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Collection time inequalities: fetching water in Ethiopia

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In 2015, WHO and UNICEF reported that only 12% of Ethiopia's population have access to water on premises. High proportion of the population thus needs to fetch water for their survival. Considering the importance of time to fetch water on an individual's health and well-being, we aim to demonstrate where water fetching issues are the most prevalent. This study highlights the widespread burden of fetching water and the significant disparities in terms of accessibility with regards to the location of the source within population groups. Characterization of collection time by regions, type of source, education level and water fetcher illustrated where work mostly remains to reach universal access to drinking water.

Introduction and background

In Ethiopia, the proportion of the population with access to an improved water source was reported by WHO and UNICEF to have increased from 13.5% to 57.3% between 1990 and 2015, thus successfully attaining target 7C of the Millennium Development Goals (MDGs) established in 2000. Despite this reported achievement, the burden of fetching water remains widespread where water on premises is not commonly provided. In 2015, 87.9% of Ethiopia's national population did not have access to water on premises and needed to fetch it (JMP, 2015). In previous work we showed that the inclusion of collection time, in particular fetching times over 30 minutes, had a considerable impact on the portion of the populations considered to have access to improved water sources. When a threshold of over 30 minutes was taken into account, the proportion of the population said to have access decreased of more than 15% (Cassivi et al. 2016).

Location of the source is likely to have an impact on water accessibility (White et al. 1972). It was shown that moving a source of water within 30 minutes will not necessarily enhance the water consumption unless the source is installed in the residence (Cairncross and Feachem, 1993). Households with access to a piped water source will consume around three times more water per person compared to households without a piped connection (White et al. 1972). An insufficient quantity of water available for consumption and hygiene enhance the exposition risk to feco-oral water-washed diseases (Cairncross and Feachem, 1993). Personal health problem also relates to time expended through fetching water. Time associated to collecting water can be considered lost at the expense other activities such as education, work, healthcare and childcare, which could lead to a lack of hygiene and other quality of life measures (Curtis, 1986). Finally, the task of fetching water can result in different injuries like physical disorders, accident and violence (Geere, 2015).

The proportion of the population with access to water on premises in Ethiopia differs by settlement type. The majority of households in urban areas were reported to have on premise access (56.2%), while in rural areas this drops to only 1.5% (JMP, 2015). It was previously shown that time to collect water was generally higher in rural than in urban areas worldwide and among Sub-Saharan countries (Bain et al. 2014; Graham et al. 2016). The prevalence of households without water on premise and collection time higher than 30 minutes in rural Ethiopia was among the highest in Sub-Saharan African (i.e. after Mauritania and Somalia) (Graham et al. 2016). Ethiopia has one of the highest rural populations in the world with a proportion reaching 81% in 2015 (World Bank, 2016). It is clear that taking the location of households into account

when considering access is important. Within both rural and urban locations, the population will differ by other factors that likely influence water access including education level.

A higher income would generally allow individuals to live where better infrastructure exists. Even where infrastructure for water does not exist, those with greater wealth may still occupy locations with better access to essential resources such as water. Thus, another means of examining access to water would be household income. Wealth quintiles developed for national households' surveys are based on household assets including the type of water access and sanitation facilities (DHS, 2015) and thus unreliable for water related studies. However, Yang et al. (2012) excluded water supply assets in their socio-economic status and found that the proportion of the population in Ethiopia using an improved water source was considerably higher in the highest socio-economic groups. It suggests that this is indeed an important consideration. Although direct measures of wealth are not available, a proxy for higher income could be educational achievement, which is available in national households' surveys. Likewise, Seyoum and Graham (2016) have shown that education level was positively associated with access to an improved water source in Ethiopia. Perhaps this will also arise from collection time analysis.

The influence of location relates to environmental context and education level relates to the household. Other important considerations relate to the individual. It has been noted that women are more likely to fetch water than men (Sorenson et al. 2011), but differences may occur for the time spent accessing water between the genders. Further, for households with children, differences may exist depending on the gender of the child. In cases where men fetch water, are they more likely to travel shorter or longer distances? Are there differences between adults and children? Do girls travel longer distances than boys?

This research will examine water service level and inequalities in collection time based on a three levels of measures: environmental, households and individuals. This is a timely exercise to characterise where efforts should be made towards the new Sustainable Development Goals (SDGs) drinking water target which aimed at universal access to water by 2030.

Methodology

The data source for this study comes from Ethiopia's Demographic and Health Survey (EDHS) 2011 which was implemented by the Ethiopian Central Statistical Agency (CSA) as part of the DHS Program of the United States Agency for International Development (USAID). The dataset contains a sample of 16,702 households selected with a stratified, two-stage cluster design, which is representative of the population at the national and the residence (urban-rural) level.

The sample was not self-weighting and thus a population weight was applied to all analysis in order to ensure an accurate representation of the population. The variable "population weight" was created by multiplying the number of de jure members of the household (i.e. those that are usually present, regardless of whether they are present or absent at the time of the survey) by the existing household weight variable. Multiple variables were used for this study: place of residence, head of the household, education level, main source of drinking water, location of the main source, time to collect water (i.e. return trip including queuing), water fetcher (i.e. person who usually collect drinking water). Main source of drinking water was disaggregated within improved/unimproved WHO classification (i.e. improved water sources included water piped into dwellings, water piped to yard/plot, public tap or standpipes, tubewell or boreholes, protected dug well, protected spring, rainwater, cart with a small tank/drum, tanker-truck, and bottled water). One-way analyses of variance (ANOVA) were completed with these factor variables on collection time average. Post-hoc multiple-comparison tests (Bonferroni, Scheffe and Sidak) were then applied in order to identify which groups were statistically different from each other when more than one category existed. The different statistical analyses were conducted with STATA SE version 14.

Results and discussion

Water service levels, which are ladders used by JMP to monitoring SDGS, were measured for all Ethiopian's households (WHO/UNICEF, 2017). At the national scale, 48% of the population had access to an unimproved water, of which more than a third relied on surface water sources. Among half of the population that had access to an improved water source, 18% did not have access within 30 minutes and were thus considered as having limited access. Fewer than 10% of the population was found to have access to an improved water source on their premises. Without access to piped water on premises, households are more likely to use alternative sources which can be located further away and, as a result, the quantity of water used is expected to be reduced which is related to health problems (Stelmach and Clasen, 2015).

Considering the impacts on individuals' health, the issue of water accessibility warrants further research. Disaggregation of the population in different socio-economic groups (i.e. urban/rural; education level) can further elucidate inequalities in terms of access (Table 1). Results displayed important differences in terms of service levels within region and education level groups. It appears that service level is greater in urban than in rural areas. Levels of service also generally increase with levels of education of head of the household. Analysis of service levels shows that socio-economic characteristics are likely to influence access to an improved water source as well as collection time needed to fetch water.

Table 1. Water service level in different settings (%)

Groups / Characteristics		Improved sources			Unimproved sources	
		On premises (0 minute)	Basic (1-30 minutes)	Limited (> 30 minutes)	Unimproved	Surface water
National		9.7	23.6	18.2	31.1	17.4
Region	Urban	49.1	35.0	10.5	3.9	1.2
	Rural	1.0	21.1	19.8	37.0	20.9
Education level (Head of the household)	No education	4.7	22.4	18.4	33.3	20.9
	Primary	10.3	24.1	19.1	32.1	14.3
	Secondary	37.5	28.7	14.1	13.6	6.1
	Higher	48.9	30.9	10.8	6.2	2.8

Additional analyses on collection time needed to fetch water were carried to assess where specific disparities might occur (Table 2). Analysis of variance within different groups of the population (i.e. urban/rural; improved/unimproved, education level, water fetcher) helped to identify whenever a significant difference is observed.

Urban – Rural

The national average collection time to fetch water reached 49 minutes. Excluding households with access to water on premises results in an average of 54 minutes. This small difference is explained by the fact that few people have access to a water source on premises (10%). A significant difference ($p<0.001$) is observed between urban and rural areas regardless of the consideration of the source's location (i.e. all or only off premises). It is clear that time collection to fetch water is considerably higher in rural (56 min.) than in urban areas (18 min.). The difference in time collection between regions is larger when all types of source is considered, which can be explained by the fact that access to water on premises (i.e. 0 minutes) is more commonly provided in urban areas. These results confirm previous findings which have shown that rural and urban areas are opposed with the strongest inequities (Seyoum and Graham, 2016). Considering that more than 3 people out of four live in a rural area in Ethiopia, Bain et al.'s (2014) assertion that improving water service coverage of the rural population should be prioritized to reduce inequalities between urban and rural areas, is supported.

Improved – Unimproved

Significant differences in collection time are also observed when the type of drinking water source is taken into consideration. First, without regard to the location of the source, time to collect water is higher for unimproved than for improved sources ($p<0.005$). When only off premises sources are considered, the average time to collect water is 7 minutes longer than when an improved water source is reached ($p<0.001$). These findings could suggest that people without access to water on premises, even if they must walk a long distance, are more likely to use, or at least opt to use, an improved water source. It is not known whether they had unimproved sources of water closer to the point of use. The necessity to walk farther for an unimproved water source would likely reflect the absence of any other source closer to the house. Previous

study shown an increasing trend, from 2000 to date, in the proportion of the population who need between 30 and 60 minutes to fetch water (Seyoum and Graham, 2016). This could be explained by the reduction of the population who initially spent more than one hour to collect water. Future research should further examine those trends and determine whether there is a difference in the willingness to travel further for a higher quality source of water.

Table 2. Average collection time with regards to different household characteristics

Groups / Characteristics		Location of the source			
		All sources		Off premises	
		n	Mean (Minutes)	n	Mean (Minutes)
National		16 608	49.03	13 471	54.46
Region***	Urban	5 077	17.85	2 219	35.16
	Rural	11 531	55.87	11 252	56.64
Type of source [a]	Improved	10 344	47.46	7 241	58.43
	Unimproved	6 261	50.71	6 227	51.04
Education level (Head of the household) [b c]	No education	9 256	52.99	8 400	55.84
	Primary	4 998	47.62	4 029	53.29
	Secondary	1 181	30.05	554	48.07
	Higher	1 130	21.07	454	41.45
Water fetcher	Woman	-	-	9 726	53.12
	Man [d]	-	-	1 456	68.94
	Girl under 15 y/o	-	-	1 587	52.68
	Boy under 15 y/o	-	-	516	54.12

*** p<0.001
[a] Variables improved and unimproved are statistically different to each other at p<0.005 for all sources and at p<0.001 for off premises sources
[b] For all source, all variables are statistically different to each other at p<0.001, except secondary vs higher at p<0.01.
[c] For off premises sources, only higher education and no education are statistically different to each other at p<0.001
[d] Man is statistically different from all other variables at p<0.001. The remaining variables are not statistically different.

Education level

Important disparities are observed regarding the highest education level achieved by a household member. The average collection time for off premises sources reaches up to 56 minutes when the head of the household has no education. For all types of sources, the average ranged from 21 minutes for households with higher education to 53 minutes for households with no education. Results show that the average collection time decreases when education level increases, for both all sources and off premises sources. Differences within education level groups for all types of sources were found to be significant. For off premises sources, only higher education and no education levels were found to be statistically different to each other ($p<0.001$). This finding could be explained by the small number of people with higher education (7%) and by the fact that more than 40% of them had access to water on premises while fewer than 10% of the population with no education has access to water on premises. This may, however, relate to overall problems of developing infrastructure, whether it be essential services such as water and sanitation or social services such as education.

Water fetcher

Because collection times are not of relevance when the water source used is on premises, analysis related to water fetcher was only conducted for off premises sources. Significant differences in collection time were only found for males and the others ($p<0.001$) compared to the other types (i.e. adult woman, girl, boy). The average collection time for males was 69 minutes while for women and children under 15-year-olds the average was about 53 minutes to collect water. These results suggest that men might be more likely to fetch water when the trips are the longest. It could also mean that men who live independently may live in more isolated locations. It should also be noted that a man was the water fetcher in roughly 11% of households. No difference was found between women and children's access times. These findings can be explained by the task sharing within the household. As estimated in previous research, Ethiopia is the Sub-Saharan African country with the highest number of women (4.7M) and children (1.3M) who spend more than 30 minutes to fetch water (Graham et al. 2016). This again may have implications for educational achievement due to time constraints. Present results confirm that women are the primary collectors in Ethiopia with about 70% of the work load. As also suggested by Graham et al. (2016), gender ratios and women/children implication in water collection should be considered for measuring accessibility to water.

Differences in collection time are observed within all categories. The results here are probably correlated. Individuals with higher education are more likely to live in urban areas and to have access to water on premises. Further, the percentage of individuals living in urban areas is considerably smaller. It may also be that men who fetch water are much more likely to live in rural than urban areas, explaining the long distances. It will be necessary to conduct multi-variate regression analysis so that these interrelations are accounted for. Overall findings reflect the importance of monitoring progress in different settings as suggested in previous studies (Bain et al, 2014; Seyoum and Graham, 2016).

Certain limitations related to data reliability must also be stated. First, the variables used are self-reported values which can lead to problems of accuracy with respect to time (Ho et al. 2014). Recall bias can lead to round off estimations of collection time. Moreover, time to fetch water was reported by the head of the household and constitute an assessment which was not verified by the survey holder. Second, estimations related to time to collect water doesn't take into account the frequency of these trips. Water fetching trip frequency is not available in DHS surveys which might have an impact on time lost. Finally, it is not known how much of that time is queuing time, and whether that might also affect frequency.

Conclusion

Water access inequalities within Ethiopia's population can be characterizing with collection time analyses. The research shows significant differences in average fetching time within population groups. Disparities between urban and rural population were apparent, with urban areas having a lower average than rural areas. Results illustrate that people walk farther for an improved than for an unimproved source when water on premises is not provided. This study also confirmed that collection time decrease with education level increase. Differences within water fetcher, finally, raised gender equity issues. Yet considerably fewer, men were found to spend more time collecting water than women and children. This study attempted to target the most vulnerable population to prioritize intervention regarding access to water improvements. However, more complete statistical analyses are needed to confirm groups correlations.

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