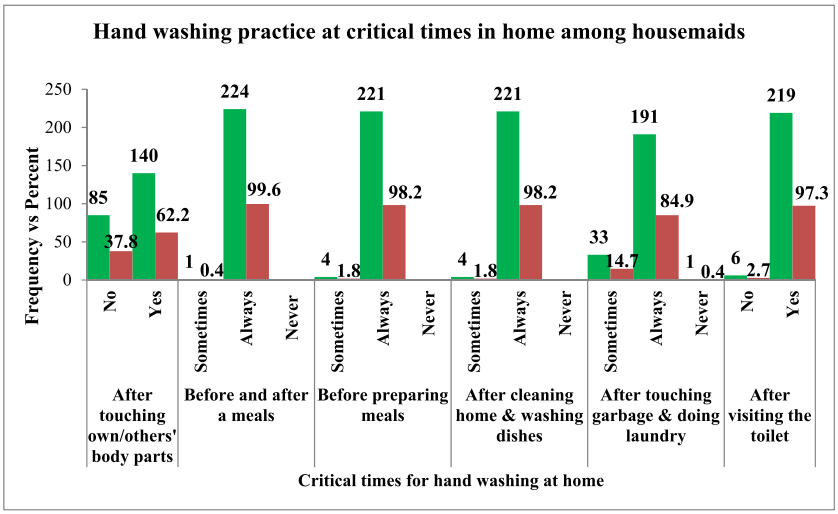

Fig. 1. Hand washing practice at critical times among housemaids (n = 225) working in communal residences in Jimma City, Southwest Ethiopia, 2022.

3.3.2. Handwashing facility-related characteristics at the household level

The result indicated that 223 (99.1 %) households in the communal living residences had a specific hand washing station/area. Among these, 96(42.7 %), 40(17.8 %), and 89 (39.6 %) were located near the latrine, cooking place, and elsewhere inside the house respectively. In addition, 212 (94.2 %) of those specific hand washing stations/areas were supplied with water and soap. However, it should be noted that all households where housemaids were engaged hadn't posters and protocol levels for hand hygiene at all (Table 3).

3.4. Factors associated with hand hygiene status

In Bivariable logistic regression, those variables including the occupational status of the head of household, the effectiveness of the head of household to attach the fact to perform optimal hand hygiene, fingernail status, frequent hand washing, how to wash hands, washing hands frequently with soap or other detergents, follow five steps to wash hands the right way, removing watch, ring, & bracelet during hand washing and washing hands for 20 s were significantly associated with HHS. All variables with a p-value $\leq$0.25 in bivariable analyses were included in the multivariable logistic analysis. The variables such as the occupational status of heads of households, effective the head of the household to attach the fact to perform optimal hand hygiene, and removal of a watch, ring, and bracelet during hand washing were found to be significantly associated variables with the HHS of housemaids with p-value $<$0.05 (Table 4).

In the study, housemaids engaged in the heads of households having an occupation of merchant were 97 % less likely to have good HHS than their counterparts (AOR = 0.030, 95 % CI: 0.003, 0.348). Compared to housemaids working in the ineffective heads of household to attach to the fact to perform optimal hand hygiene, housemaids working in the effective head of household to attach to the fact to perform optimal hand hygiene had 13.955 times higher odds of HHS (AOR = 13.955, 95 % CI: 1.442, 13.500). Housemaids who experienced the removal of a watch, ring, and bracelet during hand washing were 21 times more likely to have good HHS than their counterparts (AOR = 20.844, 95 % CI: 2.190, 9.842) (Table 4).

4. Discussions

Hand hygiene is the first-line defense mechanism and the best strategy for the prevention of disease that could come from housemaids who are affected by many factors [12,82]. Despite this, little was known about HHS and its associated factors among housemaids working in dwellings in Ethiopia, particularly in the study area. The findings from this study would provide basic information for decision-makers and baseline data for further studies. The present study aimed to assess HHS and its associated factors among housemaids working in communal living residences in Jimma City, Southwest Ethiopia.

Effective hand hygiene involves the removal of unwanted matter and the reduction of microbial colonization on the surface of the hands [83]. In this study, the proportion of good HHS among the housemaids was only 28.0 % (95 % CI: 22.2, 33.8). This could be a result of the proper use or application of detergents during handwashing including both liquid and solid types of soap such as Sky, lifebuoy, Sunlight, and top detergent (ajax in the local name) which were available in the locality. The reason for the decrement in the proportion of good HHS among housemaids might be the ineffectiveness of the head of household to attach to the fact to perform

Table 3
Hand hygiene status observation and infrastructure survey at households in communal living residences in Jimma City, Southwest Ethiopia.

Water storage practice	Observation recorded	Frequency	Percent
The condition of the container cover used to store water at home	Covered barrel	219	97.3
	Open barrel	3	1.3
	Others (Jar)	3	1.3
Condition of the stored water	Visibly clean	203	90.2
	Visibly dirty	22	9.8
Washing condition of the storage container	Water only	39	17.3
	Water and soap	175	77.8
	Others (sand, ash, clothes & stitch)	11	4.90
Handwashing			
Availability of a wall mount/individual ABHR	No	97	43.1
	Yes	128	56.9
Specific HW station/area	No	2	0.90
	Yes	223	99.1
The location of the hand-washing facility	Near the latrine	96	42.7
	Near the cooking place	40	17.8
	Elsewhere inside the house	89	39.6
Availability of soap and water in the hand washing station/area	Only water	12	5.30
	Soap and water were available	212	94.2
	Soap and water were unavailable	1	0.40
Type of soap available	Liquid soap	120	53.3
	Powdered soap	92	40.9
	Others	12	5.30

Others represent: top detergent (ajax in the local name), laundry soap like Sky and sunlight

Table 4
Binary logistic regression showing factors associated with HHS among housemaids (n = 225) working in communal living residences in Jimma City, Southwest Ethiopia, 2022.

Study variables	Category	HHS		Chi-square and *P*-value	COR (95%CI)	Sig.	AOR (95 % CI)
		Poor	Good				
Occupational status of the heads of households	GE	102	49	$\chi^2_{df(2)} = 8.187$	1	1	1
	Merchant	53	9	P = 0.0170*	0.353 (0.168, 0.740)	0.0050	0.030 (0.003, 0.348)*
	Others	7	5		0.714 (0.145, 3.511)	0.5610	0.407 (0.020, 8.401)
Head of the household to attach the fact to perform optimal hand hygiene	Ineffective	37	5	$\chi^2_{df(1)} = 6.636$	1	1	1
	Very effective	125	58	P = 0.0100*	6.250 (2.710, 3.413)	0.0230	13.955 (1.442, 13.500)*
Fingernail status	Not trimmed	29	20	$\chi^2_{df(1)} = 3.352$	1	1	1
	Trimmed	11	165	P = 0.0620	36.536 (14.238, 93.752)	0.0750	4.623 (0.017, 5.876)
Frequent washing hands	No	7	11	$\chi^2_{df(1)} = 2.768$	1	1	1
	Yes	33	174	P = 0.0960	5.649 (2.196, 14.532)		
How to wash hands	Water only	22	8	$\chi^2_{df(1)} = 0.133$	1	1	1
	Water and soap	124	53	P = 0.7160	6.958 (2.958, 16.369)		
Washing hands frequently with soap or other detergents	No	2	3	$\chi^2_{df(1)} = 2.216$	1	1	1
	Yes	122	50	P = 0.1370	6.000 (2.713, 13.270)		
Follow five steps to wash hands the right way	No	100	36	$\chi 2_{df(1)} = 1.715$	1	1	1
	Yes	46	25	P = 0.1900	10.707 (2.500, 45.861)		
Removing watch, ring and bracelet during hand washing	No	23	123	$\chi^2_{df(1)} = 5.517$	1	1	1
	Yes	7	54	P = 0.0190*	1.972 (0.820, 4.743)	0.0080	20.844 (2.190, 9.842)*
Washing hands for 20 s	No	26	79	$\chi^2_{df(1)} = 3.283$	1	1	1
	Yes	12	90	P = 0.0700	3.020 (1.388, 6.572)		

HHS: Hand hygiene status, **GE**: Government employees, **CI**: Confidence Interval; **1**: For reference category; **COR**: Crude Odd Ratio; **AOR**: Adjusted Odd Ratio; **: *P*-value<0.05; **GE**: government employees; **Others**: Other professional workers

optimal hand hygiene, the occupational status of the heads of households being merchants, and not removing accessories during hand washing. This result is lower than the study results reported across the world: Saudi Arabia (65.4 %) [45]; China (96.1 %) [84] and Ethiopia [42,43,76]. The disparity might be because of differences in the study participants, socio-demographic characteristics, and study settings/area [42,43,45].

Pieces of evidence indicated there was an improvement in hand hygiene practice during the era of the Covid-19 pandemic in different parts of the world. For instance, 95.8 % and 96.1 % of study participants maintained hand hygiene in Qatar and China respectively [84,85]. Despite this, there was no positive impact of the COVID-19 pandemic on the improvement of hand hygiene at an individual level in the study area.

An improvement in hand hygiene needs a multimodal strategy [2,38]. It can be achieved through placing reminders or posters elsewhere in the working environment, being a role model head of household/manager, and providing required hand washing facilities [86,87]. Placing reminders/posters elsewhere in the working environment alarms housemaids while they perform activities at home whereas being a role model by the head of household means an individual performs good hand hygiene can teach it to others, and provision required hand washing facilities such as water and soap is a very important parameter to keep hand hygiene. Recent studies conducted in different countries showed there was an improvement in hand hygiene practice through multidimensional interventions through availing hand washing facilities. An interventional study conducted in Bangladesh disclosed that there was a reduction in the frequency of inadequate hand hygiene after fulfilling hand hygiene facilities [87]. Similarly, a study done in Malawi revealed an increment in the availability of hand hygiene facilities from a baseline of 22 %–95.6 %, there was a change in hand hygiene practice from a baseline of 37 % to >80 % [88].

Untrimmed and unclean fingernails lead to bacterial colonization of hands. It should be short and rinsed thoroughly during hand washing [89]. Regarding fingernail status in this study, more than three-quarters of the study participants trimmed their fingernails. This result is higher than the results reported in Alexandria, Egypt [90] and Debre Tabor, Ethiopia [26]. The variation might be due to a decrease in sample size which was 50 and 220 in Egypt and Ethiopia [26,90]. Another reason for the difference could be the working environment (residency) and referent pressure in which study participants were engaged [46]. Proper hand hygiene involves trimming and cleaning fingernails because pathogens and dirt can accumulate under them [91]. In addition, long or untrimmed nails can hinder the effectiveness of hand hygiene. Thus, handwashing with soap and making fingernails short can enhance it [91,92].

Accordingly, 81.3 % of study participants were engaged in the very effective head of household to attach to the fact to perform optimal hand hygiene. The effective head of household can clearly show or teach his/her employees the way and when to keep hand hygiene and afford hand washing facilities such as water and soap, and alcohol/sanitizer in the absence of water and soap. This result is

supported by a study done in Denmark [58]. An effective head of household should be a picture and give feedback on hand hygiene performance, and access reminder posters in the working environment that can be aware and demonstrate the fact to perform good hand hygiene simple and understandable way [55,58].

Handwashing is the process of mechanical removal of extraneous substances using hand-washing agents [1]. Equally, frequent handwashing is the habit of prolonged exposure to water and soap, ABHR, and antiseptic agents to remove extraneous matter resulting from contact with dirt [74]. In this study, the proportion of frequent hand washing among study participants was 92.0 %. Regarding hand washing with water and soap, 78.7 % of the respondents replied that they wash their hands with water with soap. Of these, 76.4 % of study participants wash their hands frequently with soap/other detergents. Frequent handwashing and the use of soap could be because of the working environment, settings of living, the status of the head of household, and accessibility to media about the importance of hand washing with water and soap. However, frequent handwashing doesn't indicate the effectiveness of removal efficiency of microbes from the hands. This result is in line with results reported in Arab residents of Qatar (95.8 %) [85]; England (>85 %) [93], and Ethiopia (98.6 %) [49]. The result is higher than the result reported in Saudi Arabia (68.7 %) [45]. The discrepancy might be due to differences in the working environment, the referent pressure, and the activities performed at home in which housemaids engaged might mandate the use of water and soaps.

However, pieces of studies indicated that washing hands frequently with soap or without soap doesn't indicate good HHS. This is due to the ineffectiveness of hand-washing agents [94]. In addition, an efficient hand-washing regimen depends on a multitude of factors such as hand-washing techniques, types of soap, water quality, and jewelry and fingernails [95]. For instance, the effective removal of commensal microbes through hand-washing depends on the combination of water, plain soap, or antimicrobial soap [61].

Hand washing at critical times is a very important strategy to cut the cross-transmission of disease-causing pathogens [11,96]. Fortunately, in this study, 99.6 %, 98.2 %, 84.9 %, and 97.3 % of respondents replied that they wash their hands always while performing different activities including before and after meals, before preparing meals, after cleaning the home and washing dishes, after touching garbage and doing laundry and after visiting toilet respectively. This result is nearly coherent with a result reported in Aman Sub-City, Southwest Ethiopia [49]. The result is higher than the result reported in the Sagnarigu Municipality of Ghana [11]. The difference could be because of differences in living settings and other sociodemographic factors such occupational status of households.

Although the majority of participants reported washing their hands frequently, the prevalence of bacterial contaminants on their hands was high at 72 %. The isolation of bacteria from hands might be because of improper hand hygiene practices such as not removing a watch, ring, and bracelets during hand washing and lack of effective referent to attach to the fact to perform optimal hand hygiene. In addition, other reasons might be due to improper application of supplied detergents during handwashing including both liquid and solid types of soap such as Sky, lifebuoy, sunlight, and top detergent (ajax in the local name), or the quality of detergent. Microbial contamination of hands could be due to the ineffectiveness of handwashing agents [94]. This result is nearly coherent with the results reported in Sari City, Iran (62.2 %) [97], Tripoli, Libya (71.41 %) [98], Alexandria, Egypt (60 %) [90], Mauritius (91.0 %) [27] and Ethiopia (83.9 %) [99]. The result is higher than the results reported in Eastern India (37.9 %) [23], the Omdurman Area of Sudan (23.2 %) [21], and Ethiopia [26,28,100,101]. Another reason might be because of handwashing water quality and fecal contamination. A study conducted by Berhanu and his colleagues revealed that the microbial quality of water used for hand washing significantly determines HHS [17].

In this study, housemaids engaged in the heads of households having an occupation of merchant were 97 % less likely to have good HHS than their counterparts (AOR = 0.030, 95 % CI: 0.003, 0.348). This result is in line with a study done in Kolladiba town, Northwest Ethiopia (AOR = 0.09, 95 % CI: 0.02, 0.37) [48]. This result is also supported by a study conducted in Arba Minch Town (AOR: 1.65, 95 % CI: 1.03, 7.98) [46]. The occupational status of heads of households might potentially impact/influence the housemaids' actual HHS in performing different activities at home.

Compared to housemaids working in the ineffective heads of household to attach to the fact to perform optimal hand hygiene, housemaids working in the effective head of household to attach to the fact to perform optimal hand hygiene had 13.955 times higher odds of HHS (AOR = 13.955, 95 % CI: 1.442, 13.500). The effective heads of household attach that fact to perform optimal hand hygiene which involves the way how and when housemaids keep their hand hygiene, fulfilling facilities needed for hand hygiene such as water and soap, alcohol, and demonstrating that hand hygiene prevents different diseases. This result coincided with the study conducted in Arba Minch Town, Ethiopia [46]. In addition, the result is supported by a study conducted in India [60]. Effective hand hygiene needs support and encouragement from the concerned bodies, especially the administration [55].

Housemaids who experienced the removal of watch, ring, and bracelet during hand washing were 21 times more likely to have good HHS than their counterparts (AOR = 20.844, 95 % CI: 2.190, 9.842). This kind of hand-washing practice is very crucial to minimize bacteria colonization of hands. This study suggests the need to encourage the removal of a watch, ring, and bracelet during handwashing to help in the improvement of HHS among housemaids.

Strength of the study: It contributed a real and general result about HHS of housemaids that directed the focus of the responsible body to address the issues that require immediate intervention or measures before affecting a large public, and it provided the basic information for decision-makers and baseline data for further researchers interested in the topic of study. However, this study has limitations: 1st: the current study didn't undertake microbial hand contaminants such as fungi and parasitic contaminants rather than identification of the presence of bacteria from hand swabs; 2nd: the microbial qualities of hand washing water due to the constraint of resources and 3rd: all predictable variables were self-reported and 4th: lack of control that might limit the ability to draw the causal inferences or make policy recommendations based on findings due to cross-sectional nature of study design.

5. Conclusions

The finding suggests hand hygiene status among housemaids was poor (72 %). This emphasized housemaid could be a potential source of foodborne disease. These revealed microbial contaminations of the hands of housemaids employed to do housework could be very important potential sources of disease-causing pathogens. The study identified several factors associated with hand hygiene status, including the occupational status of heads of households, the effectiveness of the head of household, and the removal of accessories during handwashing.

Therefore, it is recommended that there is a need for more improvements in hand hygiene status. The head of household shall be responsible for availing hand washing facilities such as soap, water, and alcohol and accessing all suitable conditions like education and training for their employees to improve hand hygiene. Thus, housemaids shall follow all necessary steps of hand washing like the removal of a watch, ring, or bracelet during hand washing, and be eager to keep their hand hygiene wisely. In general, local, regional, national, and other stakeholders who are engaged in hygiene shall create awareness and advocate hand hygiene and its relevance in communicable disease prevention for the wider community. In addition, further study should be conducted by using different study designs like longitudinal, case-control, randomized controlled trials, and cohort rather than cross-sectional to draw causal inferences. Similarly, the presence of fungi and parasites, and total plate count should be investigated in the wider community.

Declarations

Ethical approval and consent to participate.

The study was conducted after ethical clearance was approved with reference number IHRPGS/437/22 from the Institutional Review Board of the Institute of Health Sciences, Jimma University. In addition, permission was obtained from the responsible bodies of residential administration and each household. Personal protective equipment was applied such as the use of a mask during data collection to prevent transmission of Covid-19. Furthermore, oral and written informed consent was sought from each study participant. The purpose of the study was explained so that it doesn't pose a risk to them. The overall information obtained from the study participant and their privacy was kept strictly confidential using codes. All methods were performed under relevant guidelines and regulations. In this study, no human tissue was collected and not used as one of the study materials.

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Data availability statement

All relevant data are within the manuscript. Additionally, data will be made available upon request to the corresponding author.

CRediT authorship contribution statement

Tadele Shiwito Ango: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Tizita Teshome:** Conceptualization, Formal analysis, Validation, Writing – original draft, Writing – review & editing. **Tesfalem Getahun:** Conceptualization, Formal analysis, Validation, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests.

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