Walking for Water and Fuelwood: Welfare Implications for Women and Children in Ghana

Monica Lambon-Quayefio
(University of Ghana)
mplambon@gmail.com

Paper prepared for the IARIW-TNBS Conference on "Measuring Income, Wealth and Well-being in Africa", Arusha, Tanzania November 11-13, 2022

Session 5: Gender

Time: Saturday, November 12, 2022 [8:30 AM - 10:00 AM]

Walking for Water and Fuelwood: Welfare Implications for Women and Children in Ghana

Abstract

Monica Lambon-Quayefio
University of Ghana

In most SSA countries, the burden of collecting fuelwood and water is gendered. Competing needs for women's time compel them to make choices which present challenges for poverty reduction. The study investigates the impact of women's limited access to clean fuel and water on children's and women's welfare outcomes using the third wave of the Ghana socio economic panel survey. An instrumental variable approach is employed to address the endogeneity of women's time allocation and results suggest that limited access to safe water and clean fuel has significant implications for children's human capital development. I find similar negative effects for women's own health and labour market outcomes. Findings from the study have important policy implications regarding the provision of basic infrastructure for improved welfare outcomes.

Keywords: unpaid work; health, labour, Ghana
JEL: C26; J22

1. Introduction

The slow progress in modern energy sources, particularly non-solid cooking fuels and the limited access to clean water across many sub-Saharan African (SSA) countries, explain the time women and children spend on these house chores. UNICEF (2016) reports that women and children spend over 200 million hours collecting these essential resources for their households. In SSA, for

instance, about two-thirds of the population report accessing water outside of their homes (Pickering et al. 2010). On average, it takes approximately 33 minutes to collect water for rural households and 25 minutes on a round trip for households in urban areas. In most cases, multiple trips are required within the day to fetch enough water and fuel for household use. Time spent on collecting firewood, as reported by Cundale et al. (2017) and Gwavuya et al. (2012) ranges from 4 to 20 hours per week depending on the level of deforestation.

The situation is not any different in Ghana, where only 41 percent of the population has access to portable water, according to data from the World Bank (2020). One out of every four people in Ghana spends over 30 minutes to access portable water (UNICEF,2018). The same report also highlights the strong linkage between poverty status and the time that people spend to fetch water. For example, compared to wealthier people, households in the lowest wealth quintiles are most likely to spend over 30 minutes collecting water. There is also high inequality in water access within regions. As expected, households in the northern regions are significantly more likely to spend over 30 minutes collecting water than households found in the Greater-Accra (UNICEF, 2018). In recent times, illegal mining activities that have become widespread have exacerbated access to portable water, particularly in many rural communities across the country (Yeleiere et al., 2018).

Similar trends are noted for access to clean cooking fuel. Using the most recent Ghana living Standard Survey, Bofah et al., (2022) report that about 74.64 percent of Ghanaian households still depend on solid fuels (wood and charcoal) as their main source of cooking fuel. A further disaggregation of the data suggest that access is more limited for rural households (88.1 percent) compared to urban households (56.77 percent), consistent with the International Energy Agency report on energy use (International Energy Agency, 2009). A higher proportion of rural households (72.03 percent) rely on wood (including twigs, leaves, animal dung and crop waste) compared to about 12.55 percent of urban households.

As with other country contexts in SSA, Bawakyellenuo et al., (2021) emphasize that women and children, particularly in the rural areas, are overburdened with the tasks of collecting water and fuelwood for household use. The time use data collected by the Ghana Statistical Service in 2009 shows that on average, an adult woman spends approximately 48 minutes collecting fuel for household use while a recent report by UNICEF (2018) also shows an average of 30 minutes for households to access safe drinking water.

The time burden associated with collecting water and firewood has extremely high opportunity costs for both women and children. Twumasi et al., (2021) and Karimu (2015) have highlighted that productivity losses from poor health and time wasted seeking cooking fuel can have implications for productive work for both women and children. For instance, the demand on children's time for collecting water and firewood affects their opportunity to enjoy their childhood and study, which may affect their health, schooling outcomes and ultimately, have implications for their human capital development (Levison et al. 2018).

Baguma et al., (2013) argue that the fact that water is obtained outside the home causes its storage for future use, which influences the quality of water available to promote overall health and well-

being. The heavy loads that children and women often carry on their heads may lead to strained backs, necks, and shoulders. This physical strain associated with hauling water and firewood is often compounded because the terrain they ply is often uneven and undulating. Geere et al. (2010) provide evidence that suggests that walking long distances to fetch water is strongly associated with pain and fatigue. Similarly, Geere et al., (2018), using cross-sectional data from Ghana, South-Africa and Vietnam, show that the pressure from carrying heavy water is associated with increased risk of tissue deformation and physical disability. Bassani et al. (2010) and Spears (2012) provide evidence to support the negative correlation between access to water and the health and education outcomes of children in India.

Water collection labour can negatively affect children's schooling outcomes in sub-Saharan African countries (Graham et al. 2016). Fetching water and fuelwood can potentially reduce the time children have at their disposal for schoolwork. Sometimes, children are pulled out of school to assist with fetching water or fuel wood or engage in childcare while mothers go in search of water and fuelwood for the household (Koolwal and Van de Walle 2013). In Ghana, Porter et al., (2012) find that children's lateness to school is due to water fetching activities, and the overall impact, therefore, is reduced school attendance and performance among children (Levison et al. 2018). Kassouf et al. (2020) and Choudhuri and Desai (2021) also reported similar findings on the negative effect of house chores on children's health and education outcomes in Brazil and rural India, respectively.

The long distances women have to travel to fetch water and fuelwood for their households have been associated with their 'time poverty', a concept popularized in the theoretical literature by Vickery (1977) with foundations from the Becker's (1965) seminal work on time allocation. The various dimensions of time-poverty have further been explored by other studies including Bardasi and Wodon (2009), Harvey and Mukhopadhyay (2007), Zacharias (2011) and Martey et al., (2021; 2022). The interest in time poverty, particularly relating to the burden of unpaid housework and its implications for female labour force participation and other welfare outcomes, has been revived in recent empirical literature. This is partly because of the increased availability of time use data. Bardasi and Wodon (2009) and Koolwal and Van de Walle (2013) and Martey et al., (2021; 2022) have applied the concept to capture the inability of women to allocate sufficient time to more important activities, leading them to make difficult trade-offs. Women's increased time poverty because of unpaid domestic work ultimately restricts their involvement in paid employment and other social and recreational activities.

Seymour et al., (2017) argue that the forgone opportunity has the potential to perpetuate a cycle of gender inequality, poverty, and socio-economic empowerment of women. Aside from the restrictions to participate in the labour market, the strain and stress of travelling long distances to haul water and fuelwood for households can have a deleterious effect on women's health and general well-being, similar to children.

Hyde et al. (2020) have documented the various pathways through which a high burden of domestic work can negatively impact women's and children's health outcomes. Using a women's health survey in the United States, Ranji et al., (2018) find that domestic responsibilities undertaken by women are critical to women's decision to seek health care services. Similar findings in the United States have been reported by Stein et al., (2000) who found increased odds of delayed HIV care by women due to care giving responsibilities within their households. In South Africa, McGray (2004) finds evidence that women's time spent on domestic chores is associated with decreased prenatal care utilization. The burden of domestic responsibilities on women reduces their likelihood of completing their education and obtaining decent jobs. Increased burden reduces the number of hours that women can work in paid employment compared to men. These impediments, according to Hyde et al., (2020) lead to a situation where women are funneled into lower-paying jobs.

While there is a burgeoning literature that explores the impact of access of water and clean energy sources on women's labour market, their children's health and schooling outcomes, rigorous empirical evidence is still limited and patchy as noted by Köhlin et al., (2011), Koolwal and Van de Walle (2013) and Choudhuri and Desai (2021). Particularly for Ghana, there is limited rigorous empirical evidence on the impact of limited access to safe water and clean energy on various welfare outcomes for both women children and women using nationally representative data.

The current study aims to contribute to the literature in three main ways. First, beyond the use of extensive margin measures of schooling, this paper is able to examine the effect of access to water and fuelwood on learning outcomes using math and english test scores and hours spent in school and hours missed in a school week. Although other studies such as Kassouf et al., (2020) also use test scores as a measure of learning outcomes, their focus was on children's time spent on domestic chores rather than mother's time, as is considered in the current study. Other studies in the literature, including Koolwal and Van de Walle (2013) and Agesa and Agesa (2019) have measured schooling outcomes by only relying on children's enrolment or attendance. The limitation of using enrolment, as noted by these authors, is that school enrolment does not guarantee attendance and even if children attend school, it does not assure their presence in school for the full day. The use of test scores and total class hours spent in school, therefore, in this paper, allows for a more precise measure of the effect of women's limited access to water and clean cooking fuel on learning outcomes. A study that is closest to the current paper is Choudhuri and Desai (2021who consider the effect of mother's time allocation to fetch water and fuel on children's study time, educational expenses on children and math scores using a matching technique in rural India. The present paper considers a wider range of education outcomes- class hours and missed hours, likelihood of repeating a grade, school attendance and mathematics and English scores.

Second, the paper explores the effect of limited access to water and fuelwood on children's health outcomes. While previous studies have not been able to empirically examine health effects of mother's time spent on accessing water and wood on children due to data limitations, the current study takes advantage of the anthropometric measures to explore the long-term health effects for both children and mothers.

Third, besides extensive margin measures of labour market outcomes typically considered in previous studies, this current paper also considers the effect on the number of hours women can engage in paid employment rather than merely measuring their probability of being in paid employment.

The main research questions explored in this paper are the causal implications of access to water and clean source of energy on children and women's welfare outcomes. The specific research questions the paper seeks to answer are:

1. What is the impact of access to water and fuelwood on children's education outcomes?
2. To what extend does the burden of accessing water and fuelwood affect the health outcomes of children and women?
3. To what extent does the time spent on accessing water and fuelwood for household use affect women's labour market outcomes?

I structure the rest of the paper as follows. The following section describes the data and in section 3, the empirical strategies employed are discussed. The empirical results are presented in section 4. Section 5 provides a discussion of the findings, and the concluding session highlights the policy implications of the study.

2. Data and Descriptive Statistics

The third[1] wave of the Ghana Socio-economic Panel Survey is employed for this study. This panel survey, which is a collaborative effort between the Global Poverty Research Lab at Northwestern University, the Economic Growth Centre at Yale University and the Institute of Statistical Social and Economic Research at the University of Ghana has produced three waves since its inception in 2009 when the first wave was collected and completed in 2010. The second wave was from 2013 to 2014 and the third wave from 2018 to 2019.

The current study relies on the third wave of the panel, which, like the first two waves, is a nationally presentation dataset which covers all the ten regions of the country. The survey follows a two-stage stratified sampling technique, where about 334 enumeration areas are proportionally sampled based on the estimated population shares for each region in 2009. Smaller regions were therefore over-sampled to ensure that a sizeable number of households to be selected in the second stage, which involved the random selection of about 15 households in each enumeration area. The survey comprises 5010 households with over 16000 individuals. The third wave interviewed a sample of the split households and individuals who moved out of the original households to form new households. Including the split households increased the number of the households in the third wave compared to the original households encountered in the first wave.

This dataset is ideal for the current study because it contains detailed and relevant information required to answer the research questions in this study. Based on the household, women and children's questionnaire, the data contains variables including travelling time to access water and fuelwood for household use. In addition, the data contains information on anthropometric measures and measures of subjective general health by adult women in the sample. Information

[1] Due to a lot of missing values on relevant variables in the second wave and the fact that the first wave did not have some relevant variables, this study could not take full advantage of the panel structure of the data set.

collected on children's test scores also makes this dataset ideal for examining the relationship between access to water and more precise measures of children's learning outcomes. Individual level information on labour market activities allows for the measurement of women's labour market participation, which forms part of the research question that the study focuses on. The structure of the data allows children to be matched to their mothers within households.

The two main independent variables of interest are time travelled to access water and cooking fuel. Access to water is defined by how long it takes the mother to travel to fetch water from their general source of water. This is measured in hours. As noted by Koolwal and Van de Wall (2013 time travelled to access water is a preferred measure than distance because this concept captures the difficulty of the terrain as well as times spent waiting in line to fetch water. About 33 percent of the study sample source their water from boreholes. The data also suggests that 17.8 and 11.4 percent of women source their water from public standpipes and rivers or streams, respectively. Only 2.2 percent have inside plumbing with about 9 percent accessing water from a standpipe inside their compound. [2] On average, it takes about 13 minutes (0.21 hrs) to fetch water outside of the household. Most boreholes in Ghana are constructed within communities and close to households and this explain the relatively low average time travelled to fetch water compared to other contexts.

Time travelled to fetch fuel is also measured in hours and according to the data, women spend close to two hours (1.71hrs) to fetch fuel wood for household use with heterogeneity noted by region of residence and locality of residence. The data suggests that women from the three northern regions (northern (1.91 hrs), upper east (2.23) and upper west (1.93) record travel times that are above the average in the sample. This is expected because of their relatively low access to other alternative cooking fuels compared to other parts of the country. Women from the western region also reported higher (than above the mean at 1.96hrs) of walking time to access cooking fuel.

It is important to emphasise that even though these measures are based on individual's recall of time, recall bias will be minimised given that individuals constantly trek to fetch water or firewood as argued (Koolwal and Van de Walle 2013).

Measures of children's education outcomes considered include both extensive and intensive margin measures. Intensive margin measures include English and math scores, hours of class attended, and hours of classes missed in the past week prior to the survey. Extensive margin education measures include school attendance in the past week prior to the survey and whether the child has ever repeated a grade.

The math and English tests are administered to children above 9 years old while the other education measures are collected for children five years and above. The mathematics test comprises eight set of questions while the English test comprises seven questions which are administered to test the arithmetic and reading skills of children. For both test scores, the average is calculated. The grade repetition and school attendance are coded as dummy variables, taking on a value of 1 if the child attended school or has ever repeated a grade and zero otherwise.

[2] Table in the appendix provides the percentages of households in the study sample their source of water.

As expected, in the study context, the sample records a high child school attendance rate of 93 percent. Only 13 percent of the children in the sample have ever repeated a grade. The average number of hours that children spend in school averages at about 26 hours per week, while the average number of hours missed is about 1.5 hours per week. Approximately 82 percent of children attended at least the average school hours while an average of 64 percent of children in the sample missed out on school above the average of 1.5hrs per week. With respect to learning outcomes, close to 80 percent of children scored above the median score of 5 out of 8 mathematics questions while 71 percent obtained an above the average score of 6 out of 7 questions.

The health outcomes of both children and women are based on various anthropometric measures such as arm circumference, body mass index (for children older than five years) and body mass index (bmi)-to-age, and waist-to-height ratios are constructed based on the World Health Organisation's construction of these indexes which are used as proxies for children's health outcomes. For adult women, the appropriate measures used are arm circumference, bmi and waist-to-height ratios. Besides these, subjective health ratings which are collected only for adults in the household are used as a measure of women's subjective health.

Women's labour market outcomes considered in the study include both extensive and intensive measures. For extensive labour market measures, the study uses women's participation in wage work, ownership or operation of a business enterprise, working on own farm and unpaid work. The disaggregated nature of the data allows for the exclusion of women who work as contributing workers on households' non-farm businesses and household farms from wage employment. To a large extent, the exclusion of contributing labour allows for the proxies to be strongly aligned with women's wage employment. Unpaid employment, therefore, includes women's domestic work as well as contributing labour. All four variables are captured as binary variables.

These labour market outcomes are available for individuals who are 15 years and above. The average number of days worked within a week is used as a proxy for the intensity of women's labour market participation. The average number of days women work in the sample is about 4.5 days in a week and about 23 percent of women in the sample work less than this average. Only 5 per cent of the women in the sample reported being in wage employment. The proportion of women either engaged in unpaid domestic work or contributing labour is the largest at 43 per cent. Just over a quarter (27 percent) of the women in the sample operate their own business while 20 percent work on their own farms.

Other variables included in the analysis are children's age, education level and gender, father's presence within the household, mother's employment status, household size, dependents (children below the ages of 15 years and adults above the age of 65 years), household wealth status, area and region of residence. Tables I and I provide shows the descriptive statistics of both child and mother level characteristics.

Table I: Mother Level Variables

Variable	Obs	Mean	Std
Time travelled to water	4092	0.206	0.286

Time travelled to Fuel Wood	1378	1.710	1.134
Body Mass Index	4092	280.682	7837.36
Waist to height Ratio	4092	0.530	1.169
Subjective Health: Very Healthy	4085	0.688	0.463
Leisure hours (having more than 10 hrs of leisure)	1409	0.579	0.494
Women in Wage Employment	4079	0.051	0.219
Women in Unpaid Employment	3385	0.430	0.495
Women Operating Own Business	4079	0.274	0.446
Women Working on Farm	4079	0.208	0.406
Women working more than (4.5) days in a week	4092	0.779	0.415
Mother's Age	4092	44.6	18.01
Household Size	4092	5.01	2.53
Number of Dependents	4092	1.946	1.684
Household in Urban Locality	4092	0.360	0.480
Mother has no education	4092	0.003	0.053
Mother has basic education	4092	0.101	0.297
Mother has high school education	4092	0.360	0.480
Mother has secondary or higher education	4092	0.570	0.496
Mother is Married or in Consensual Union	4092	0.557	0.497
Mother was formerly married (widowed, divorced/separated)	4092	0.254	0.435
Mother is Single	4092	0.190	0.392

Table II: Child Level Variables

Variable Name	Observations	Mean	Std Deviation
arm circumference	3382	20.687	7.937
body mass index for age	2736	0.044	1.518
waist for height ratio	3382	0.583	7.479
Body mass index	3382	6095.17	337200
Age of child	3382	14.285	7.182
Child is Male	3382	0.553	0.553
Father Present in the household	3382	0.723	0.447
Education Related Variables			
child has no education	3016	0.062	0.241
Child has primary education	3016	0.570	0.495
child has high school	3016	0.368	0.482
Child currently attends school	2364	0.931	0.253
Child ever repeated a grade	3083	0.128	0.334
Mathematics Test Score (above median score)	3320	0.786	0.410
English Test Score (above median score)	3320	0.714	0.453
Number of Class hours (above median hours)	3312	0.838	0.368
Number of missed hours (above median hours)	3312	0.643	0.480

3. Empirical Strategies

Estimating an empirical model that ignores the endogeneity in the hypothesized relationship between women's time allocation in accessing water and cooking fuel, and general welfare outcomes can result in biased estimates and an overstatement of impacts (Koolwal and Van de Walle 2013). Two levels of endogeneity concerns are acknowledged in the literature. The first highlights the possible non-randomness in the provision of water and clean energy options in various geographic communities. Unobserved characteristics relating to the socioeconomic environments pertaining to districts and communities may jointly influence women's access to water and cleaner cooking fuel alternatives. Including regional dummies as well as whether households are in urban or rural localities, which to a large extend influence the provision of water and clean energy infrastructure could be a way of minimizing this source of endogeneity using observational data (Koolwal and Van de Walle 2013).

The second source of endogeneity which emanates from individual decision-making regarding time allocation to fetching water and cooking. Several unobserved characteristics, including a higher desire for improved health and education outcomes of children and an aspiration for increased welfare outcomes, may induce households to invest in cleaner sources of cooking fuel. It is this second source of endogeneity which the paper attempts to resolve using the instrumental variable approach. Similar to Agesa and Agesa (2019) and Choudhuri and Desai (2021) I consider a set of infrastructure variables as instruments implemented in a two-staged regression to purge the second the endogeneity resulting from the omitted variable bias at the individual level.

The first stage estimation purges the endogeneity in the access to water and fuelwood variable before estimating its average effect on the outcomes of interest in the second stage. The first stage estimation is specified in equations 1 and 2 for access to water and wood, respectively.

$$Access\_water_i = \alpha + \beta Infrasctructure + \psi Avgtime\_water + \varepsilon_i \quad (1)$$

$$Access\_wood_i = \gamma + \lambda Infrasctructure + \omega Avgtime\_wood + \epsilon_i \quad (2)$$

Where $Access\_water_i$ and $Access\_wood_i$ represents the travel time to access water and to fuelwood for each woman within the household, respectively. $Infrasctructure$ represents a set of factors such as households' connectivity to electricity and use of mobile phone. $Avgtime\_water$ and $Avgtime\_wood$ represents the households' neighbours' average time for accessing water and cooking fuel respectively and where $\alpha, \beta, \psi, \gamma, \lambda$ and ω are all parameters to be estimated in the first stage regressions.

Connectively to electricity connection and access to mobile phones to a large extent reflects the level of development in a particular area. The provision of such infrastructure is often not uniform across the country. For instance, urban areas are more likely to be connected to electricity, which then influences their access to labour-saving appliances and devices which go a long way to reduce the time spent on fetching water and wood. Most often than not, neighborhoods that are connected

with electricity are most likely to have clean sources of water within the household. This is because the provision of such utilities goes side by side. Similarly, development brought about by the provision of electricity indirectly presents improved cooking energy sources, which then eliminates the reliance of firewood and other solid cooking fuel sources to cleaner and modern cooking fuels and hence reduced time for searching and fetching wood. The provision of electricity and its associated technologies made available to households have positive implications for the health of individuals within the household through continuous access to clean water (and therefore reduced illness) and better nutrition. Furthermore, the resulting reduced time spent on fetching water and wood can be channeled into income-generating activities or productive activities such as schooling.

The average time travelled by other households within districts is used as an additional variable in explaining access in equations 1 and 2. These average times for neighbours are calculated at the district level. The district is the smallest administrative units within which services such as education and health and the provision of other social amenities are managed.

The second stage of the regression is specified in equation 3 as follows:

$$Welfare_i = \gamma + \delta Access_i + \varphi X_i + \eta_i \qquad (2)$$

Where the dependent variable, $Welfare_i$ is set of health, education, and labour market outcomes as indicated in data section. The vector X_i consists of a set of other explanatory variables including child level and mother level characteristics including the age, educational level, presence of father within the household, whether or not mother is in unpaid employment, household wealth tercile, locality of residence and region of residence. $\varepsilon_i , \epsilon_i \, and \, \eta_i$ present the error terms in all three equations. In equation 2, the coefficient δ captures the impact of women's access to water and fuelwood on the welfare outcomes of interest. The instrumental variable strategy adopted here assumes that the set of variables considered as instruments are correlated with the welfare outcomes of both women and children through women's access to water and fuelwood.

The 2SLS estimator is used with robust standard errors where dependent variables are continuous and the probit option is used for binary dependent variables. The generalised methods of moments (gmm) estimator is employed with the poisson model when the dependent variables are count variables. Following Montiel Olea and Pflueger (2013) and Pflueger and Pflueger and Wang (2015) all estimations are tested for strength of instruments used. The test statistic for all estimates considered rejects the null hypothesis (at 5% significance level) that the instruments used in the analysis are weak instruments.[3] For all the outcomes considered, the results from the tests (shown in appendix table 1) suggest that all instruments are strong.

4. **Results and Discussion**

[3] The weak instrument validity test, developed by Pflueger and Wang (2015) is estimated for all the regressions and the F-statistic reported and compared with the critical values at 5% for both the TSLS and LIML estimations. Details are shown in table 2 in the appendix.

For all estimations on health outcomes, both for women and children, the results show that limited access to water has the potential to reduce the overall health outcomes of children (Table III) and women (Table V). For all four anthropometric measures of health considered the impacts are all negative, although not statistically significant. In the case of women, although negative effects are noted for the two anthropometric measures (body mass index and waist to height ratios) these are not statistically significant. However, the negative effect on women's subjective health is high and significant. The predicted values suggest that an hour's increase in the time travelled for water for domestic use reduces the probability that a woman would rate herself as 'very healthy' by about 133 percent. The negative impact on women's subjective health rating is consistent with Geere et al., (2018) who note that the physical strain of carrying water on their heads for long distances may increase the likelihood of neck pains and bodily pains as well as have negative implications of tissue growth and development, thereby reducing women's body mass index and their waist to height ratios in the long run.

Table III: Effects of Access to Wood on Child Health Outcomes

	Arm Circumference	**Body Mass Index**	**Waist to Heigh Ratio**	**Body Mass Index to Age**
Access to wood	-0.310	-61424.501	-1.248	-0.130
	(-0.36)	(-0.94)	(-0.86)	(-0.57)
Child's Age	0.439***	1914.393	0.044	-0.051***
	(20.50)	(1.20)	(1.22)	(-5.74)
Father Present	-0.138	14371.171	0.410	0.185
	(-0.34)	(0.48)	(0.61)	(1.55)
Child is Male	-0.259	14648.643	0.314	-0.254**
	(-0.94)	(0.71)	(0.69)	(-3.35)
Household Size	0.032	2514.539	0.054	-0.019
	(0.52)	(0.55)	(0.53)	(-1.14)
Wealth Tercile (Middle)	-0.564	-17708.321	-0.446	0.011
	(-1.60)	(-0.67)	(-0.76)	(0.11)
Wealth Tercile (Middle	-0.504	-27163.413	-0.648	0.272
	(-0.85)	(-0.61)	(-0.66)	(1.64)
Urban	-1.881***	-28736.577	-0.673	-0.439***
	(-3.91)	(-0.80)	(-0.84)	(-3.07)
Mother is Unemployed	0.046	7557.382	0.059	-0.104
	(0.15)	(0.32)	(0.11)	(-1.21)
Central	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)
Greater-Accra	-0.038	-19277.603	-0.371	-0.003
	(-0.05)	(-0.30)	(-0.26)	(-0.01)
Volta	5.638**	-61171.071	-1.207	0.227
	(2.32)	(-0.34)	(-0.30)	(0.34)
Eastern	-4.995***	-31767.523	-0.843	-0.166
	(-6.82)	(-0.58)	(-0.69)	(-0.79)
Ashanti	1.607**	-28161.537	-0.607	0.230

	(2.31)	(-0.54)	(-0.52)	(1.26)
Brong-Ahafo	0.569	24411.418	0.636	0.424*
	(0.61)	(0.35)	(0.41)	(1.67)
Northern	-3.262***	-17989.797	-0.460	0.025
	(-4.92)	(-0.36)	(-0.42)	(0.14)
Upper East	-0.281	-38846.599	-0.858	0.283*
	(-0.48)	(-0.89)	(-0.88)	(1.73)
Upper West	-12.971***	-9944.259	-0.066	0.469**
	(-17.01)	(-0.17)	(-0.05)	(2.20)
10.r_code	-7.325***	-3984.316	-0.214	1.026***
	(-9.30)	(-0.07)	(-0.16)	(4.64)
_cons	17.186**	80768.958	2.055	0.639
	(8.99)	(0.56)	(0.65)	(1.30)
Wald chi2	1065.0	2.50	13.08	107.10
Prob>chi2	0.000	1.000	0.787	0.000
R2	**0.363**	**0.001**	**0.003**	**0.058**
N	**1956**	**1956**	**1956**	**1657**

Table IV: Effects of Access to Water on Child Health Outcomes

	Arm Circumference	Body Mass Index	Waist to height ratio	Body Mass Index to Age
Access to water	-2.910	-82109.713	-1.961	0.144
	(-1.58)	(-1.02)	(-1.09)	(0.33)
Child's Age	0.410***	944.550	0.021	-0.050***
	(19.30)	(1.02)	(1.04)	(-7.11)
Father Present	0.015	6878.862	0.192	0.151*
	(0.05)	(1.10)	(1.35)	(1.95)
Child is Male	-0.391*	9601.173	0.183	-0.268***
	(-1.78)	(0.98)	(0.84)	(-4.63)
Household Size	0.028	1596.750	0.035	-0.032**
	(0.54)	(1.01)	(0.99)	(-2.41)
Wealth Tercile: Middle	-0.697**	-23242.118	-0.556	0.038
	(-2.12)	(-1.02)	(-1.10)	(0.45)
Wealth Tercile: Rich	-0.562	-26311.172	-0.642	0.153
	(-1.27)	(-1.02)	(-1.12)	(1.35)
Urban	0.038	-18387.375	-0.441	-0.009
	(0.12)	(-1.02)	(-1.10)	(-0.11)
Mother is Unemployed	-0.343	9914.991	0.157	-0.049
	(-1.46)	(0.91)	(0.64)	(-0.76)
Central Region	0.547	5526.565	0.134	0.012
	(1.20)	(0.97)	(1.05)	(0.08)
Greater-Accra	-6.849***	11532.124	0.132	1.528***
	(-9.88)	(1.01)	(0.52)	(9.07)
Volta	-4.978***	-3765.001	-0.263***	-0.007
	(-7.86)	(-0.90)	(-2.76)	(-0.04)
Eastern	1.984***	2913.078	0.051	-0.032
	(4.10)	(0.85)	(0.66)	(-0.24)

Ashanti	1.076***	36614.157	0.819	0.252**
	(2.60)	(1.01)	(1.01)	(2.02)
Brong-Ahafo	-2.829***	653.734	-0.064	-0.063
	(-5.54)	(0.37)	(-1.55)	(-0.48)
Northern	0.318	-9268.983	-0.201	0.141
	(0.66)	(-0.98)	(-0.95)	(1.03)
Upper-East	-12.576***	-12873.324	-0.303	0.204
	(-26.64)	(-0.75)	(-0.72)	(1.30)
Upper-West	-6.167***	15536.220	0.306	0.979***
	(-5.39)	(0.99)	(0.88)	(3.90)
_cons	17.696***	623.817	0.569***	0.599***
	(24.17)	(0.22)	(8.24)	(2.97)
Wald chi2	3063.59	3.69	46.07	261.74
Prob>chi2	0.00	0.999	0.000	0.000
r2	**0.361**	**0.003**	**0.003**	**0.089**
N	**3413**	**3413**	**3413**	**2760**

Similar negative findings are reported for the impact of travel time to fetch wood on children's health outcomes (Table IV). Again, while the signs are negative, none of the four measures of health show significant impacts. In contrast to the effect of access to water on women's health outcomes, the estimates show positive and significant effects of access to wood. Access to wood improves women's body mass index by 0.683 km/m2 and increases the probability of women reporting improved self-health rating by 66 percent. However, the results suggest that increased time to access wood for domestic use significantly reduces women's probability of enjoying more than 10 hours of leisure (sleeping and watching television) by about 91 percent

.

Table V: Effects of Access to Water on Woman's Health Outcomes

	Body Mass	**Waist to Height**	**Subjective Health**	**Leisure Hours**
Access to water	-1372.432	-0.008	-1.336***	-0.511
	(-1.61)	(-0.02)	(-3.53)	(-0.50)
Household size	-12.486	-0.005	0.026*	0.042**
	(-0.31)	(-1.01)	(1.92)	(2.57)
Dependents	20.349	0.017	-0.011	0.004
	(0.15)	(1.03)	(-0.51)	(0.17)
Age	-9.434	-0.001*	-0.034***	0.002
	(-1.22)	(-1.74)	(-16.35)	(1.03)
Basic Education	166.992	0.098*	-0.316	0.556
	(0.50)	(1.72)	(-0.86)	(1.36)
High School	193.030	0.120**	-0.129	0.369
	(0.56)	(2.04)	(-0.35)	(0.92)
Secondary	455.390	0.178**	-0.160	0.603
	(1.15)	(2.12)	(-0.44)	(1.50)
Formerly Married	-177.824	-0.016	-0.297***	0.289***
	(-0.83)	(-0.45)	(-5.51)	(3.81)
Single	-76.343	-0.076*	-0.304***	0.579***
	(-0.16)	(-1.66)	(-4.20)	(6.45)
Urban Locality	-146.570	-0.004	0.051	-0.186*

	(-1.52)	(-0.11)	(0.83)	(-1.94)
Wealth Tercile: Middle	-325.127*	-0.066	-0.145**	-0.552***
	(-1.95)	(-1.45)	(-2.68)	(-7.75)
Wealth Tercile: Rich	-420.155**	-0.074**	-0.197**	-0.613***
	(-1.97)	(-2.27)	(-2.63)	(-5.60)
Central Region	11.360	-0.025	0.172*	0.347**
	(0.16)	(-0.56)	(1.72)	(2.94)
Greater-Accra	37.737	-0.157***	0.684***	-0.005
	(0.52)	(-3.55)	(6.45)	(-0.05)
Volta	-59.861	-0.233***	0.492***	0.166
	(-0.84)	(-4.64)	(5.11)	(1.52)
Eastern	92.845	0.091	0.662***	0.374**
	(0.82)	(0.80)	(6.96)	(2.92)
Ashanti	41.532	-0.041	0.360***	0.641***
	(0.46)	(-0.88)	(4.22)	(5.92)
Brong-Ahafo	-40.433	-0.152**	0.488***	0.549***
	(-0.52)	(-2.77)	(4.93)	(4.44)
Northern	-155.887	-0.138	0.481***	0.203
	(-1.24)	(-1.20)	(4.76)	(1.17)
Upper-East	3256.574*	-0.104	0.622***	0.315**
	(1.94)	(-0.63)	(5.58)	(2.18)
Upper-West	247.315	-0.190	1.297***	0.249
	(0.93)	(-1.01)	(7.27)	(0.60)
Wald chi2	6.36	486.33	798.87	126.72
Prob>chi2	0.991	0.00	0.00	0.00
r2	0.012	0.008		
N	**4092**	**4092**	**4411**	**4431**

Table VI: Effects of Access to Wood on Woman's Health Outcomes

	Body Mass Index	**Waist to Height**	**Subjective Health**	**Leisure Hours**
Access to wood	1892.577	0.653***	0.667***	-0.905***
	(0.98)	(3.99)	(4.02)	(-18.74)
Household Size	34.835	0.016	0.029	-0.039**
	(0.70)	(0.71)	(1.37)	(-2.18)
Dependents	84.445	0.021	-0.007	0.046*
	(0.79)	(0.64)	(-0.21)	(1.75)
Age	13.586	0.002	-0.017**	-0.006**
	(0.91)	(0.65)	(-2.29)	(-2.09)
Basic Education	-921.503	-0.850*	-0.445	0.655**
	(-0.74)	(-1.72)	(-0.87)	(2.41)
High School	-867.788	-0.629	-0.185	0.553**
	(-0.74)	(-1.28)	(-0.35)	(2.11)
Secondary	-913.727	-0.941*	-0.308	0.676**
	(-0.75)	(-1.94)	(-0.59)	(2.60)
Formerly Married	79.124	-0.018	-0.164	-0.050
	(0.42)	(-0.17)	(-1.45)	(-0.64)

Single	269.572	-0.427*	-0.117	-0.106
	(0.61)	(-1.94)	(-0.63)	(-0.68)
Urban Locality	-60.987	-0.050	-0.080	0.024
	(-0.27)	(-0.43)	(-0.70)	(0.22)
Wealth Tercile: Middle	-169.695	0.224**	-0.112	-0.132
	(-0.73)	(2.04)	(-1.43)	(-1.53)
Wealth Tercile: Rich	-127.762	0.363**	-0.073	-0.176
	(-0.46)	(2.10)	(-0.56)	(-1.28)
Cenrtal Region	984.451	0.552**	0.436**	-0.345**
	(0.95)	(3.25)	(2.69)	(-2.68)
Greater-Accra	1302.621	0.979***	1.101**	-0.522**
	(0.92)	(3.45)	(3.25)	(-2.35)
Volta	708.785	0.342**	0.643***	-0.294**
	(0.92)	(2.32)	(4.48)	(-2.47)
Eastern	725.011	0.335**	0.737***	-0.251*
	(0.97)	(2.10)	(4.44)	(-1.86)
Ashanti	1522.187	0.367*	0.855***	-0.557***
	(0.96)	(1.69)	(6.06)	(-4.81)
Brong-Ahafo	897.894	0.497***	0.679***	-0.277**
	(0.94)	(3.48)	(4.90)	(-2.24)
Northern	56.695	0.038	0.329**	-0.095
	(0.23)	(0.27)	(2.42)	(-0.83)
Upper-East	1699.426	-0.610**	0.355	0.349*
	(1.00)	(-2.68)	(1.32)	(1.86)
Upper-West	-37.117	-0.330*	0.783**	-0.022
	(-0.14)	(-1.65)	(3.03)	(-0.18)
Wald chi2	1.23	68.31	389.29	147.32
Prob>chi2	1.00	0.00	0.00	0.00
N	**1376**	**1391**	**1401**	**1401**

Other variables that have significant effects on children's health include the presence of father within the household, household size, gender of child, household wealth as well as locality of the household. Apart from distance travelled to access water and fuel wood, other variables that significantly affect women's health include their age, household size, education, marital status, household wealth as well as the locality of the household.

Second, estimates suggest that limited access to water and cooking fuel have negative implications for school outcomes. For both activities, increased time spent reduces the likelihood of children attending school and increases the hours that children miss school. Increased time spent fetching wood for household use reduces the likelihood of children attending school by about 68 percent and the likelihood that children will miss more than 2 hours of school a week by 50 percent as shown in table VII. Although the probability of repeating a grade reduced and the effect on class hours is negative, the results are not statistically significant. Similar results for school attendance are found for access to water (see table VIII).The likelihood of attending school reduces

significantly by over 200 percent while the chance of children missing more than 2 hours of school per week is double that obtained for limited access to wood.

One mechanism through which improved access to fuelwood and water can explain the negative impact on school attendance is the increased allocation of time to sibling childcare and assistance with other domestic activities such as preparing food which may be required to facilitate children's school attendance. In some instances, because children may be required to assist their mothers with such chores, they are likely to attend school late, thereby, missing some school hours.

Table VII: Effects of Access to Wood on Child School Outcomes

	School Attendance	Missed Hours	Class Hours	Repeat Grade
Time to Wood	-0.683***	0.496***	-0.101	-0.214
	(-5.78)	(4.01)	(-0.65)	(-1.04)
Age of Child	-0.060***	0.067***	0.071***	0.025***
	(-3.19)	(6.58)	(6.29)	(2.88)
Primary	0.000	-0.141	-0.011	0.437**
	(.)	(-1.13)	(-0.08)	(2.14)
High School	0.000	0.153	-0.043	0.281
	(.)	(0.94)	(-0.22)	(1.21)
Public School	-0.019	-0.151*	0.082	0.089
	(-0.12)	(-1.74)	(0.74)	(0.85)
Father Present	0.067	-0.034	0.001	0.070
	(0.63)	(-0.56)	(0.01)	(0.91)
Child is Male	0.024	0.055***	0.009	-0.025
	(0.84)	(3.62)	(0.50)	(-1.36)
Household Size	-0.054	0.026	-0.201**	-0.119
	(-0.44)	(0.37)	(-2.38)	(-1.36)
Mother Unemployed	0.036	-0.134*	-0.121	-0.036
	(0.27)	(-1.82)	(-1.31)	(-0.39)
Wealth Tercile (Middle)	0.059	-0.064	-0.183	-0.119
	(0.28)	(-0.51)	(-1.17)	(-0.75)
Wealth Tercile (Rich)	0.262	0.098	-0.193	-0.162
	(1.47)	(0.96)	(-1.54)	(-1.28)
urban	-0.447*	-0.004	-0.535**	-0.220
	(-1.72)	(-0.02)	(-2.35)	(-0.99)
Cenrtal Region	0.000	-0.253	0.000	-0.345
	(.)	(-0.48)	(.)	(-0.55)
Greater-Accra	0.003	-0.233	-0.310	-0.302
	(0.01)	(-1.39)	(-1.42)	(-1.62)
Volta	-0.667***	-0.255	-1.081***	0.307*
	(-3.20)	(-1.62)	(-5.88)	(1.70)
Eastern	-0.913***	-0.120	-0.616***	-0.134
	(-4.22)	(-0.59)	(-2.81)	(-0.57)
Ashanti	-0.230	-0.421***	-0.666***	-0.017
	(-1.03)	(-2.58)	(-3.56)	(-0.10)

Brong-Ahafo	-0.278	-0.133	-1.155***	-0.403***
	(-1.31)	(-1.00)	(-6.54)	(-2.60)
Northern	-0.109	-0.161	-0.562**	0.045
	(-0.46)	(-1.00)	(-2.48)	(0.24)
Upper-East	0.839**	0.065	-0.257	-0.197
	(2.52)	(0.37)	(-1.09)	(-0.94)
Wald chi2	327.54	474.78	169.24	71.91
Prob>chhi2	0.000	0.000	0.000	0.000
N	**1278**	**1780**	**1772**	**1780**

Table VIII: Effects of Access to Water on Child School Outcomes

	School Attendance	Missed Hours	Class Hours	Repeat Grade
Access to water	-2.242***	1.004***	0.583	-0.814*
	(-4.42)	(2.71)	(1.45)	(-1.86)
Age of Child	-0.063***	0.074***	0.067***	0.013***
	(-4.15)	(12.91)	(9.56)	(2.80)
Primary School	0.000	-0.117	-0.132	0.399***
	(.)	(-1.13)	(-1.19)	(2.58)
High School	0.000	0.196	-0.250*	0.275
	(.)	(1.54)	(-1.75)	(1.61)
Public School	-0.235**	-0.157***	-0.015	0.119*
	(-2.01)	(-2.63)	(-0.22)	(1.69)
Father Present	-0.001	-0.002	0.028	0.036
	(-0.01)	(-0.03)	(0.50)	(0.64)
Child is Male	0.030	0.048***	0.027*	-0.008
	(1.39)	(4.04)	(1.92)	(-0.58)
Household Size	0.122	0.026	-0.081	0.027
	(1.13)	(0.47)	(-1.33)	(0.42)
Mother is Unemployed	-0.175	-0.063	-0.027	-0.110
	(-1.48)	(-1.02)	(-0.37)	(-1.44)
Middle	-0.331**	-0.081	0.109	-0.321***
	(-2.18)	(-0.93)	(1.06)	(-2.97)
Rich	0.224*	0.094	0.007	-0.121
	(1.74)	(1.40)	(0.09)	(-1.48)
urban	0.136	0.020	-0.326**	-0.066
	(0.60)	(0.18)	(-2.36)	(-0.48)
Cenrtal Region	0.157	0.039	-0.297**	-0.434***
	(0.65)	(0.31)	(-2.04)	(-2.74)
Greater-Accra	-0.037	-0.193*	0.022	-0.097
	(-0.18)	(-1.70)	(0.15)	(-0.76)
Volta	-0.449**	-0.344***	-0.494***	0.227*
	(-2.28)	(-3.22)	(-3.91)	(1.94)
Eastern	-0.348**	-0.236**	0.070	-0.156
	(-2.03)	(-2.49)	(0.57)	(-1.42)
Ashanti	-0.003	-0.443***	-0.171	-0.060
	(-0.02)	(-4.33)	(-1.34)	(-0.50)

Brong-Ahafo	0.200	-0.288***	-0.816***	-0.402***
	(0.99)	(-2.73)	(-6.60)	(-3.03)
Northern	-0.105	0.180	0.008	-0.094
	(-0.51)	(1.36)	(0.05)	(-0.67)
Upper-East	1.542***	0.014	-0.178	-0.096
	(3.86)	(0.06)	(-0.72)	(-0.37)
Wald chi2	368.87	623.07	271.76	85.84
Prob>chi2	0.000	0.000	0.000	0.000
N	**2336**	**3312**	**3312**	**3312**

The estimations only show a significant decline in math scores due to limited access to water. As shown in table IX, travel time to access water reduces the likelihood of a child obtaining at least the average score by about 18 percent. Interestingly, the effect on both math and English scores is positive, although not statistically significant. Overall, the negative effect on performance is an expected result in the Ghanaian context. This is because children are usually expected to assist their mothers with childcare and domestic chores as well as run errands, especially when their mothers leave the house in search of water and fuelwood. There is, therefore, little time for self-study to complement lessons learnt during class hours. The significant hours of lesson time missed by children as a result of not attending school or attending late may also explain the poor learning outcomes. As expected, other significant determinants of learning outcomes include age, gender and educational level of child, household size, household wealth, locality and region of residence.

Third, the estimates from tables X and XI provide empirical evidence for the effect of access to water and wood on women's labour market outcomes. Considering the various measures of labour market outcomes in this study, the results show that time travelled to fetch water for domestic use (see table X) significantly increases the probability of working on own farm by about 190 percent and reduces the likelihood of being in unpaid work by 120 percent. However, the likelihood of women working more than the average hours is increased by 75 percent.

Table IX: Effects of Access to Wood and Water on Child Learning Outcomes

	Water Access		**Wood Access**	
	English	Mathematics	English	Mathematics
Access to Water/Wood	0.038	-0.183*	0.014	0.009
	(0.27)	(-1.73)	(0.16)	(0.14)
Age of Child	-0.002	0.001	0.005*	0.007***
	(-0.96)	(1.10)	(1.88)	(2.99)
Primary	0.299	0.757***	0.405	0.829***
	(1.19)	(3.43)	(1.31)	(3.24)
Hight School	0.596**	1.033***	0.687**	1.090***
	(2.36)	(4.68)	(2.21)	(4.24)
Father is Present	0.071***	0.036**	0.049	0.032
	(3.51)	(2.21)	(1.46)	(1.13)
Child is Male	-0.015	0.034**	-0.037	0.034*
	(-0.87)	(2.54)	(-1.45)	(1.68)
Household Size	-0.012**	-0.006*	-0.007	-0.004
	(-2.36)	(-1.73)	(-1.04)	(-0.87)

Mother is Unemployed	-0.021	-0.019	-0.028	-0.015
	(-1.03)	(-1.20)	(-0.90)	(-0.59)
Wealth Tercile (Middle)	0.078***	0.055***	0.057*	0.040
	(3.34)	(2.95)	(1.92)	(1.63)
Wealth Tercile (Rich)	0.115***	0.066***	0.131***	0.034
	(3.96)	(2.80)	(3.04)	(0.82)
urban	0.068***	0.033*	0.048	0.031
	(3.09)	(1.89)	(1.45)	(1.04)
Cenrtal Region	0.158***	0.088**	0.061	0.050
	(2.79)	(2.38)	(0.62)	(0.87)
Greater-Accra	0.268***	0.248***	0.448***	0.251*
	(5.89)	(7.53)	(3.24)	(1.83)
Volta	0.372***	0.242***	0.342***	0.200***
	(8.36)	(6.89)	(5.33)	(4.10)
Eastern	0.206***	0.099***	0.168**	0.004
	(4.22)	(2.70)	(2.17)	(0.06)
Ashanti	0.281***	0.159***	0.291***	0.117*
	(6.68)	(5.33)	(3.08)	(1.66)
Brong-Ahafo	0.248***	0.093***	0.261***	0.038
	(5.54)	(2.79)	(4.02)	(0.78)
Northern	-0.088	0.045	-0.217***	-0.059
	(-1.60)	(1.30)	(-3.03)	(-1.33)
Upper-East	0.231***	0.166***	0.193***	0.112**
	(4.66)	(4.45)	(2.95)	(2.34)
Upper-West	0.112	0.187***	0.079	0.054
	(1.30)	(2.88)	(1.07)	(0.99)
_cons	0.980***	0.629***	0.805**	0.467
	(3.78)	(2.80)	(2.08)	(1.49)
N	**2390**	**2390**	**1311**	**1311**

The results of distance travelled to access cooking fuel also show a negative and significant effect on the likelihood of women being in paid employment. Increased travel time to access wood reduces women's chance of being wage employment by 61 percent. However, women's probability of owning and operating their own business is increased by 65 percent. While the effects on the probability of working on own farm and being involved in unpaid work are negative, they are not statistically significant. The results indicate no significant effect on work intensity, although the sign is negative. Other factors that significantly affect women's labour market outcomes, according to the study, include women's age, education, marital status, household wealth, the number of dependents and the location of the household.

Table X : Effects of Access to Water on Woman's Labour Market Outcomes

	Wage Work	**Operate Business**	**Own Farm Work**	**Unpaid Work**	**Work Intensity**
Access to water	-0.049	0.422	1.897***	-1.239**	0.754*
	(-0.07)	(0.97)	(5.31)	(-3.28)	(1.84)
Household Size	-0.012	-0.006	-0.029**	0.032**	0.145***

	(-0.52)	(-0.43)	(-2.10)	(2.42)	(8.94)
Dependents	-0.049	-0.006	-0.009	0.008	-0.154***
	(-1.39)	(-0.30)	(-0.41)	(0.39)	(-6.44)
Age	-0.016***	-0.006***	0.005**	-0.002	-0.009***
	(-5.77)	(-3.71)	(3.13)	(-1.30)	(-5.41)
Basic Education	0.000	-0.122	-0.598	-0.217	-0.850
	(.)	(-0.28)	(-1.43)	(-0.53)	(-1.58)
High School	0.000	0.076	-0.591	-0.384	-0.587
	(.)	(0.17)	(-1.43)	(-0.95)	(-1.10)
Secondary	0.000	-0.350	-0.681*	-0.208	-0.584
	(.)	(-0.80)	(-1.65)	(-0.52)	(-1.09)
Formerly Married	0.031	-0.142**	0.447***	-0.513***	-0.124**
	(0.28)	(-2.36)	(7.61)	(-8.20)	(-2.05)
Single	0.011	-1.116***	-0.618***	0.347***	-0.134*
	(0.12)	(-13.24)	(-6.32)	(4.68)	(-1.90)
Urban Locality	0.259**	0.362***	-0.506***	-0.248***	-0.195**
	(2.80)	(6.18)	(-6.50)	(-3.88)	(-3.03)
Wealth Tercile: Middle	0.118	0.380***	-0.059	-0.253***	0.002
	(1.09)	(6.56)	(-1.06)	(-4.59)	(0.03)
Wealth Tercile: Rich	0.167	0.381***	0.093	-0.371***	0.070
	(1.20)	(4.95)	(1.21)	(-4.98)	(0.89)
Cenrtal Region	-0.189	0.265**	-0.323**	-0.123	0.168
	(-1.23)	(2.54)	(-3.23)	(-1.10)	(1.60)
Greater-Accra	0.090	0.039	-1.008***	0.069	0.458***
	(0.67)	(0.38)	(-6.15)	(0.61)	(4.36)
Volta	-0.488**	0.034	-0.307**	0.100	0.093
	(-2.85)	(0.34)	(-3.20)	(0.97)	(0.94)
Eastern	-0.095	0.151	-0.326***	-0.011	-0.118
	(-0.63)	(1.46)	(-3.39)	(-0.11)	(-1.19)
Ashanti	-0.100	-0.163*	-0.373***	0.279**	0.028
	(-0.77)	(-1.74)	(-4.20)	(2.94)	(0.31)
Brong-Ahafo	-0.501**	0.031	-0.004	0.249**	0.131
	(-3.10)	(0.30)	(-0.04)	(2.47)	(1.28)
Northern	-0.738***	-0.237**	-0.748***	0.711***	0.175
	(-4.07)	(-2.16)	(-7.22)	(7.06)	(1.55)
Upper-East	-0.474**	-0.386**	-0.472***	0.535***	0.881***
	(-2.38)	(-2.93)	(-4.24)	(4.69)	(6.14)
Upper-West	0.000	-0.753***	-1.157***	1.086***	0.315
	(.)	(-3.49)	(-6.60)	(6.05)	(1.44)
Wald Chi2	209.04	595.41	474.93	438.38	444.21
Prob>chi2	0.00	0.00	0.00	0.00	0.00
N	**4165**	**4417**	**4417**	**3564**	**4431**

Table XI: Effects of Access to Wood on Woman's Labour Market Outcomes

	Wage Work	Operate Business	Own Farm Work	Unpaid Work	Work Intensity
Access to wood	-0.610*	0.653***	-0.291	-0.263	-0.381
	(-1.95)	(3.99)	(-0.95)	(-0.70)	(-1.34)
Household Size	0.062	0.016	-0.057**	0.025	0.058*

	(1.31)	(0.71)	(-2.22)	(0.92)	(1.83)
Dependents	-0.136	0.021	0.053	-0.037	-0.033
	(-1.54)	(0.64)	(1.45)	(-1.01)	(-0.82)
Age	-0.015**	0.002	0.015**	-0.013***	-0.001
	(-2.23)	(0.65)	(3.04)	(-3.59)	(-0.23)
Basic Education	0.000	-0.850*	-0.204	0.328	0.000
	(.)	(-1.72)	(-0.41)	(0.56)	(.)
High School	0.000	-0.629	-0.175	0.042	0.000
	(.)	(-1.28)	(-0.36)	(0.07)	(.)
Secondary	0.000	-0.941*	-0.212	0.299	0.000
	(.)	(-1.94)	(-0.42)	(0.50)	(.)
Formerly Married	-0.048	-0.018	0.805***	-1.025***	-0.412***
	(-0.27)	(-0.17)	(5.42)	(-6.51)	(-3.70)
Single	-0.204	-0.427*	-0.384**	0.177	-0.500**
	(-0.88)	(-1.94)	(-2.01)	(0.92)	(-3.04)
Urban Locality	0.280	-0.050	-0.049	-0.079	-0.206
	(1.61)	(-0.43)	(-0.40)	(-0.57)	(-1.59)
Wealth Tercile: Middle	-0.038	0.224**	-0.005	-0.173*	0.046
	(-0.25)	(2.04)	(-0.05)	(-1.66)	(0.52)
Wealth Tercile: Rich	-0.210	0.363**	0.155	-0.443**	0.225
	(-0.88)	(2.10)	(1.09)	(-2.48)	(1.57)
Central Region	-0.364	0.552**	0.058	-0.363	0.167
	(-1.50)	(3.25)	(0.24)	(-1.44)	(0.63)
Greater-Accra	-0.327	0.979***	-1.317**	0.110	0.093
	(-0.71)	(3.45)	(-2.63)	(0.21)	(0.21)
Volta	-0.694**	0.342**	-0.225	-0.199	0.011
	(-2.54)	(2.32)	(-1.16)	(-0.93)	(0.05)
Eastern	-0.328	0.335**	-0.095	-0.205	-0.193
	(-1.55)	(2.10)	(-0.51)	(-1.05)	(-1.10)
Ashanti	-0.792***	0.367*	-0.322	0.118	-0.102
	(-3.45)	(1.69)	(-1.12)	(0.31)	(-0.34)
Brong-Ahafo	-0.639**	0.497***	-0.218	-0.047	0.227
	(-2.97)	(3.48)	(-1.02)	(-0.19)	(0.90)
Northern	-1.039**	0.038	-0.395**	0.349*	0.258
	(-1.98)	(0.27)	(-2.55)	(1.90)	(1.54)
Upper-East	0.000	-0.610**	-0.710**	0.947***	1.002***
	(.)	(-2.68)	(-2.40)	(4.52)	(4.26)
Upper-West	0.000	-0.330*	-0.645**	0.737***	0.580**
	(.)	(-1.65)	(-3.05)	(3.45)	(2.76)
Wald Chi2	106.06	270.81	256.38	301.29	132.27
Prob>chi2	0.00	0.00	0.00	0.00	0.00
N	**1197**	**1391**	**1391**	**1308**	**1393**

5. Conclusions

In most developing country contexts, including Ghana, the burden of fetching water and fuelwood for domestic use falls disproportionately on women and children within the households. In most communities where clean water sources and cooking fuel are not readily available, women and children are required to travel far distances to carry water and in search of firewood for cooking.

The time spent by women and children in accessing these essential utilities has the potential to affect their health and other outcomes, including schooling and learning outcomes for children and labour market outcomes for adult women. However, available empirical evidence is scanty, especially in most sub-Saharan countries, due to the absence of time use data.

The current study explores the effect of women's time spent on accessing water and fuel wood on welfare outcomes for both women and their children. The paper focuses on dealing with the endogeneity that arises due to unobserved characteristics that my jointly influence women's decision of allocating time for fetching water and fuel for cooking. The instrumental variable approach is adopted to address this type of endogeneity.

Overall, the study finds evidence of significant effects of limited access to water and to clean cooking fuel on women and children's health, children's schooling and learning outcomes and women's labour market outcomes. The long distances travelled in search of cooking fuel and water have been demonstrated to have negative implications for children's anthropometric measures. The findings suggest that not only is school attendance affected by mother's limited access to water and cooking fuel, but the number of missed hours in school can potentially be affected by household's limited access to water and cooking fuel. Similar findings are highlighted for women's health and labour market outcomes. The limited access to water and cooking fuel appears to reduce women's likelihood of being in wage employment. Also, the study provides evidence to suggest that women are more likely to work on their own farm or operate their own businesses because of the burden of providing water and fuelwood for their household. It is important to note that travel time reduces women's chance of being in unpaid employment. There is some evidence to support the hypothesis that limited access to cooking fuel for household use can have negative implications for the number of days women can work. The reduced work intensity, therefore, has the potential to reduce women's earning capacity within the household.

The empirical evidence from the paper has important policy implications. Improving water access and providing clean energy sources for cooking can have important welfare implications for children's human capital development and poverty beyond the unequal distribution of these chores, which falls disproportionately on women and girls. Children's schooling outcomes and women's labour market outcomes can potentially be improved if policy makers focus on ensuring that communities have access to water within their households and cleaner sources of energy for household use. Also, there is the need for policy makers to strengthen existing policies and programs such as the distribution of liquified petroleum gas cylinders and support the production of affordable locally manufactured cooking stoves to improve access to cooking fuel to reduce the time women spend on accessing cooking fuel. Overall, the investment in such infrastructure has the potential to complement and maximize the impacts of various poverty reduction and gender empowerment strategies towards the achievement of the sustainable development goals associated with poverty reduction and gender equality. While the current focus of the paper does not consider threshold analysis, future work in this area would provide added benefits for policy making.

Bibliography

Abdourahman, O. (2010). Time Poverty: A Contributor to Women's Poverty. *The African Statistical Journal, 11*(1), 16-37.

Agesa, R., & Agesa, J. (2019). Time Spent on Household Chores (Fetching Water) and the Alternatives Forgone for Women in Sub-Saharan Africa: Evidence from Kenya. *Journal of Developing Areas, 53*(2), 29-42. doi:doi:10.1353/jda.2019.0019

Bardasi, E., & Wodon, Q. (2009). Working Long Hours and Having No Choice: Time Poverty in Guinea. *Policy Research Working Paper, No. WPS 4961*.

Baguma, D., Hashim, J., Aljunid, S., & Loiskandl, W. (2013). Safe-water shortages, gender perspectives, and related challenges in developing countries: The case of Uganda. *Science of the Total Environment, 442*(C), 96-102.

Bassani, D., Jha, P., Dhingra, N., & Kumar, R. (2010). Child Mortality from Solid-Fuel Use in India: A Nationally Representative Case-Control Study. *BMC Public Health, 10*(1), 1-9.

Bawakyillenuo, S., Crentsil, A., Agbelie, I., Danquah, S. B.-D., & Menyeh, B. (2021). *The landscape of energy for cooking in Ghana:A Review.* UKAID, MECS Intention for Change. MECS, UKAID.

Becker, G. (1965). A Theory of the Allocation of Time. *The Economic Journal, 755*(299), 493-517.

Choudhuri, P., & Desai, S. (2021, September). Lack of access to clean fuel and piped water and children's educatonal outcomes in rural India. *World Development*(145), 105535.

Bofah, R. O., Appiah-Konadu, P., & Nnaemeka, P. N. (2022, February). Transition to cleaner cooking enery in Ghana. *Clean Energy, 6*(1), 193-201.

Cundale, K., Thomas, R., Malava, J., Havens, D., Mortimer, K., & Conteh, L. (2017). A Health Intervention or Kitchen Applicance? Household Costs and Benefits of a Cleaner Burning Biomass-fuelled Cookstove in Malawi. *Soc. Sci. Med, 183*, 1-10. doi:https://doi.org/10.1016/j.socscimed.2017.04.017

Fry, L., Cowden, J., Watkins, D. J., Clasen, T., & Mihlecic, J. (2010). Quantifying Health Improvements from Water Quantity Enhancement: An Engineering Perspecitve Applied to Rainwater Harvesting in West Africa. *Environ Sci Technol, 44*, 9535-9541. doi:10.1021/es100798j

Geere, J., Hunter, P., & Jagals, P. (2010). Domestic Water Carrying and Its Implication for Health: A Review and Mixed Methods Pilot Study in Limpopo Province, South Africa. *Environ Health, 9*(52). doi:10.1186/1476-069X-9-52

Geere, J., Bartram, J., Bates, L., Danquah, L., Evans, B., Fisher, M. B., . . . al, e. (2018). Carrying Water May be a Major Contributor to Disability from Musculoskeletal Disorders in Low-Income Countries: A Cross-Sectional Survey in South Africa, Ghana and Vietnam. *Journal of Global Health, 8* (1), 010406. doi:doi: 10.7189/jogh.08.010406

Goodin, R. E., Rice, J. M., Bittman, M., & Saunders, P. (2005). The Time-Pressue Illusion: Discretionary Time vs. Free Time. *Social Indicators Res, 73*, 43-70. doi:https://doi.org/10.1007/s11205-004-4642-9

Graham, J., Hirai, M., & Kim, S. (2016). An Analysis of Water Collection Labour Among Women and Children in 24 Sub-Saharan African Countries. *PloS One, 11*(6), e0155981. doi:https://doi.org/10.1371/journal.pone.0155981

Gwavuya, S. G., Abele, S., Barfuss, I., Zeller, M., & Muller, J. (2012). Household Energy Economics in Rural Ethiopia: A Cost-Benefit Analysis of Biogas Energy. *Renew. Energy, 48*, 202-209. doi:https://doi.org/10.1016/j.renene.2012.04.042

Harvey, A., & Mukhopadhyay, A. (2007). When Twenty-Four Hours in not Enough: Time Poverty of Working Partents. *Social Indicators Research, 82*, 57-77. doi:https://doi.org/10.1007/s11205-006-9002-5

Hyde, E., Greene, M., & Darmstadt, G. (2020). Time poverty: Obstacle to women's human rights, health and sustainable development. *Journal of Global Health, 10*(2).

International Energy Agency. (2009). *World energy outlook.* Paris:: OECD/IEA.

Karimu, A. (2015). Cooking fuel preferences among Ghanaian households: an empirical analysis. *Energy for Sustainable Development*(27), 10-17.

Kassouf, A. L., Tiberti, L., & Garcias, M. (2020). Evidence of the Impact of Children's Household Chores and Market Labour on Learning from School Census Data in Brazil. *Journal of Development Studies, 56*(11), 2097-2112. doi:10.1080/00220388.2020.1736284

Köhlin, G., E.O, S., S.K, P., & C, W. (2011). Gender and Development. *Policy Research Working Paper*, No. WPS 5800.

Koolwal, G., & van de Walle, D. (2013). Access to water, women's work and child outcomes. *Economic Development and Cultural Change, 61*, 369-405.

Levison, D., DeGraff, D., & Dungumaro, E. (2018). Implications of Environmental Chores ofr Schooling: Children's Time Fetching Water and Firewood in Tanzania. *The European Journal of Development Research, 30*(2), 217-234. doi:doi.org/10.1057/s41287-017-0079-2

Martey, E., Etwiere, P., & Koomson, I. (2022). Parental time poverty, child work and school attendance in Ghana. *Child Ind Res, 15*, 1489-1515.

Martey, E., Etwire, P., Atinga, D., & Yevu, M. (2021). Household energy choice for cooking among the time and consumption poor in Ghana. *Energy, 226*, 120408.

McGray, T. (2004). An Issue of Culture: The Effects of Daily Activities of Prenatal Care Utilization Patterns in Rural South Africa. *Social Sci Med, 59*, 1843-55. doi:10.1016/j.socscimed.2004.02.033

Montiel Olea, J., & Pflueger, C. (2013). A robust test for weak instruments. *Journal of Businesses and Economic Statistics*(31), 358-369.

Najam-us-Saqib, & Arif, G. (n.d.). Time Poverty, Work Status and Gender: The Case of Pakistan. *The Pakistan Development Review, 51*(1), 23-46. doi:http://www.jstor.org/stable/23733822

Pflueger, C., & Wang, S. (2015). A Robust Test for Weak Instruments in Stata. *The Stata Journal: Propmoting Communications on Statistics and Stata, 15*, 216-225.

Pickering, A., Davis, J., Walters, S., Horak, H., Keymer, D., Mushi, D., . . . Boehm, A. (2010). Hands, Water and Health: Fecal Contamination in Tanzanian Communities with Improved , Non-Networked Water Supplies. *Environmental Science and Technology*(44), 3267-3272.

Porter, G., Hampshire, K., Abane, A., Munhali, A., Robson, E., Mashiri, M., & al, e. (2012). Child Porterage and Africa's Transport Gap: Evidence from Ghana, Malawi and South Africa. *World Development, 40*, 2136-2154.

Ranji, I., Rosenzweig, C., & Gomez, I. S. (2018). *Overview: 2017 Kaiser Women's Health Survey.* KFF. Henry J. Kaiser Family Foundation.

Seymour, G., Malapit, H., & Quisumbing, A. (2017). *Measuring Time Use in Development Settings.* World Bank. doi:https://doi.org/10.1596/1813-9450-8147

Spears, D. (2012). Height and Cognitive Achievement Among Indian Children. *Economics and Human Biology, 10*(1), 210-219.

Stein, M., Crystal, S., Ananthanarayanan, A., Andersen, R., Turner, B. J., Zierler, S., . . . Schuster, M. (2000). Delays in Seeking HIV Care due to Competing Caregiver Responsibilities. *American Journal of Public Health, 90*(7), 1138-1140. doi:https://doi.org/10.2105/ajph.90.7.1138

Twumasi, M., Jiang, Y., Addai, B. A., Liu, D., & Ding, Z. (2021). Determinants of houssehold choice of cooking energy and the effect of clean cooking energy consumption on household members' health status: the case of rural Ghana. *Sustainable Production and Consumption, 28*, 484-495.

UNICEF. (2018). *Water, Sanitation and Hygiene.* Accra: UNICEF.

UNICEF. (2016, August 29). Retrieved July 2022, from https://www.unicef.org/press-releases/unicef-collecting-water-often-colossal-waste-time-women-and-girls

UNICEF. (2018). Retrieved from Water, Sanitaton and Hygiene: https://www.unicef.org/ghana/water

Vickery, C. (1977). The Time-Poor: A New Look at Poverty. *The Journal of Human Resources, 12*(1), 27-48. doi:doi:10.2307/145597

World Health Organisation. (2016). Burning Opportunity: Clean Household Energy for Health, Sustainable Development, and Wellbering of Women and Children. In W. Bank, *Family, Women's and Children's Health.* Geneva, Switzerland: (No. ISBN 978 92 4 156523 3, (NLM classification: WA 754)).

World Bank . (2020). *World Bank Indicators.* Retrieved from World Bank Indicators: https://data.worldbank.org/indicator/SH.H2O.SMDW.ZS?locations=GH.

Yeleliere, E., Cobbina, S., & Duwiejuah, A. (2018). Review of Ghana's water resources: the quality and managment with particular focus on reshewater resources. *Applied Water Sci, 8*(3), 1-12

Zacharias, A. (2011). *The Measurement of Time and Income Poverty.* Annandale-on-Hudson, NY: Levy Economics Institute of Bard College.