Determining the Health Cost of Inadequate Water, Sanitation and Hygiene in Pakistan

WaterAid

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Cover Photo:

Momal Abdul Qayyum, women's health visitor, sitting with her family. She says: "Unfortunately, now the canal's water supply is irregular, sometimes arriving every eighth day and other times after a fortnight. To make it suitable for use, villagers collect the water and filter it through cloth, as it tends to become muddy when the canal water levels decrease." Ameer Bakhsh Kalui village, District Badin, Pakistan. (September 2023)

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Abbreviations

2SD	Two standard deviations below the median of the reference population
CPI	Consumer Price Index
D.G. Khan	Dera Ghazi Khan
GOP	Government of Pakistan
HIES	Household Integrated Economic Survey
KPK	Khyber Pakhtunkhwa
MHM	Menstrual Hygiene Management
MICS	Multiple Indicators Cluster Survey
OD	Open defecation
OLS	Ordinary Least Squares
PCRWR	Pakistan Council of Research in Water Resources
PKR	Pakistani rupees
PSLM	Pakistan Social and Living Standards Measurement Survey
SDG	Sustainable Development Goals
UK	United Kingdom
UNICEF	United Nations Children's Fund
UTIs	Urinary Tract Infections
WASH	Water, sanitation, and hygiene
WHO	World Health Organisation
WSP	Water and Sanitation Program

Abstract

This study investigated the relationship between inadequate water, sanitation, hygiene (WASH), and health costs from the perspective of patients and their families. It calculates the costs of illness for the treatment of malaria, diarrhea, and typhoid; presents estimates of annual household expenditure on WASH services and the cost of accessing open defecation (OD) sites and shared toilets; provides correlations between WASH spending and cost of illness; and studies the health profiles of selected districts of Punjab and Sindh with a focus on selected diseases and childhood malnutrition. The analysis is based on the data from the Household Integrated Economic Survey (HIES) 2018-19. It employs a disease prevalence-based approach to calculate the cost of illness, and the human capital method, which measures productivity loss due to illness using the market value of a patient's contribution to present production. The results suggest that the total cost of illness to affected households was PKR 116.13 billion in June 2019 prices (i.e., PKR 209.23 billion in March 2023 prices). Overall, the highest cost burden to households was due to malaria (PKR 57.72 billion), followed by typhoid (PKR 37.43) and diarrhea (PKR 20.99). The average total costs per episode of malaria, diarrhea, and typhoid was PKR 5688, PKR 1757, and PKR 7818, respectively. Households in Punjab paid a lion's share of the costs. The cost of illness was disproportionately borne by the poorest income quintile, who paid 9.4% of their household income, compared to 3.1% borne by the richest income quintile. The lack of toilets in dwellings results in 53.85 million people defecating in the open or using shared toilets, mostly in rural areas by consuming 3.5 million hours, which cost them annually PKR 215 billion in lost access time. Households spend on WASH services to gain improved access, which costs them PKR 168.3 billion. Households in Sindh and Balochistan are deprived because a large proportion of their population has no access to safe water or sanitation services. Owing to the significant gap in access to WASH services, lower-income households are the most vulnerable. We also raised the question of whether increased household spending on WASH means that households are better protected from these diseases. Multivariate analysis showed that increased household spending on sanitation lowers the cost of diarrhea; however, other WASH spending had no statistically significant correlation with the cost of illness. The study also examined the case profile of WASH diseases in selected districts of Punjab, and the status of stunting, wasting, and underweight children in Punjab and Sindh. In recent years, childhood malnutrition rates in Punjab have declined significantly; however, the same rates in Sindh have either increased or remained constant. There are wide disparities in malnutrition rates by district in both provinces. Policymakers have latitude in designing adequate intervention strategies to mitigate health expenditures on households.

Executive Summary

This report examines the relationship between inadequate water, sanitation, and hygiene (WASH), and health costs to households in Pakistan. It calculates the cost of illness to the households for the treatment of malaria, diarrhea, and typhoid; presents estimates of annual household expenditure of WASH services and the cost of accessing open defecation (OD) sites and shared toilets; provides an analysis of correlations between WASH spending and cost of illness; and provides the health profiles of selected districts of Punjab and Sindh with a focus on the case profile of selected diseases and the trends of childhood malnutrition in the two provinces.

Pakistan has made significant progress in improving access to WASH services. However, more than 21 million people still have no access to basic drinking water, 69 million do not have access to basic sanitation, and 42 million do not have access to basic hygiene facilities. Pakistan has yet to attain basic-level WASH services. A higher goal of safely managed water and sanitation offers greater benefits and time savings than the basic WASH.

This report calculates the cost of malaria, diarrhea, and typhoid from the perspective of households to determine the economic burden of inadequate WASH. It classifies health costs into direct and indirect costs, and measures indirect costs using the human capital method, which measures productivity loss due to illness using the market value of a patient's contribution to present production. The analysis is conducted using a disease prevalence-based approach using retrospective quarterly data from the Household Integrated Economic Survey (HIES) 2018-19 [1]. The key findings of this report are summarized below.

Annual Cost of Illness to the Affected Households

The health cost of inadequate WASH to the affected households in Pakistan was PKR 116.13 billion in June 2019 prices (i.e., PKR 209.23 billion in March 2023 prices). Of the total cost, 53.1% was the direct cost of healthcare and 46.9% was accounted for by productivity loss due to absence from work, school, and caregiving. Overall, the highest cost burden to households was due to malaria, followed by typhoid and diarrhea at 50%, 32.2%, and 17.8%, respectively. Households in Punjab paid a lion's share of the cost as their health costs accounted for 58.2% of the total, whereas households in Sindh shared only 20.7% of the cost. This highlights the need for interventions aimed at preventing the incidence of diseases caused by WASH inadequacy in vulnerable districts. The provision of affordable healthcare and financial protection, together with WASH inclusion and integration into health system approaches, can mitigate the negative impact of illnesses on the economic well-being of households.

Average Cost Per Episode of Malaria, Diarrhea, and Typhoid

The disaggregated results of the cost of illness revealed that the average total cost per episode of malaria, diarrhea, and typhoid fever in June 2019 prices were PKR 5688, PKR 1757, and PKR 7817, respectively (we could multiply these values and other 2018-19 values by 1.8017 to obtain the cost of illness per case for March 2023 prices). The higher cost per episode of typhoid fever reflected the more severe nature of the disease compared to malaria and diarrhea; however, the number of cases of malaria was far greater than that of typhoid fever. The average total cost of malaria to households in the reference period (i.e., one quarter) was PKR 6375, whereas the average total costs of diarrhea and typhoid fever were PKR 1866 and PKR 8160, respectively.

[1] HIES 2018-19 data covers the fiscal year from July 2018 to June 2019.

Health Burden Disproportionately Falls on Poor Households

The aggregate cost of malaria, diarrhea, and typhoid to households in the reference period was PKR 4905, which varies significantly across provinces. The average total cost ranged from PKR 5553 in Punjab to PKR 3171 in Sindh. The total health burden was equivalent to 6.5% of the household income in the reference period. The loss was disproportionately borne by the poorest and poor quintiles, who spent 9.4% and 7.4% of their household income, respectively, compared to the richest and richer quintiles, who spent 3.1% and 4.5% of their income, respectively. The results call for addressing disparities by improving access to affordable health care.

Open Defecation Incurs Huge Cost to Rural Households

Open defecation is directly linked to household spending on WASH services because a lack of adequate sanitation can force households to practice open defecation or use shared toilets. The lack of toilets in dwellings results in loss of time, convenience, and dignity, especially for women and girls. The results show that 53.82 million people in Pakistan (11.6%) either defecate in open or use shared toiles by spending 3.56 million hours accessing OD sites or shared toilets, of which 90% of the time was spent in rural areas. The annual economic cost to households for lost access time to OD sites was PKR 145.7 billion in June 2019, of which 96.5% of the cost was rural. In addition, the value of lost time due to shared toilets was PKR 69 billion (66% in rural and 34% in urban areas). The average cost of inadequate sanitation within dwellings was estimated at PKR 6441 per household (PKR 4372 for accessing OD sites and PKR 2069 for shared toilets).

Households that practice OD or use shared toilets may spend less on better hygiene owing to a lack of resources. Thus, spending on good sanitation and hygiene are closely related. This can lead to a vicious cycle in which poor sanitation and hygiene promote the spread of WASH disease and increase healthcare costs. OD is a major source of untreated fecal waste near human settlements, which increases the level of bacterial contamination that causes diarrhea.

Access to WASH Services is a Major Challenge

Lack of access to WASH services is a challenge for a large proportion of the Pakistani population, particularly in rural areas. Households invest in WASH services to gain improved access. Our estimates show that annually, households in Pakistan spent PKR 168.3 billion on WASH services in 2018-19 prices. Of these, 64% were spent on hygiene services, 19% on water, and 17% on sanitation services. Households in the selected districts of Sindh and Balochistan spent disproportionately more on WASH services, mainly because of a lack of public investment in water and sanitation infrastructure, which has made access to water and sanitation much more challenging than in other regions. Households spend time accessing piped water from public water-supply schemes, whereas many households also rely on private sources of water for their water needs, such as tube wells or boreholes. Some households also invest in water treatment technologies or bottled water to ensure that the water is safe for drinking. However, private water sources are expensive to maintain. While access to proper toilets and handwashing facilities is essential for preventing WASH-related diseases, many Pakistanis lack access to these services, which increases their risk of waterborne diseases.

Upper Income Households Spend Disproportionately More on WASH

An average household in Pakistan spent PKR 5048 per annum on WASH services in June 2019. Of these, 64% of the total spending was on hygiene services alone. Access to menstrual hygiene products and services is limited, particularly in

remote areas where women and girls often resort to using unsafe and unhygienic materials. Of the total spending on hygiene (PKR 3240), 27% was on menstrual hygiene management, 38% on domestic hygiene, and 35% on personal hygiene (hand washing).

We also found that households in the upper-income quintiles spent significantly more on WASH services than those in the lower-income quintiles. The average household in the highest income quintile spent 4.6 times more per quarter (PKR 9723) on WASH services than the households in the lowest income quintile (PKR 2109). Spending on WASH services monotonically increased from the lower-to the upper-income quintiles, which revealed a significant gap in access to basic WASH services, where the lower-income groups are the most vulnerable.

Correlation between WASH Spending and Cost of Illness

Households spend a meager amount of PKR 939 per annum on drinking water and PKR 869 per annum on sanitation services. Households in Balochistan and Sindh faced significant challenges in water and sanitation services, because a large proportion of their population had no access to safe water and sanitation facilities. It is more expensive for these households to maintain WASH services. As a result, they spend more on WASH services than households from other parts of the country.

The cost of illness is a complex issue, and understanding its determinants can help inform strategies to reduce the economic burden of the disease and to improve health outcomes. Holding other things constant, the cost of illness may be affected by expenditure on clean drinking water, better sanitation, and hygiene. Multivariate analysis showed that increased household spending on sanitation lowers the cost of diarrhea; however, other WASH spending had no statistically significant correlation with the cost of illness. The results indicate that every PKR 1000 increase in household spending on sanitation lowered the total illness cost of diarrhea by PKR 159. Moreover, the average age of the patients, education of the head, and days of illness positively affected the total cost of malaria, diarrhea, and typhoid. Household income status positively affected the total illness cost of malaria and typhoid; however, household size and households located in rural areas negatively affected the cost of malaria illness. The cost of diarrhea also increased with the incidence of illness but did not vary by income group. Finally, the incidence of typhoid negatively affected the total and direct costs.

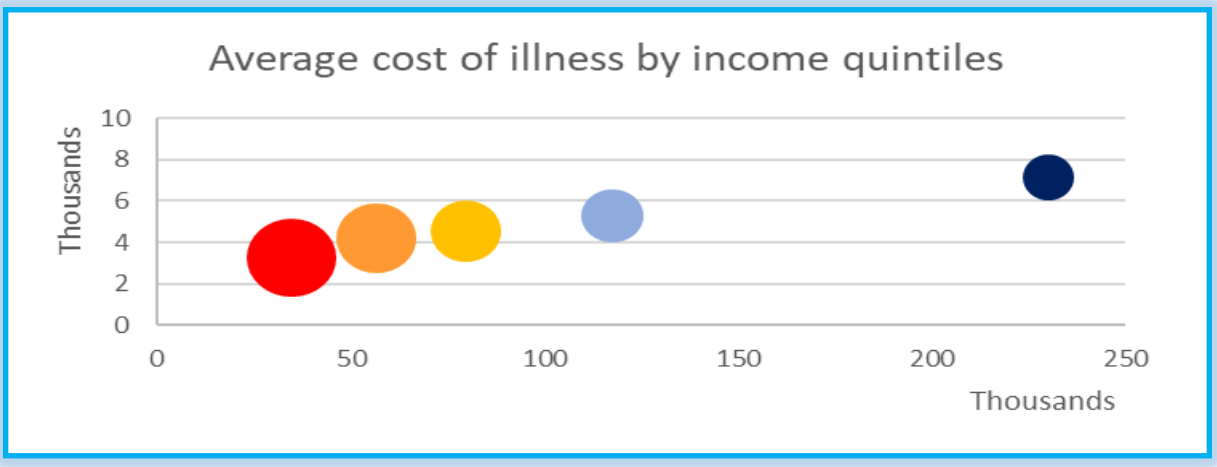
Case Profile of WASH Diseases in Selected Districts of Punjab

The case profiles of ten selected districts of Punjab show that Muzaffargarh, Rajanpur, Bahawalnagar, and Bahawalpur were some of the most affected districts in the province, as they had the highest number of cases of malaria and diarrhea. Multan, Muzaffargarh, Rajanpur, and Bahawalnagar districts had the highest reported cases of typhoid, while Multan, Muzaffargarh, Bahawalpur, and Khushab districts led in the case profile of urinary tract infections. These districts must make significant investments in water and sanitation facilities, promotion of good hygiene practices, and health education at the grassroots level to mitigate the negative consequences of WASH disease.

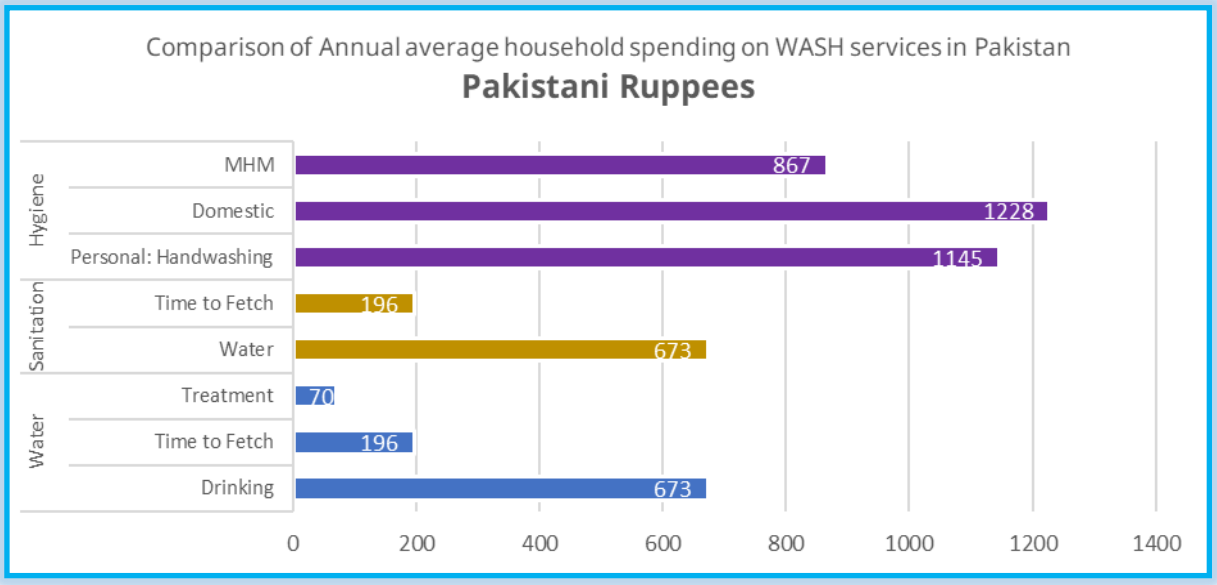
Nutritional Status of Children Under-Five in Punjab and Sindh

Data from the Multiple Indicators Cluster Survey (MICS) 2017-18 of Punjab show that there has been a remarkable decline in stunting, underweight, and wasting rates in children under five years of age in Punjab during the last few years. The latest survey data suggests that every third child is stunted, every fifth child is underweight, and every thirteenth child is wasted. Between 2007 and 2018, the stunting rates in Punjab declined by 10-percentage point from 42% in 2007 to 31.5% in 2018. However, the rates increased in some

selected districts, including Multan, Lodhran, Chiniot, and Bahawalpur but remained stagnant in Bahawalnagar, Khushab, and Rajanpur. The highest incidence of underweight children was observed in



Rajanpur and D.G. Khan. The wasting rate halved between 2014 and 2018. Similarly, Sindh MICS data suggested that the stunting rates were 18-percentage points higher than those in Punjab. Likewise, 41% of the children in Sindh were underweight and 15% were wasted. The rates in Sindh were almost double those in Punjab and there were no signs of improvement. The stunting rates increased in Sujawal, Tando



WASH and Health at a Glance

- In 2018-19, WASH-related illnesses led to 32 million lost days and a burden of PKR 116.13 billion (PKR 209.23 billion in March 2023 prices).
- The average cost of illness per episode of malaria, diarrhea, and typhoid was PKR 5,688, PKR 1,757, and PKR 7,817 in 2018-19 prices.
- The health burden (per annum) to households by disease type was PKR 25,500, PKR 7,464, and PKR 32,640 for malaria, diarrhea, and typhoid, respectively.
- The cost of illness is disproportionately borne by the poorest and poorer income quintiles.
- Increased household spending on sanitation can lower the cost of diarrhea.
- Households in Pakistan spend PKR 168.3 billion on WASH services in 2018-19 prices, with most spending on hygiene services.

Introduction

Momal Abdul Qayyum, women's health visitor, filtering water through a cloth, Ameer Bakhsh Kalui village, District Badin, Pakistan. (September 2023)

Clean water and adequate sanitation and hygiene (WASH) are essential for combating many diseases in countries such as Pakistan. This is necessary for the normal functioning of any household or community. Inaccessibility to clean water and adequate sanitation can cause diseases such as malaria, diarrhea, dysentery, typhoid, cholera, hepatitis A, dengue fever, urinary tract infections (UTIs), among others [2]. These diseases lead to the loss of schooldays in children and loss of productivity in adults, which incurs a high cost of illness. The lack of adequate sanitation facilities for girls reaching puberty makes them more likely to miss school than boys, causing a gap in their education.

UNICEF estimates that approximately 40 million people in Pakistan are forced to practice open defecation (OD) and most live in rural areas [3]. OD causes environmental pollution through water contamination (Mara, 2017). OD has many adverse effects, including a) acute effects such as infectious intestinal diseases, and b) chronic effects such as soil-transmitted helminthiases, small intestinal bacterial overgrowth, and stunting (Mara, 2017). Among the acute effects of OD, diarrhea is the most prominent and worsens with poor water quality and hygiene. Inadequate hygiene practices are also rampant. Handwashing with soap is an important element of good hygiene practices. Estimates show that three billion people worldwide do not have access to basic soap and water facilities, and more than half of the world still lacks basic sanitation facilities [4].

Pakistan has a population of 230 million and is projected to increase by more than 2.9% annually (GoP, 2022). This means that approximately four million people will need access to clean water, sanitation, and hygiene. Pakistan has made progress in improving access to water, sanitation, and hygiene (WASH). According to a recent WHO/

Momal Abdul Qayyum, women's health visitor, with a glass of water from the Jerks Canal, Ameer Bakhsh Kalui village, District Badin, Pakistan. (September 2023)

2. Malaria and dengue fever are attributed to inadequate sanitation facilities and standing rainwater near human settlements, which lead to the growth of mosquitoes of specific species.
3. Lack of Toilets Among Leading Causes of Child Deaths, Says UNICEF on World Toilet Day | UNICEF USA
4. Handwashing | UNICEF
5. For a review of literature on the impact of water pollution on public health in Pakistan, see Azizullah et al. (2011).

UNICEF Joint Monitoring Program report (2020), 90% of Pakistan's population has access to basic water, 68% has access to basic sanitation, and 80% has access to basic hygiene facilities. More than 21 million Pakistanis do not have access to basic drinking water, approximately 69 million do not have access to basic sanitation, and 42 million do not have access to basic hygiene facilities [5]. Thus, Pakistan has yet to attain basic-level services that must be achieved before embarking on higher goals of safely managed water and sanitation, which can provide greater health benefits and time savings than basic WASH. Moreover, Pakistan is off-track in achieving its targets under the Sustainable Development Goals (SDG) 6 (6.1.1 and 6.2.1), which essentially relate to safely managed water and sanitation.

The benefits of safely managed water services can be realized along with safe sanitation and good hygiene. Without WASH, well-being, dignity, and opportunities might be severely compromised, especially for underprivileged groups, such as women and girls. The lack of adequate WASH facilities negatively impacts human health because infectious diseases can easily spread due to unsafe water, improper disposal of human waste, and inadequate hygiene services, which have devastating effects on higher infant mortality rates, stunting, and wasting of under-five children, and other chronic illnesses in the public. For example, a recent World Bank report argued that a decline in poverty rates in Pakistan has not been associated with an improvement in diarrhea and stunting rates in children under five years (World Bank, 2018). The report highlights the following: 1) there are large urban-rural gaps in access to WASH because pip water and sanitation facilities are not provided in rural areas; 2) there is a high positive correlation between poverty and water and sanitation infrastructure at the district level; and 3) improved access to sanitation facilities has overlooked fecal waste management because a reduction in OD rates has not translated into improvements in child health (World Bank, 2018).

At the household level, insufficient focus and investment in WASH services has resulted in a higher incidence of water-borne diseases. Some estimates suggest that 27,000 children lose their lives every year because of waterborne disease [7]. Lack of water, sanitation, and hygiene are major causes of chronic and acute malnutrition in Pakistan. According to the Pakistan National Conservation Strategy, water-related diseases account for 40% of all communicable diseases in Pakistan. The quality of drinking water is poorly managed in Pakistan, and water pollution is a major threat to public health, with Pakistan ranking 80 among 122 countries in terms of drinking water quality (Azizullah et al., 2011) [8]. There are vast disparities in access to sanitation between the urban and rural populations, across income quintiles, and between districts.

A major weakness in most WASH sectors in Pakistan is that, due to a lack of fiscal space, there are inadequate funds available to improve the WASH infrastructure. Increased public allocations are not only insufficient; they are frequently not converted into actual spending due to complicated financial management systems and a lack of capacity to utilize funds in a timely manner. Inadequate water, poor sanitation, and poor hygiene practices can result in significant public health costs for households, firms, governments, and societies. Public health costs include premature deaths, direct and indirect costs of illness, and investments to mitigate the disease burden on households. The study of the cost of illness is an essential evaluation technique that provides decision-makers with information on the health costs of a disease, which is critical in setting priorities for healthcare policies and interventions. However, the cost of the illness provides only one part of the picture. Other costs are incurred by households, firms, and governments to mitigate the burden of the disease on society. We also need to know the costs of intervention to reduce the costs of inaction and the costs incurred by

6. https://www.aboutpakistan.com/news/27000-children-die-of-waterborne-diseases/
7. Surface and groundwater sources are contaminated with coliforms, toxic metals, and pesticides (Azizullah et al., 2011).

households, firms, and governments to mitigate the burden of disease on society.

Policymakers and other stakeholders in Pakistan need nationally representative information on the cost of illness imposed by WASH diseases. Such an analysis can be carried out from a variety of perspectives, including society, government, healthcare systems, and patients and their families, also termed the household perspective (Jo, 2014).

The first nationally representative study on the economic impacts of inadequate sanitation in Pakistan used 2006 data to measure costs from a broader societal perspective, which came to PKR 343.7 billion (World Bank, 2010). Other existing studies were conducted from a household perspective using inpatient and outpatient clinical, hospital, or public health data as well as assumptions about the valuation of lost productivity and fever severity. Although malaria, diarrhea, and typhoid are the most prevalent diseases in Pakistan, little is known about nationally representative estimates of the costs of malaria, diarrhea, and typhoid fever from the perspective of patients and their families (World Bank, 2010).

For example, Mejia et al. (2020) estimated the cost of typhoid and paratyphoid illness by taking data of 1029 patients from four hospitals in urban areas of Karachi, from enrollment to 6 weeks later. The included patients had confirmed enteric fever, as verified by blood cultures. They found that the median direct medical and non-medical costs per case were PKR 23,840 (US $ 196.37) in 2018, which was 8.2% of the annual labor income of the patients. Based on these numbers, the authors argued that enteric fever could impose a substantial economic burden on the country, which warrants prevention and control, including administration of typhoid conjugate vaccines.

Poulos et al. (2011) study community-based estimates of public and private cost in five Asian countries, including estimates based on data of Karachi, Pakistan. To measure the cost of illness, culture-proven families were surveyed after the first, second, and twelfth weeks after the illness. They used 327 episodes of typhoid fever to compute the private cost of illness for 233 children (of which a sample of 99 children was drawn from Karachi) and 94 adults (of which no adults were drawn from Karachi). On average, illness among children and adults lasted between 14 and 21 days for adults, and between 13 and 17 days for children. The paper also reports the private cost of typhoid fever to households in Karachi (with confirmed cases of typhoid fever in children aged < 18 years), which is US$ 53 per case. However, the year of the survey was not reported, therefore, it was not possible to compute the cost in the local currency. The study also found that lost workdays due to typhoid accounted for 25 – 30% of sick days for adults and children in Kolkata and 50–60% of sick days for adults and children in Jakarta.

Khan et al. (2019) investigated the economic burden of malaria in Pakistan, in the context of prevention and treatment. They collected data in October 2015 from a randomly selected sample of 360 households, using a three-month reference period. Their estimates show that the average per-person cost of malaria fever was PKR 3116 in 2015-16 prices (US$ 32), which is about 6.7% of the monthly household income. Their results also suggest that upper-income households spend higher amounts of money on effective prevention and mitigation measures. Other cost of illness studies in Pakistan have focused on diseases other than WASH [8].

This study has four objectives. First, it calculates the cost of illness to households for the treatment of malaria, diarrhea, and typhoid from the perspective of households in Pakistan, with the aim of providing estimates of the economic burden. Second, it presents the household cost of accessing OD sites and shared toilets, estimates average annual

[8] Other recent studies that have also calculated the cost of illness for Pakistani households include studies on Type-2 diabetes mellitus (Khowaja et al., 2007; Butt et al., 2022), mental illnesses (Malik et al., 2017), and non-communicable chronic diseases (Saba, 2016). Saba (2016) applied a prevalence-based approach to measure the cost of illness in the working-age population by employing household survey data from the Pakistan Panel Household Survey (PPHS) conducted in 2010. The survey collected data from 16 districts of Pakistan, but it did not cover an urban sample or allow the calculation of health costs at the national level.

household expenditure on WASH services, and provides projected annual expenditure on WASH services by region. Third, it investigates whether increased household spending on WASH services better protects them from malaria, diarrhea, and typhoid and what other factors affect the household cost of illness. Finally, it provides the health profile of selected districts of Punjab and Sindh by presenting the case profile of major WASH diseases and explores the trends of childhood malnutrition in the two provinces.

This study differs from previous studies on the cost of illness in several respects. First, most previous household-based cost of illness studies collected data from outpatient or inpatient clinics; however, this study was based on a large nationally representative household survey, which helped us generate nationally representative health costs for inadequate WASH facilities. Second, this study imputes disease days for patients from out-of-pocket expenses, because patient data on disease days are not reported . Finally, to evaluate productivity loss on disease days, most studies have applied estimates of average wages that vary by age-gender-specific wage rates or minimum wage rates, which can lead to significant variations in indirect costs.

To avoid potential discrepancies in valuation, we introduced a wage-regression-based measure to predict the opportunity cost of time loss for patients and caregivers. This novel approach is grounded in the empirical literature on labor economics.

Fouzia, using the Hand Washing station at the newly constructed Girls and Women Friendly Toilet at Government Girls High School Makli. (May 2023)

Methodology

2.1—Study Design and Settings

This study adopts household orientation to analyze the cost of illness and spending on WASH services. No attempt has been made to incorporate the cost of illness into the government or society. A retrospective study design was carried out to measure the health costs of inadequate WASH based on a prevalence-based approach, comprising the analysis of data in the reference period of one quarter, obtained from the Household Integrated Economic Survey (HIES) 2018 -19. Household weights were applied to the household's cost of illness measures in the reference period of three months and household expenditure investments on WASH services in the reference period of the same reference period to generate health cost measures at the national and provincial levels. In this study, WASH-related diseases included malaria, diarrhea, and typhoid because data on other WASH-related diseases, such as cholera and urinary tract infections, were not available in HIES 2018-19. Some complicated cases of typhoid disease may have been excluded from the sample, such as the extra-drug-resistant form (XDR), but no observation was dropped from the sample by the authors.

The cost of illness study distinguishes between direct, indirect, and intangible costs, such as the decline in quality of life and psychological suffering of loved ones (Choi and Lee, 2019). Because intangibles can hardly be quantified due to measurement issues and related controversies, they are seldom quantified in cost of illness studies

healthcare costs in the form of out-of-pocket payments. Healthcare costs include doctor fees, medicine and medical supplies, and hospitalizations. Non-healthcare costs included transportation, food, and caregivers' direct costs. Out-of-pocket spending on healthcare and non-healthcare costs was reported in HIES 2018-19 for each patient in the household.

The indirect cost represents productivity/income losses at work or at home due to disease and are borne by the patient, their families, or employers. Other indirect costs of disease may include the waste of healthy time due to discomfort, anguish,

Rubina, washing clothes, is full term pregnant and has been living in tent with her husband and four children at a roadside camp in Johi Tehsil, District Dadu, Sindh, Pakistan. (October 2022)

9. The human capital method measures losses in productivity due to illness by using the market value of patient's contribution to present or future production. A major criticism of this method is that it can overestimate foregone production by assuming that workers cannot be replaced even when the unemployment rate is high (Jo, 2014).
10. The friction cost method is designed to calculate indirect costs by assuming that a sick person can be replaced by an unemployed pool until the sick person returns to his/her job. This method argues that there is no loss of productivity during the friction period. This method has become controversial because episodes of disease and premature mortality help to reduce total unemployment (Jo, 2014).
11. Using extensive surveys to obtain individual/household preferences, the willingness-to-pay method elicits an individual's willingness to pay to reduce the probability of illness. However, such surveys are time-consuming and costly to implement (Jo 2014).

and pain resulting from the disease (Jo, 2014). The indirect cost can be measured through one of three methods: the human capital method [9], friction cost method [10], or willingness to pay [11] method (see Jo, 2014; Choi and Lee, 2019). We opt for the human capital method, which is the most used method in cost of illness studies (see, Chima et al., 2003, Sarker et al., 2013, Afroz et al., 2018, Singh et al., 2019, Khan et al., 2019, Butt et al., 2022, etc.).

The health costs can be calculated from a variety of perspectives, viz., "society, healthcare system, third-party payers, business sectors, the government, and the participants and their families" (Jo, 2014). Each perspective involves different types of cost items that can lead to different results for the same illness. However, in this study, the health costs of inadequate WASH were based on the perspectives of the patients and their families or households . The cost of illness includes direct healthcare and non-healthcare and morbidity costs, such as productivity/income loss of patients, loss of schooling and workdays of children, and caregiving costs). The premature mortality of children and adults due to the disease is also important from the perspective of cost of illness to the households, but this cost has been ignored because of the lack of reliable data on child and adult mortalities associated with diseases.

2.2—Source of Data

To compute the household cost of illness of selected WASH diseases and their expenditure on water, sanitation, and hygiene, we used data from HIES 2018-19, conducted by the Pakistan Bureau of Statistics. HIES 2018-19 has included a permanent section consisting of a dedicated questionnaire for the measurement of out-of-pocket health expenditure. The same data were used by the National Health Accounts of Pakistan to measure private out-of-pocket health expenditure by type of illness.

Micro records of household data were used to gauge the magnitude of the cost of illness and expenditure investment in WASH services. We did not choose district representative survey data from the Pakistan Social and Living Standards Measurement Survey (PSLM) 2019-20 because it does not collect data on the out-of-pocket cost of disease and injury required to measure the cost of illness for the patients [12].

The sampling frame of HIES 2018-19 was updated through the Population Census 2017 to draw a random sample consisting of 163,663 enumeration blocks from four provinces: Punjab, Sindh, Khyber Pakhtunkhwa (KPK), and Balochistan. The universe comprises all the urban and rural areas of the four provinces, excluding FATA and military-restricted areas, representing approximately 2% of the total population.

Each enumeration block contained 200 – 250 households. A stratified two-stage sample design was adopted for the survey, with urban and rural domains. The data consist of 24,809 households from the four provinces, which is expected to produce reliable results at the national, provincial, urban, and rural levels (GoP, 2020) [13]. The data provide important information on household characteristics, income, out-of-pocket health expenditure, health profiles of adults and children, spending on water, sanitation, and hygiene services, among others. The data are representative of the national, provincial, and urban/rural levels. This is the latest available data on out-of-pocket spending on diseases and injuries.

The survey captured illness episodes occurring in four quarters of the survey year. The wide variation in the availability of resources at household disposal in terms of cash and time might shape the response to illnesses. To capture seasonal variations, 20 households were selected from each PSU and the same PSUs were revisited for the survey in each quarter. In this way, five households

12. PSLM 2019-20 is the latest available household survey data that provides useful information on household characteristics, health profiles, and WASH services at the household level. The district representative survey data covers 195,000 households. However, these data were not used because they did not collect data on households' out-of-pocket health expenditures on disease and injury.

were interviewed in each quarter, who recorded illness episodes that had occurred during the reference period, which was specified as the last three months. Data were recorded for household members who had illnesses during the reference period. The data were collected over a three-month period.

The annual out-of-pocket health expenditure reported in the National Health Accounts Pakistan 2019-20 was also obtained from HIES 2018-19, by extrapolating with the consumer price index (CPI) of the health group. However, the indirect cost to households was not reported in the National Health Accounts report, which is a major contribution of this report .

2.3—Calculation of Illness Costs

Types of disease costs include: (1) direct cost, that is, out-of-pocket payments by the households for treatment of disease, and (2) indirect cost, that is, opportunity cost of time used by patients and caregivers during the illness days. The cost of illness for the households was calculated for a reference period of three months or a quarter. During this period, one or more episodes of illness were recorded in the affected households.

2.3.1—Direct Costs

The direct costs of the disease include healthcare and nonhealthcare costs. The healthcare cost consists of **out-of-pocket spending on doctors'** fees, medicines, medical supplies, diagnostic tests, medical durables, admission fees, hospitalization, etc. Non-healthcare costs include transport costs, caregiver (accompanying person) costs, and tips. Data on out-of-pocket costs of the disease are readily available from HIES 2018-19.

2.3.2—Indirect Costs

The indirect cost of illness covers the loss of working or leisure time for adults, children, and caregivers, which is measured by applying the human capital approach (see Jo, 2014; Choi and Lee, 2019, among others). Indirect costs include the productivity loss of economically active patients, productivity loss due to foregone non-market activities, schooling/workdays lost in children aged 5 – 15 years, and loss of productivity due to caregiving for adults and children aged < 16 years (Jo, 2014; Choi and Lee, 2019).

To measure productivity loss, we distinguished between severe disease days when patients were unable to work and mild disease days when they could work (WHO, 2005; Sultana et al., 2020) [14]. Data on days lost to school owing to severe illness were not reported in the HIES. To obtain the number of days lost to work, we used guidance from other studies to determine the number of days lost due to severe illness as 70% of the total number of disease days. Following Khan et al. (2019), we assumed that the number of workdays lost due to a malaria episode in Pakistan was 70% of the total days of illness for adults and children [16]. Diarrhea is often mild, lasting 1–2 days; however, chronic diarrhea can last for weeks. Following Sultana et al. (2021) and Rheingans et al. (2012), we assumed that the workdays lost due to diarrhea in adults and children were 40% of the disease days. We followed the evidence provided by Poulos et al. (2011) and assumed that the number of workdays lost for adults and children owing to typhoid fever was 50% of the total days of illness [16].

The HIES survey reported disease days for patients with malaria ranging from 1 to 15 days in all age groups. It also reports diarrheal disease days for under-five children, ranging from 1 to 5 days.

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[14] Attanayake et al. (2000) applied one day for mild illness in adults suffering from malarial morbidity and five days for severe illness while one-third of this time loss was applied to children.

[15] Khan et al. (2019) reported that, on average, a malaria episode in Pakistan persists for 3.47 days, and the workdays lost by adults were 2.94 days, which is 85% of the total number of days of illness.

[16] Poulos et al. (2011) found that on average, typhoid illness in five Asian countries lasted for 14 – 21 days for adults and 13 – 17 days for children; however, lost workdays varied across countries. For instance, lost workdays accounted for 25 – 30% of sick days in India and China, and 50 – 60% of sick days in Vietnam and Indonesia. To avoid overestimation, we assumed that the number of workdays lost due to typhoid fever was 50% of the total number of days of illness for both adults and children.

However, the survey did not report disease days for diarrhea among over five children and adults or the disease days among typhoid patients of all age groups. To mitigate data gaps, we impute missing disease days from the out-of-pocket costs of medicines and medical supplies reported in the HIES [17]. We assumed that the disease days for diarrhea in over five children and adults ranged from 1 to 10 days, and the disease days for typhoid fever ranged from 10 to 21 days .

For example, the UK National Health Society reported that typhoid fever lasts for 7 – 14 days after the initiation of antibiotic treatment [18]. However, it can take longer if complications or drug resistance is present. If at least two days are also consumed in diagnostics, no patient can have an illness duration of less than 9 days. Thus, the total duration of typhoid illness may range from 10 days to 21 days or longer.

The opportunity cost of the time lost due to illness is defined as the marginal product of labor (Chima et al., 2003). The productivity loss of economically active workers was measured by multiplying the number of days lost to disease by the actual wage rate reported in the HIES. The productivity loss of workers engaged in non-market activities, including the informal sector, household chores, childcare, and so on, is measured by the opportunity cost of days lost due to the disease [19, 20]. The productivity loss of children aged 5 – 15 years owing to missed schooldays was measured by multiplying the days lost by their opportunity cost. The HIES reports the wages of economically active adults and teenagers in the labor market. We use these wages to predict the wages of nonworking individuals. We measured the opportunity cost of time for patients and caregivers by predicting wages separately for male and female from the regression coefficients of an earnings function equation or wage regressions (see Psacharopoulos, 1987; Polachek, 2007; Heckman et al., 2008) [21]. This method provides a measure of wages that is superior to average wages. The productivity of children aged 5 – 9 years is taken as ½ of the average productivity of teenagers who are legally allowed to work [22].

The productivity loss of caregivers due to caregiving to adults and children was measured by multiplying caregiving days by the opportunity cost of caregivers [23]. Following other studies (e.g., Shepard et al., 1991; Chima et al., 2003; Sarker et al., 2013; Sultana et al., 2021), we assumed that caregivers spend one-third of their daily working

17. We conducted an experiment on the reported malaria disease days in the HIES, ranging from 1 to 15. This revealed that disease days were directly proportional to the out-of-pocket costs of medicines and medical supplies. We constructed 15 expenditure quintiles of out-of-pocket costs and collated each quintile with the corresponding disease days. Pearson's correlation coefficient between the imputed and reported days of malaria was positive and statistically significant at the 99% confidence level. We used the same method for patients' out-of-pocket costs of medicines and medical supplies to impute their disease days of diarrhea and typhoid.

18. See, www.nhs.uk

19. Other studies that have also included productivity loss from non-market activities in indirect costs include Sarker et al. (2013), Sultana et al. (2021) and Butt et al. (2022).

20. The methods used to measure the value of time lost to illness can lead to significant variations in the estimation of indirect costs (Attanayake et al., 2000). Most studies have applied estimates of average wage, varied by age-gender-specific wage rates or minimum wage rates (see Attanayake et al., 2000; Chima et al., 2000; Choi and Lee, 2019; Butt et al., 2022). Others have also used the mean per capita annual household income, or average household production to value loss of time (Riewpaiboon et al., 2014; Attanayake et al., 2000). WSP (2011) has valued the loss of time for adults engaged in non-market activities in India at 50% of the rate for adults engaged in market work.

21. We predicted the wages of all economically active workers in HIES (all workers, not just patients) using the Ordinary Least Squares (OLS) regression method separately for male and female workers. We regressed log wage (ln wage) on workers' age, age squared, and dummy variables for completed years of education, gender, region, and province. The wages of those who were not working were predicted using the estimated coefficients of employed workers and human capital endowments of workers who were not working.

22. Cropper et al. (1999) has assumed daily productivity of a teenager as ½ of an adult's productivity, while that of a child as ¼ of an adult. These arbitrary proxies for the opportunity cost of the time lost, based on average wage or average household production, can hardly be justified, as they do not vary across workers to account for their human capital endowments, including age, experience, education, gender, region, and industry of work.

23. During severe illness, patients require caregiving at home, to visit a doctor, clinic, hospital, pharmacy, and so on. In Pakistan, immediate family members, friends, and relatives often provide caregiving.

hours on caregiving. Thus, one-third of the total days lost by patients are valued at the opportunity cost of caregivers, taken as the average wage of other adults in the household.

2.4—Household Expenditure on WASH Services

The scope of household expenditure on WASH services consists of spending on (1) water for drinking and cooking, (2) sanitation, and (3) hygiene. The expenditure on WASH service data was reported for a period of one year.

2.4.1—Water for drinking

Three types of water costs were considered: a) drinking and cooking water, b) time to fetch water from outside the dwellings, and c) water treatment/ filtration cost. Spending on water for drinking and cooking is directly reported in HIES 2018-19, viz., piped water, hand pump, motorized pump, tube well, and tanker/truck for water. The reported cost is calculated by separating out water for drinking and non-drinking uses and apportioning half the costs each for drinking and sanitation uses (WSP, 2011) . The bottled water cost was also directly obtained from the survey.

Some estimates suggest that 72% of household water is hauled by the females and the rest is hauled by men and children [24]. The time spent hauling water from a cleaner source was directly reported in the survey (in minutes); however, which member of the household hauled the water was not reported. To overcome this data gap, we determined the cost of fetching water from outside the dwellings (tap, hand pump, motorized pump, tube well, protected, or unprotected springs, ponds, canals, rivers, etc.) by assuming that water is hauled by female members (>15 years) of the household) . Their costs were calculated by multiplying the time spent by the average imputed wage of females in the household. In households where men and children (<16 years) also have hauled water, there may be some deviations in wages from the true values because men's wages are higher, and the time cost of children is lower than that of adult females.

The household-level treatment cost of drinking water with an electronic water filter was directly reported in HIES 2018-19. However, a small proportion of households have also reported using other water treatment methods, such as boiling water, straining through cloth, chlorine, bleach, ceramics, sand, or other water filters. A large part of their costs involves labor costs, while their material costs are insignificant . For simplicity, we assumed their cost to be half of the treatment cost of an electronic water filter. To account for cost variation by household size, one-half of the water filter cost per household member was multiplied by the household size of those using other water treatment methods .

2.4.2—Sanitation cost

The sanitation cost consists of a) water cost for sanitation, and b) time to fetch water for sanitation. The time cost of open defecation was also calculated but was reported separately from the sanitation cost. The water cost for sanitation is determined by separating out water for drinking and non-drinking uses, and by apportioning half the costs of drinking and sanitation (WSP, 2011) . Similarly, the valuation of the time taken to fetch water for sanitation is described above. Water for sanitation was used to operate flush systems within the dwellings.

The time cost of accessing open defecation sites and shared toilets was determined from the HIES 2018-19 data. The survey reports on households that defecate in the open or use shared toilets outside their own dwellings. However, the survey did not report the extra time spent accessing open defecation sites and shared toilets. WSP (2011) reported that 56% of the Indian population defecated in open spaces in 2006. An average individual spent 20 to 25 extra minutes per day to

[24] See, Opinion: Women bear the brunt of Pakistan's water crisis | The Third Pole.

access OD sites in rural areas and 15 extra minutes per day in urban areas and used five extra minutes per day to access public toilets. However, UNICEF (2018) presented valued time savings in India of having household toilets, but the background data indicate that having toilet facilities in the household versus open defecation saved closer to one hour per adult per day [25].

To avoid overestimation, this study assumes that households that practice OD spend 40 extra minutes per person per day to access OD sites and 15 extra minutes to access public toilets. The cost of extra time is determined by applying imputed wages for persons aged 5 – 15 years and 16 years and above, whereas zero cost is applied for children below the age of five years. Because the operating costs of the flush, pour flush, and pit latrine are trivial, they are included in other costs.

2.4.3—Hygiene cost

Household spending on hygiene is classified into personal hygiene (hand washing), domestic hygiene, and menstrual hygiene management (MHM). Personal hygiene costs consist of washing hands with water and soap. Data on the proportion of households observing hand washing with water and soap and the cost of soap for hand washing are directly reported in HIES 2018-19.

Domestic hygiene costs include the costs of insecticides, toilet cleaners, floor cleaning liquids, and other cleaning items such as mops, brooms, wipers, and sponges. Household-level data on the costs of these items were reported directly in the survey. Household spending on MHM consisted of spending on sanitary towels and cotton, which was obtained directly from the HIES 2018-19 Female questionnaire. Since the survey listed expenditures on pampers/sanitary towels/cotton/toilet paper roll/tissue paper as one category, household spending on MHM was assumed to depend on how many girls and women per household were menstruating. Household spending on MHM was assumed to be zero if there were no women or girls menstruating in the household, 50% if there was one woman or girl menstruating, 60% if there were two girls or women menstruating, 70% if there were three girls or women menstruating, and 80% if there were four or more women or girls menstruating in the household.

2.5—District Health Profiles

For the health profile, administrative data were obtained from the Director General Health of Punjab. Due to the paucity of data, the analysis was restricted to data for the latest available year. Because time-series data were not available, a trend analysis of the health profile was not possible. The nutritional profile of children under five years of age was based on the Multiple Indicators Cluster Survey (MICS) 2017-18 for Punjab and Sindh. Multiple rounds of MICS data were used to conduct a trend analysis of stunting, wasting, and underweight children in the two provinces.

Nazia, a teacher at Ghazali School also works as a social mobilizer conducts an awareness session for women in her community about WASH in Muzaffargarh District, Pakistan. (March 2022)

[25] We thank Guy Hutton for sharing the data.

Cost of Illness to households

This chapter presents the cost of illness to households during the reference period of three months. The households recorded one or more episodes of illness during the reference period. We observed that 12% of households had more than one individual with malaria, 6% had more than one individual with diarrhea, and 4% had more than one individual with typhoid. The analysis begins with the types of service providers and healthcare facilities accessed by patients. This is followed by a) the analysis of the household cost of illness by type of illness and b) the aggregate cost of illness by province, income group, age and sex, and annual cost of illness.

Table 1. Percentage of visits in the reference period by source of treatment

Service provider	Malaria (%)	Diarrhea (%)	Typhoid (%)
1. HEALTHCARE ACCESSED			
a. Inpatient care	8	3	11
b. Outpatient care	91	85	89
c. Self-medication/self- treatment	2	12	0
TOTAL	100	100	100
2. PUBLIC/PRIVATE FACILITIES			
2.1 Private Sector Facilities			
a. Private hospital	10.1	6.0	9.9
b. Private doctor's clinic	72.5	45.5	61.4
c. Homoeopathic/hakeem/ herbalist, etc.	0.3	2.0	0.4
d. Pharmacy/shops	1.9	20.6	0.7
e. Private laboratory	0.1	0.0	0.8
f. Other private provider	0.3	0.6	0.3
2.2. Public Sector Providers			
a. Govt. hospitals (THQ/DHQ, tertiary, teaching & specialized hospitals)	13.9	22.6	24.1
b. Dispensary/MCHS/BHU	0.9	1.5	1.5
c. LHV/LHW	0.0	1.1	0.1
d. Military Hospital	0.0	0.0	0.4
e. Autonomous bodies/Semi-govt hospital	0.0	0.1	0.3
TOTAL (2.1 + 2.2)	100	100	100

Source: Authors' calculations from HIES 2018-19.

3.1—Patient's Health-seeking Behavior from Private and Public Facilities

A vast majority of patients in Pakistan access outpatient healthcare, viz., 91% of patients with malaria, 85% with diarrhea, and 89% with typhoid (Table 1). In-patient care was used by 11% of patients with typhoid, 8% with malaria, and 3% with diarrhea. Self-medication rates were highest for diarrhea patients (12%), followed by malaria patients (2%).

Among those who used outpatient care, 73% had malaria, 61% had typhoid, and 46% had visited a private doctor's clinic. Much fewer patients visit private hospitals for healthcare, that is, 10% of patients with malaria and typhoid, and 6% of diarrhea. Government hospitals are not popular in accessing health care. The reasons for visiting private doctors were long waiting times at public hospitals, lack of services after working hours at public sector facilities, and better attention at private doctors' clinics.

Fatima, 13, washing her hands at the school's outdoor washing facilities in Lahore, Pakistan. (March 2020)

3.2—Cost of Illness in the reference period by Type of Illness

3.2.1—Direct cost

The direct cost to households refers to the amount of money spent on the treatment or management of illnesses. As shown in Table 2, direct costs fall into two subcategories: (1) direct healthcare costs and (2) direct nonhealthcare costs. Direct healthcare costs are incurred to mitigate the disease, which include the cost of doctors' fees, medicines, medical supplies, diagnostic tests, hospitalization, and medical durables. Direct non-healthcare costs refer to expenses paid by households to visit and use medical facilities, such as costs incurred on transport, food, tips, and caregivers' direct costs.

Table 2 shows that the direct cost represents 47% of the average total cost of malaria (PKR 2992), 68% of diarrhea (PKR 1260), and 46% of typhoid (PKR 3775), of which more than 77% of the costs are direct healthcare costs and the rest are non-healthcare costs. The cost of medication, doctor fees, and diagnostic tests are the key contributors to direct healthcare costs. Moreover, transportation and other costs account for a high share of non-healthcare costs.

Table 3 reveals that a similar picture emerges from the four provinces, where the direct cost represents 48% of the average total cost in Punjab (PKR 2672), 57% in Sindh (PKR 1912), 52% in Khyber Pakhtunkhwa (PKR 3017), and 49% in Balochistan (PKR 1565). Of these, direct healthcare costs are highest in Punjab and Khyber Pakhtunkhwa at more than 80% of the direct cost, followed by 73% to 75% of direct healthcare costs in Sindh and Balochistan.

3.2.2—Indirect cost

One of the key determinants of the cost of malaria,

Table 2. Average cost of illness to households in the reference period, by type of illness (PKR)

PATIENT AND CAREGIVER COST	MALARIA	DIARRHOEA	TYPHOID
1. DIRECT COST	2992	1260	3775
1.1. Direct healthcare cost	2349	968	3103
a. Admission fee	53	7	29
b. Doctor's fee	491	168	473
c. Medicine/vaccine	1440	712	1937
d. medical supplies	87	21	92
e. Diagnostic tests	265	51	496
f. Hospitalization	6	8	65
g. medical durables	7	--	10
1.2. Direct non-healthcare cost	643	292	672
a. Transport	261	94	313
b. Food	43	36	82
c. Tips	1	1	5
d. Caregivers direct cost	7	7	45
e. Other	332	154	227
2. INDIRECT COST	3383	606	4385
a. Productivity loss of economically active patients	1652	282	1933
b. Productivity loss of patients in non-market activities	753	111	1172
c. Schooldays lost of children aged 5 – 15 years	87	8	82
d. Income loss due to caregiving to adults	716	110	965
e. Income loss due to caregiving to children	174	95	232
3. TOTAL COST OF ILLNESS (1 + 2)	6375	1866	8160
4. TOTAL COST OF ILLNESS PER EPISODE	5688	1757	7817

Source: Author's calculations from HIES 2018-19.

diarrhea, and typhoid diseases is the indirect cost due to productivity loss of adults, schooldays lost of children, and caregivers. The indirect costs of malaria, diarrhea, and typhoid to households in Pakistan were PKR 3383, PKR 1674, and PKR 4076, respectively. Indirect costs represent between 50% and 57% of the average total costs. The average productivity loss of economically active adults is relatively higher than that of other components of indirect cost, which is followed by the productivity loss of adults in non-market activities. The average indirect cost borne by households owing to caregiving was also significant (28%). However, the monetization of schooldays lost in children aged 5–15 years accounted for less than 4% of the indirect cost.

A similar pattern was observed across all four provinces. Table 3 presents an aggregate picture, which shows that indirect costs are highest in Khyber Pakhtunkhwa and Punjab, while indirect costs in Sindh and Balochistan are approximately 50% of the cost in Punjab and Khyber Pakhtunkhwa.

3.2.3—Total cost

Direct and indirect costs were added to obtain the total cost of illness for the households (Table 2). The average total cost of malaria is PKR 6375, of which PKR 2992 for the direct cost is mainly shared by the cost of medicine (PKR 1440), doctor's fee (PKR 491), and diagnostic tests (PKR 265), while PKR 3383 is for the indirect cost, which is chiefly due to the productivity loss of economically active patients. The average total cost of diarrhea is PKR 1866, which consists of direct cost of PKR 1260, shared by medicine cost (PKR 712), and doctor's fee (PKR 168).

Table 3. Aggregate cost of illness in the reference period (PKR)

PATIENT AND CAREGIVER COST	PUNJAB	SINDH	KHYBER PAKHTUNKHWA	BALOCHISTAN	PAKISTAN
1. DIRECT COST	**2672**	**1912**	**3017**	**1565**	**2470**
1.1. Healthcare cost	2159	1392	2456	1176	1956
1.2. Non-healthcare cost	513	520	560	389	514
2. INDIRECT COST	**3424**	**1702**	**3262**	**1706**	**2872**
a. Productivity loss of economically active patients	2905	1435	3006	1585	2485
b. Productivity loss of patients in non-market activities	2080	990	1718	876	1720
c. Schooldays lost of children 5 – 15 years	753	993	723	1076	867
d. Income loss due to caregiving to adults	796	398	757	423	679
e. Income loss due to caregiving to children	536	527	671	564	554
3. COST OF ILLNESS (1 + 2)	**5553**	**3371**	**5760**	**3181**	**4905**
4. Cost of illness to workers & caregiving to children	**4218**	**2756**	**4327**	**2456**	**3768**

Note: Authors' calculations from HIES 2018-19.

Of the total cost, PKR 606 is the indirect cost, mainly accounted for by the productivity loss of economically active patients. The average total cost of typhoid to households is PKR 8160, which is accounted for by the direct costs of PKR 3775 and the indirect costs of PKR 4387. As before, medicines, doctor fees, and diagnostic tests have a major share in the direct cost, while productivity loss of economically active patients (PKR 1933) and patients in non-market activities (PKR 1172) account for a large share of the indirect cost. The average cost per episode varies across households, depending on the severity of the disease and the type of treatment sought. An average household incurs PKR 5688 per episode for the treatment of malaria, PKR 1757 per episode for diarrhea, and PKR 7818 per episode for typhoid.

3.3—Aggregate Cost of Illness in the Reference Period

Table 3 presents the aggregate cost of malaria, diarrhea, and typhoid illness for households in the reference period. This shows that the average total cost in Pakistan is PKR 4905, which varies significantly across provinces. The average total cost was highest in Khyber Pakhtunkhwa (PKR 5760), followed by Punjab (PKR 5553), Sindh (PKR 3371), and Balochistan (PKR 3181).

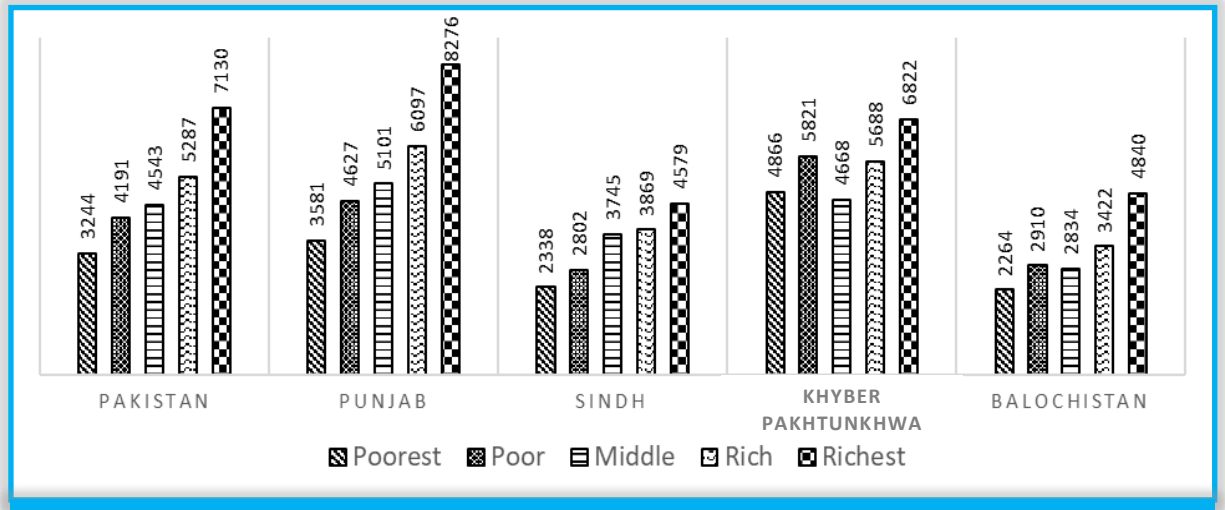


Figure 1. Aggregate average cost of illness in the reference period, by income quintiles

3.3.1—Sensitivity analysis

We also conducted a sensitivity analysis to explore how the cost of illness estimates change when a more conservative definition of the indirect cost of illness is applied. The indirect cost estimates in Table 3 are based on five indicator variables, as depicted in rows 2a–2e. Using the conservative definition of indirect cost, only the productivity loss of economically active patients and caregiving to children (rows 2a and 2e) is monetized. The revised estimates are presented in Table 3 (row 4), which shows that the total cost decreases by 24.7% in Pakistan, 25.5% in Punjab, 19.3% in Sindh, 27.2% in Khyber Pakhtunkhwa, and 23.4% in Balochistan.

more on the treatment of WASH diseases than the poorest quintile . A similar pattern was observed in the four provinces. This is not because the disease rates are higher for the rich but because the unit cost of care is higher for the rich than for the poor. Because richer quintiles have better WASH services, their disease rates are lower than those of poorer quintiles. This argument is elaborated on below.

Figure 2 shows that a different picture emerges when we consider the share of cost in the total income of households in the reference period. The burden of WASH disease is disproportionately borne by the lower-income quintiles who suffer major harm as they lose wages and devote a

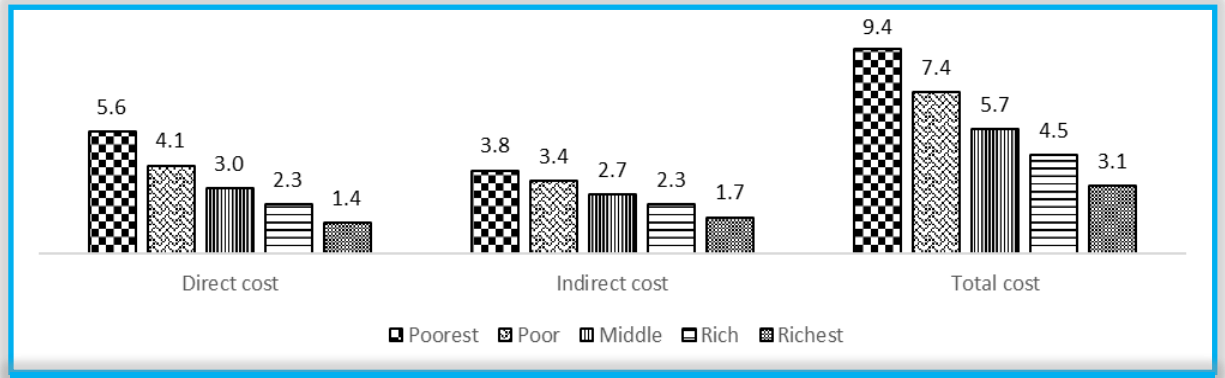


Figure 2. Cost of illness as a percent of household income in Pakistan (%)

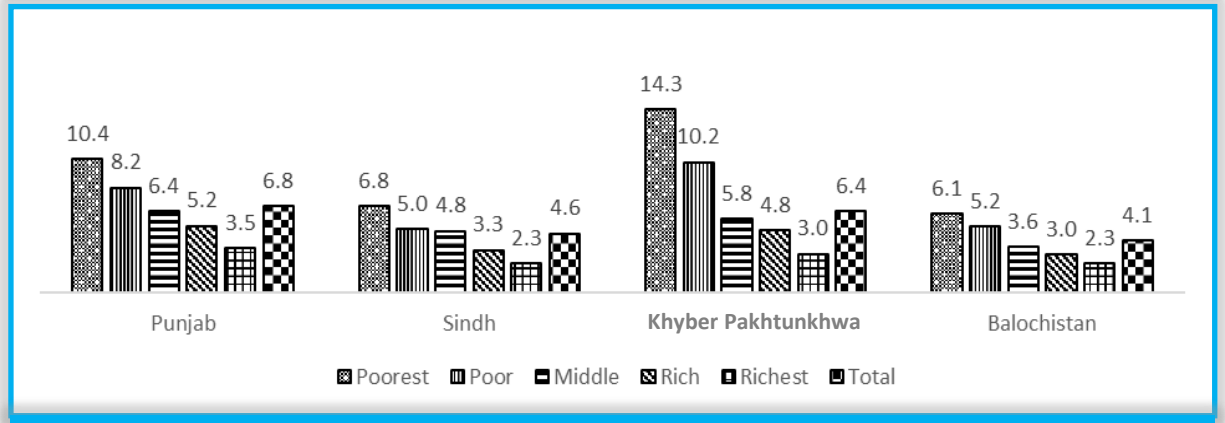


Figure 3. Cost of illness as a percent of household income in provinces (%)

3.3.2—Differential impacts on the poor

Figure 1 presents households' average cost of illness by income quintiles. The average total cost of WASH diseases monotonically increases from the poorest quintile to the richest quintile; that is, the average total cost of the poorest quintile is the lowest and that of the richest quintile is the highest. The richest quintile in Pakistan spends 2.2 times

disproportionately large part of their income to treatment costs. The poorest and poor income quintiles pay 9.4% and 7.4% of the household income, respectively, while the richer and richest income quintiles spend 4.5% and 3.1% of their income, respectively.

Figure 3 shows that across provinces, the poorest and poor quintiles of Khyber Pakhtunkhwa bear the highest disease burden, at 14.3% and 11%,

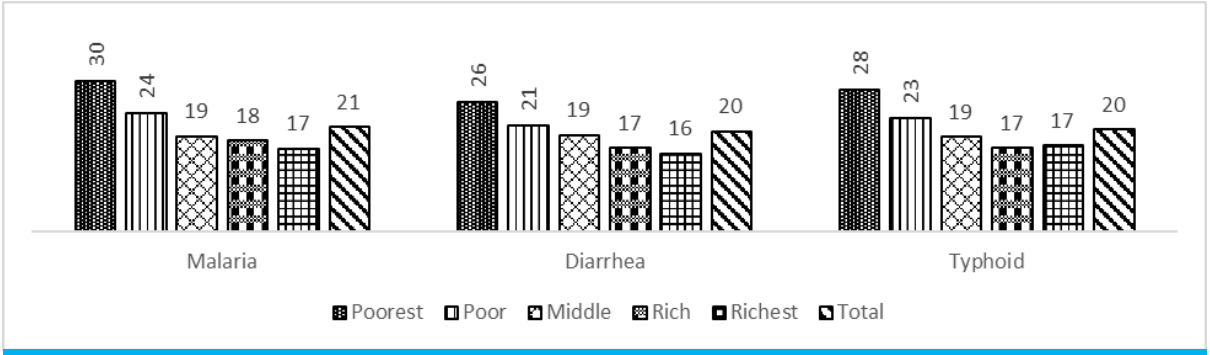


Figure 4. Disease rates for malaria, diarrhea, and typhoid in Pakistan, by income quintiles

respectively. In Punjab, the disease burden on the poorest and poor quintiles was relatively lower than the Khyber Pakhtunkhwa, but higher than the burden on the equivalent quintiles of Sindh. In Punjab, the poorest and poor quintiles spend 10.4% and 8.2% of their income, respectively, compared with only 7.2% and 5.1% in Sindh, respectively. It would be of interest to explore if this is because of higher disease rates for the lower income groups.

Figure 4 depicts the disease rates in Pakistan for malaria, diarrhea, and typhoid by income quintiles. Disease rates were defined as the number of cases of illness divided by the total number of members in a household. The rates of malaria, diarrhea, and typhoid were significantly higher among the poorest and poor households (> 20 %) than among the richest and richer households. Because the disease rates are higher for the lower-income groups, they spend a relatively higher proportion of their income on the cost of illness.

3.3.3—Aggregate cost by age and sex

Generally, healthcare costs are expected to increase with age, because the risk of chronic diseases and other health problems increases with age. However, this is not the case for WASH diseases, which can occur in any age group. We found that the direct cost of illness is similar across age groups, but the cost of illness is higher for adults who have higher indirect costs of illness.

Figure 5 shows that the average total cost of illness by age group was higher among adults than among children. This is explained by the higher indirect cost for adults due to loss of productivity. The average total cost in Pakistan ranges between PKR 2107 and PKR 5581. As expected, the peak cost occurred at 46-59 years before its decline. Thus, due to higher indirect costs, the largest average total cost was observed for patients aged 46 – 59 years and 60 years and older, while the lowest costs were observed among patients aged 0 – 4 years. A similar pattern prevails in Punjab and Khyber Pakhtunkhwa provinces, where the average treatment cost for patients aged 46 – 59 years is the highest, but in Sindh and Balochistan, peak costs occur for children aged 5 – 15 years (Figure 5).

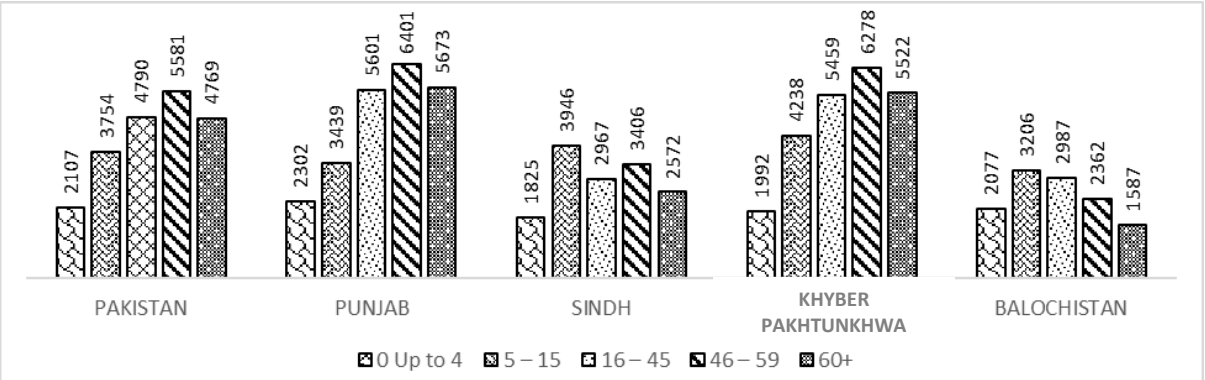


Figure 5. Aggregate average cost of illness in the reference period, by age group

Little is known about sex-specific costs of illness in

Figure 6. Aggregate average cost of illness in the reference period, by gender

Pakistan. Gender differences in health-seeking behaviors due to access to healthcare, and social and cultural factors can contribute to differences in the cost of illness for men and women. Figure 6 indicates that men in Pakistan bear a disproportionate burden of the cost of illness, which is higher for men (PKR 4657) than for women (PKR 3960), and the same pattern persists in the four provinces. The difference in the average total cost between males and females is due to the higher disease rates for males than for females. The HIES 2018-19 data indicates that the overall disease rates in Pakistan for malaria, diarrhea, and typhoid were 20.8%, 20%, and 20.3%, respectively. However, the disease rates were 7-percentage point higher for malaria, 3.8-percentage points higher for diarrhea, and 3.2-percentage points higher for typhoid in males than in females.

3.3.4—Aggregate cost by regions:

The cost of illness due to WASH diseases can vary by province and region, depending on factors such as disease rates, which depend on access to clean drinking water, better sanitation, hygiene, access to healthcare facilities, the cost of healthcare in various regions, and productivity loss of patients. Table 4 presents household costs of illness by region.

The highest direct cost of illness is incurred in the capital territory of Islamabad, Khyber Pakhtunkhwa, central Punjab, and ten selected districts of Sindh (due to Karachi district). Private clinics are more expensive to access in these regions, with a large rural-urban differential. For example, the Pakistan Economic Survey 2021-22 reports doctor consulting fees in various cities, which shows that the fees are higher in Peshawar, Faisalabad, and Islamabad capital territories than the national average (GoP, 2022). The lowest direct cost of illness was incurred in Balochistan, ten selected districts of Punjab, and Sindh Central. The

Table 4. Household average cost of illness by regions

Regions	Population share (%)	Direct cost (PKR)	Indirect cost (PKR)	Total cost (PKR)
Central Punjab	41	2753	3103	5856
Ten selected districts of Punjab	12	1958	1500	3458
Sindh Central	13	1718	1577	3683
Ten selected districts of Sindh	12	2444	1332	3034
Khyber Pakhtunkhwa	15	3017	2743	5760
Balochistan	6	1565	1612	3177
Islamabad	1	7024	9124	16149
Pakistan	**100**	**2470**	**2434**	**4904**

Note: Authors' calculations from HIES 2018-19. The selected districts of Punjab include Multan, Lodhran, D.G. Khan, Muzaffargarh, Chiniot, Rajanpur, Bahawalnagar, Bahawalpur, Khushab, and Pakpattan. The selected districts of Sindh include Tharparkar, Karachi, Sujawal, Tando Mohammad Khan, Jacobabad, Thatta, Kashmore, Kambar Shahdadkot, Umerkot, and Badin.

Table 5. Annual days lost due to malaria, diarrhea, and typhoid in 2018-19 (million, days)

	Malaria	Diarrhea	Typhoid	Total
Days lost of economically active patients	5.99	1.1	3.6	10.7
Days lost of patients in non-market activities	4.03	0.8	3.4	8.2
Schooldays lost of children aged 5 – 15 years	1.93	0.3	1.1	3.2
Days lost of caregivers	4.31	1.3	2.9	8.5
TOTAL	16.26	3.5	11.0	30.7

Source: Authors' calculations from HIES 2018-19.

doctor's consulting fees in Hyderabad and Sukkur in Sindh were 56% and 34% lower than the national average, respectively (GoP, 2022).

The indirect cost of illness is also higher in more urbanized regions such as Islamabad, central Punjab, and Khyber Pakhtunkhwa where productivity loss is relatively higher than in other regions. Thus, the total cost of illness was higher in these regions. In summary, the cost differential across regions can be explained by differences in the cost of healthcare, loss of productivity due to illness, and access to healthcare.

3.4 —Annual Cost of Illness to the Households

The annual cost of illness for households in Pakistan that suffer from WASH diseases such as malaria, diarrhea, and typhoid can be significant. These costs can be substantial, particularly for the poor and those who do not have access to affordable health care for health insurance. The cost of illness includes direct out-of-pocket costs, as well as indirect costs such as loss in productivity due to illness or caregiver costs.

Pakistani households bear substantial losses in the productivity of economically active workers, workers involved in non-market activities, and schooldays lost by children and caregivers. Based on HIES 2018-19, we estimated that households lose 30.7 million days annually due to malaria, diarrhea, and typhoid illnesses (Table 5). Of this, 16.26 million days (53%) were lost due to malaria, 11 million days (36%) due to typhoid, and 3.5 million days (11%) due to diarrhea. Most of the loss occurs due to days lost of economically active patients who made up 10.7 million days (35%) of the total, which is followed by 8.5 million days of caregivers (28%), 8.2 million days of patients who work in non-market activities (27%), and 3.74 million schooldays lost of children (10%).

We also monetized the number of days lost by applying household weights to the quarterly cost of illness estimates. The estimates for 2018-19 are extrapolated to January 2023 based on the consumer price index (CPI) of the health group for the year 2018-19 and January 2023 [26]. Table 6 presents the annual health costs of malaria, diarrhea, and typhoid treatment for affected households. The results indicate that the annual cost of illness is PKR 116.13 billion in 2018-19 prices (PKR 209.23 billion in March 2023 prices). Of this, annual direct and indirect cost of illness is PKR 61.63 billion and 54.50 billion, respectively. The direct and indirect cost in March 2023 prices comes to PKR 111.04 billion, and 98.19 billion, respectively. The highest cost burden to households was due to malaria, followed by typhoid, and diarrhea. Overall, the cost burden of malaria in Pakistan is more than double (2.75 times) the cost burden of diarrhea and 59% higher than the cost burden of typhoid.

Punjab has the largest share of the health cost

[26] To inflate the cost of illness to January 2023, we multiplied the cost of illness by the ratio of the two CPIs of 1.8017 (i.e., CPIMarch23/ CPIJune19 =219.14/ 121.63).

accounting for 58.2% of the total cost, while households in Sindh share 20.7% of the disease burden. Of the total health costs in Punjab, 48.5% of the loss was due to direct costs and 51.5% was due to indirect costs of illness. In Sindh, losses to households due to direct and indirect costs were 66.9% and 36.1%, respectively. The cost burden of malaria is 65% of the total out-of-pocket cost, which is huge. From another perspective, the overall per capita health cost of malaria, diarrhea, and typhoid was PKR 777 per annum, and households in Punjab spent 46% more than households in Sindh. Overall, these costs can be a significant burden for those already facing economic hardships. This highlights the need for policies and programs that can prevent the incidence of WASH diseases in vulnerable regions and provide affordable healthcare and financial protection to households to mitigate the impact of illness on their economic well-being.

Table 6. Average annual cost of malaria, diarrhea, and typhoid to households (PKR billion)

Cost of illness	Cost of illness in July 2018 to June 2019			Cost of illness in April 2022 to March 20		
	Pakistan	Punjab	Sindh	Pakistan	Punjab	Sindh
Direct cost of illness	**61.63**	**32.78**	**16.08**	**111.04**	**59.06**	**28.97**
Malaria	28.65	13	10.46	51.62	23.44	18.85
Diarrhea	14.65	8.64	3.47	26.39	15.57	6.25
Typhoid	18.33	11.13	2.16	33.03	20.05	3.89
Indirect cost of illness	**54.50**	**34.84**	**7.95**	**98.19**	**62.77**	**14.32**
Malaria	29.07	17.65	5.06	52.38	31.80	9.12
Diarrhea	6.34	4.02	1.16	11.42	7.24	2.09
Typhoid	19.10	13.17	1.73	34.41	23.73	3.12
Total cost of illness	**116.13**	**67.62**	**24.03**	**209.23**	**121.83**	**43.29**
Malaria	57.72	30.65	15.52	103.98	55.23	27.95
Diarrhea	20.99	12.66	4.63	37.82	22.81	8.34
Typhoid	37.43	24.30	3.89	67.43	43.79	7.00
Per capita cost (PKR)	**777**	**936**	**641**	**1400**	**1686**	**1155**

Source: Authors' calculations from HIES 2018-19.

Household Expenditure on WASH Services

Water, sanitation, and hygiene are essential services for maintaining public health. However, the cost of WASH services can vary according to household and region. Access to safe water, and basic sanitation and hygiene facilities remains a major challenge for many households, especially in rural areas.

According to the PSLM 2015-16 report, Pakistani households spend an average of 2.6% of their total household expenditure on water, sanitation, and hygiene. Rural households spent slightly more time (2.7%) than urban households (2.5%). Low-income quintiles spend a higher proportion of their income on WASH (3.6%) than the highest income quintile (1.8%). However, these figures do not reflect the true cost of WASH, as many households depend on unsafe water sources or sanitation facilities owing to a lack of access or affordability, which reflects in the cost of illness results in the previous chapter . Moreover, maintaining WASH infrastructure is also a challenge in far-flung areas owing to the lack of maintenance services and high repair and maintenance costs.

Shahida, with clean water collected from WaterAid installed pump in the villlage of Muhammad Urs Sehejo, Chatto Chand Union Council, Thatta, Sindh, Pakistan. (July 2018)

Improved quality drinking water and better sanitation and hygiene practices at the household level can prevent the incidence of diseases and deaths from complications arising from these morbidities. Moreover, improved sanitation and hygiene practices are expected to shield households from potential productivity losses due to days lost from illnesses and caregiving by adults to patients. Improved access to better hygiene practices serves as a barrier to fecal contamination routes to sanitation-oriented diseases. Thus, increased use of toilets, promotion of personal hygiene (handwashing with soap and safe water management), and improved access to drinking and sanitation water can help avert adverse health impacts on households.

In the following sections, we present cost of accessing OD sites and shared toilets, household expenditures on WASH services by provinces, and income quintiles, and annual household expenditure on WASH services by regions.

4.1—Cost of Accessing Open Defecation Sites and Shared toilets

Open defecation and household spending on WASH services are closely linked, as households that lack access to adequate sanitation are forced to practice open defecation or use shared toilets. These households may spend very little on WASH and may not spend time on better hygiene due to a lack of resources. This can lead to a vicious cycle in which poor sanitation and hygiene practices contribute to the spread of the disease and increased healthcare expenses, which further strain household resources.

Open defecation is still practiced by a significant portion of the population, especially in rural areas. Lack of access to good toilets within dwellings results in a loss of time, convenience, and dignity, especially for women and girls. Open defecation incurs significant costs for households, including

Table 7. Annual time cost of accessing OD sites and shared toilets in Pakistan, 2018-19

	Pakistan	Rural	Urban
Proportion of households practicing OD (%)	11.59	18.06	1.03
Proportion of household using shared toilets (%)	13.32	16.69	8.77
Hours spent on accessing OD sites (million)	2.58	2.49	0.09
Hours spent on accessing shared toilets (million)	0.98	0.71	0.27
Value of time spent on accessing OD sites (PKR, billion)	145.7	140.6	5.2
Value of time spent on accessing shared toilets (PKR, billion)	69.0	45.5	23.5
Average cost per household for accessing OD sites (PKR)	4372	6800	408
Average cost per household for accessing shared toilets (PKR)	2069	2199	1858

healthcare expenses, lost productivity, and caregiving. Moreover, it is well known that untreated fecal waste near human settlements increases the level of bacterial contamination (E. coli) in surface and ground water, which orally transmits the bacteria and sustains high levels of diarrhea (World Bank, 2018). A major source of untreated fecal waste is OD.

We estimated the cost of accessing open defecation sites and shared toilets from HIES 2018-19. The cost is estimated based on a single visit per person per day to OD sites and shared toilets using 40 minutes per person per day for OD sites and 15 minutes per person per day for shared toilets . The survey data show that 11.6% of the population in Pakistan practice open defecation, of which 18.1% belong to rural areas and 1% belong to urban areas (Table 7). An additional 13.3% of the population (16.7% rural and 8.8% urban) used shared toilets. So, 53.82 million people either defecate in open toilets or use shared toiles. They spent 3.56 million hours (2.58+0.98) accessing OD sites or shared toilets, of which 90% of the time was spent in rural areas.

We estimate that the economic cost of lost access time comes to PKR 145.7 billion (PKR 140.6 billion in rural, and PKR 5.2 billion in urban areas). The economic cost of lost time due to shared toilets is estimated to be PKR 69 billion, of which PKR 45.5 billion in rural and PKR 23.5 billion in urban areas. The average cost per household for accessing OD sites and shared toilets is PKR 4372 and PKR 2069, respectively; this is the cost of not having sanitation. The rural population bears most of the cost for accessing OD sites and shared toilets.

4.2—Household Expenditure on WASH Services

Households in Pakistan spend in WASH services to mitigate the impact of disease burden. This cost includes that of water, sanitation, and hygiene services. We report the spending on WASH services for all households in the survey. We compute household-level expenditure in WASH services from the micro records of HIES 2018-19. Water cost consists of drinking water, time to fetch drinking water, and water treatment cost. The drinking water cost is directly reported in HIES 2018-19, but as explained in the methodology, the cost of time to fetch water and the water treatment cost are imputed. The sanitation cost was calculated based on the water cost for sanitation and time to fetch water for sanitation. Water for sanitation was used to operate the flush system in the dwellings.

Table 8 reports the average household spending on WASH services in Pakistan and the four provinces in 2018-19 prices. This shows that although households spend a huge sum on accessing groundwater resources (including piped water, tube wells, tanker trucks, bottled water, etc.), they also incur large costs in fetching drinking water from outside their dwellings. Households spend PKR 939 on water for drinking, of which 72% is spent on payment for groundwater sources, 21% on fetching drinking water from outside the dwellings, and only 7% on water treatment cost.

Table 8. Annual average household spending on WASH services in 2018-19

	Punjab	Sindh	Khyber Pakhtunkhwa	Balochistan	Pakistan
WATER					
Drinking water cost (PKR)	428	1337	258	1722	673
Time to fetch drinking water cost (PKR)	191	224	120	352	196
Water treatment cost (PKR)	107	29	4	0	70
Total	**727**	**1590**	**381**	**2074**	**939**
SANITATION					
Water for sanitation cost (PKR)	428	1337	258	1722	673
Time to fetch water for sanitation (PKR)	191	224	120	352	196
Total	**620**	**1561**	**377**	**2073**	**869**
HYGIENE					
Personal hygiene: hand washing (PKR)	935	1398	1464	1549	1145
Domestic hygiene (PKR)	1199	1708	778	588	1228
MHM (PKR)	1025	585	830	398	867
Total	**3158**	**3690**	**3071**	**2535**	**3240**

Source: Authors' calculations from HIES 2018-19.

Households in Balochistan and Sindh incur the largest expenditure in drinking water, at PKR 2074 and PKR 1590, respectively. These households incurred relatively higher costs for drinking water because piped drinking water is not accessible to a sizable population in the country, especially in rural settings. However, household expenditure in Punjab and Khyber Pakhtunkhwa is relatively lower than in the other two provinces.

Table 8 also shows that households spend PKR 869 in sanitation services, which is highest in Balochistan and Sindh at PKR 2073 and PKR 1561, respectively, and lowest in Khyber Pakhtunkhwa at PKR 377. Households in Pakistan accrue 77% of sanitation costs on water for sanitation, which is disproportionately high in the Balochistan and Sindh provinces. The remainder of the cost is incurred to fetch surface water for sanitation. Expenditure in sanitation are low and not expected to shield them from the direct and indirect costs of illness. Balochistan and Sindh provinces face significant challenges related to water and sanitation, because a large portion of their population lacks access to safe water and sanitation facilities. Consequently, households in these provinces may spend more than those in other parts of the country. Because Balochistan is a water-scarce region, maintaining sanitation facilities and practicing safe hygiene are more difficult and expensive. Historically, Balochistan has received much less expenditure in water and sanitation infrastructure than other provinces, which has contributed to making access to water and sanitation much more challenging than in other regions.

According to data from the Pakistan Demographic Health Survey 2017-18, the percentage of households with access to handwashing facilities and basic hygiene varies across provinces, with the highest access in Punjab and Khyber Pakhtunkhwa and lowest access in Balochistan and Sindh. The number of water treatment facilities was highest in Sindh (mostly in Karachi) and lowest in Balochistan. Lack of hygiene services leads to higher costs in these regions. For example, hygiene costs in the Sindh and Balochistan provinces are more than average, whereas those in Punjab and Khyber Pakhtunkhwa are less than average.

Access to menstrual hygiene products and services is limited, especially in remote areas. Thus, women often resort to using unsafe and unhygienic

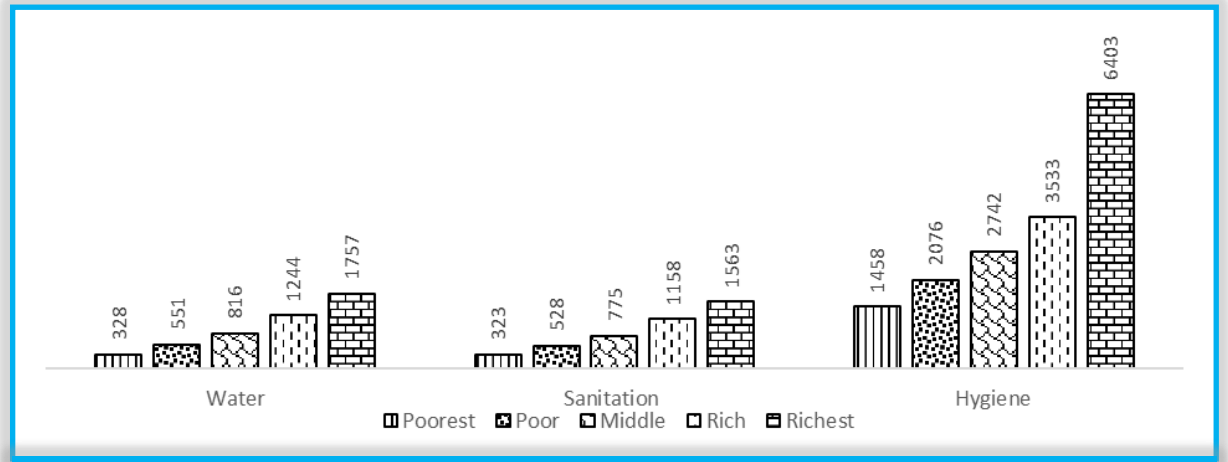


Figure 7. Annual average household expenditure on WASH services, by income quintile

materials. We found that households in Pakistan spend PKR 3240 on hygiene, of which 38% is spent on domestic hygiene, 35% on personal hygiene, and 27% on menstrual hygiene management.

There were significant disparities in WASH spending according to income quintile. Figure 7–9 show that spending on WASH services monotonically increases from the lower-to the upper- income quintiles. We find that lower income-groups in Pakistan spend significantly less on WASH services than upper-income groups. For example, households in the lowest income quintile spend an annual average of PKR 2109 on water, sanitation, and hygiene services, while those in the highest income quintile spend PKR 9723, which reveals a significant gap in access to basic WASH services, where the poorest and poor households are the most vulnerable. A similar pattern prevailed in all provinces.

Investment in WASH services varies significantly across provinces and regions, where smaller provinces receive less investment and larger provinces receive more investment. As a result, PSLM 2019-20 shows that only 54% of the rural population has access to improved drinking water, whereas only 28% of the population has access to improved sanitation facilities. Thus, the government needs to increase investments in WASH services in rural areas. Due to the lack of

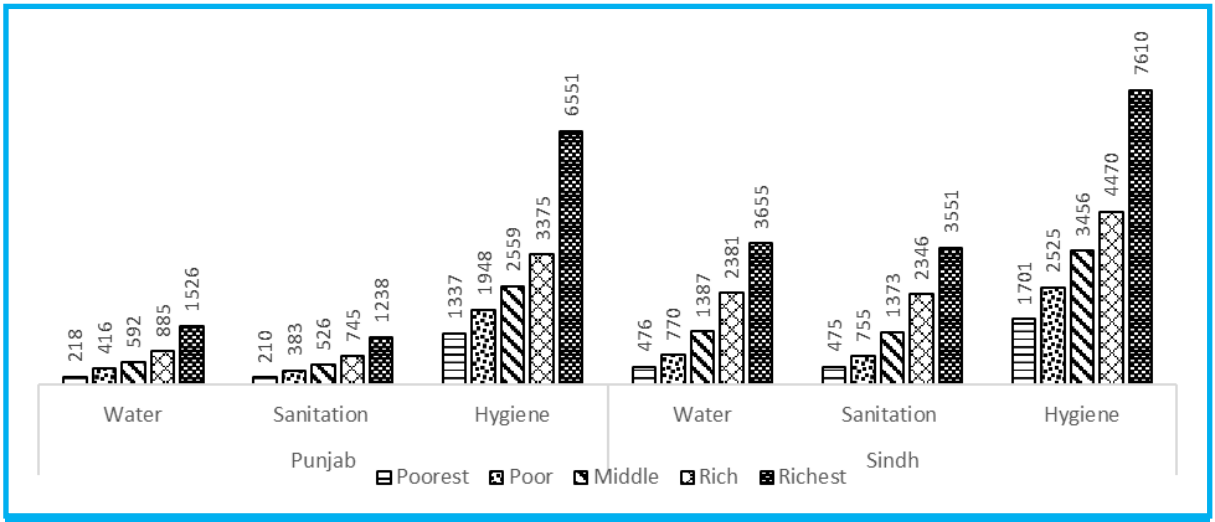


Figure 8. Annual average household expenditure on WASH in Punjab and Sindh, by income quintile

WASH services, households in Balochistan and Sindh incur highest cost on drinking water (Figure 8 and 9), as they travel long distances to fetch water. The other two provinces present a contrasting picture, as households in these provinces incur much less cost on drinking water.

Table 9 presents the regional distribution of the average annual spending by all households on

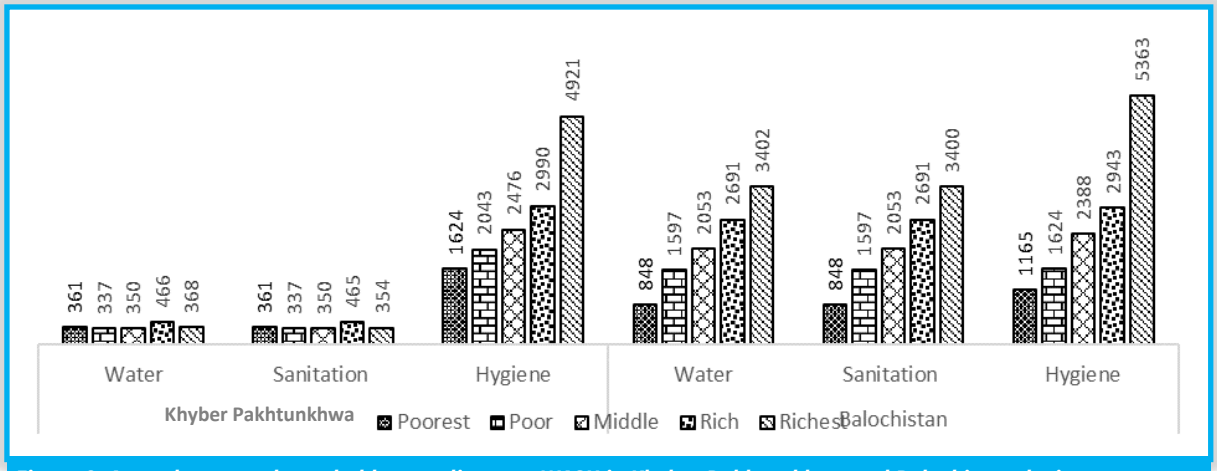


Figure 9. Annual average household expenditure on WASH in Khyber Pakhtunkhwa and Balochistan, by income

WASH services. This shows that expenditure in WASH services is highly skewed across the regions. The households in Pakistan spend, on average, PKR 5048 on WASH services. The households in the 10 selected districts of Sindh spent almost double the nation al average. Similarly, households in Balochistan spent 32% more on WASH services than the national average. This indicates that these regions are more constrained by a lack of essential services (water and sanitation) as people travel long distances to fetch water for drinking, sanitation, and hygiene. It is pertinent to note, however, that higher household expenditures in WASH services in deprived regions of the country may not protect them from negative spillovers of the incidence of diseases and associated health costs. Such expenditures are not meant to mitigate the impact of these diseases. They are made for bare survival in remote regions of the country.

4.3—Annual Household Expenditure on WASH Services by region

Owing to limited government funding and inadequate infrastructure, universal access to WASH services is a distant goal in Pakistan. A recent report by the Pakistan Council of Research in Water Resources (PCRWR) estimated that only 50% of the country's population has access to safe drinking water and less than 30% has access to basic sanitation facilities. These conditions are particularly severe in rural areas, where access to clean water and sanitation is limited. Governments and international donors are already working to improve access to WASH services in deprived regions; however, data on their spending are unavailable. WaterAid and UNICEF are attempting to improve access to safe water and sanitation in rural areas.

Table 10 shows that overall expenditure in WASH

Table 9. Average annual expenditure by household on WASH services in 2018-19, by regions

Regions	Population share (%)	Water (PKR)	Sanitation (PKR)	Hygiene (PKR)	Total (PKR)
10 selected districts of Punjab	14	420	392	1986	2798
Other Punjab	43	808	678	3522	5007
10 selected districts of Sindh	12	2667	2633	4157	9457
Other Sindh	11	492	469	3215	4176
Khyber Pakhtunkhwa	14	381	377	3071	3830
Balochistan	5	2074	2073	2535	6682
Islamabad	1	1562	1311	4287	7159
Pakistan	100	939	869	3240	5048

Note: The selected districts of Punjab include Multan, Lodhran, D.G. Khan, Muzaffargarh, Chiniot, Rajanpur, Bahawalnagar, Bahawalpur, Khushab, and Pakpattan. The selected districts of Sindh include Tharparkar, Karachi, Sujawal, Tando Mohammad Khan, Jacobabad, Thatta, Kashmore, Kambar Shahdadkot, Umerkot, and Badin.

services is highest in other Punjab (PKR 71.3 billion) because of the sheer size of its population. Although the ten selected districts of Punjab and Sindh have similar population shares, the households in Sindh spend more than twice as much on WASH services (PKR 36.7) than their counterparts from Punjab (PKR 13.4 billion). Similarly, a comparison of the selected districts of Sindh with other Sindh districts highlights the disparity in WASH expenditures between the two regions. This differential can be accounted for by disproportionate expenditures in water and sanitation services in the ten districts of Sindh. Households in Balochistan also spend more time disproportionately than those in other parts of Pakistan. Households from the Sindh and Balochistan provinces face significant challenges related to water and sanitation, because a large part of their population has no access to safe water and sanitation services.

Table 10. Annual expenditure on WASH services by households, by regions (PKR billion)

Regions	Population share (%)	Water (PKR)	Sanitation (PKR)	Hygiene (PKR)	Total
10 selected districts of Punjab	14	2.0	1.9	9.5	13.4
Other Punjab	43	11.5	9.7	50.2	71.3
10 selected districts of Sindh	12	10.4	10.2	16.1	36.7
Other Sindh	11	1.9	1.8	12.2	15.9
Khyber Pakhtunkhwa	14	1.8	1.8	14.5	18.1
Balochistan	5	3.2	3.2	3.9	10.2
Islamabad	1	0.6	0.5	1.6	2.7
Pakistan	100	31.3	29.0	108.0	168.3

Note: The selected districts of Punjab include Multan, Lodhran, D.G. Khan, Muzaffargarh, Chiniot, Rajanpur, Bahawalnagar, Bahawalpur, Khushab, and Pakpattan. The selected districts of Sindh include Tharparkar, Karachi, Sujawal, Tando Mohammad Khan, Jacobabad, Thatta, Kashmore, Kambar Shahdadkot, Umerkot, and Badin.

Correlation between WASH Spending and Cost of Illness

Does increased spending on WASH services mean that households are better protected from diseases? In this subsection, we attempt to answer this question. Moreover, we identify other

$$Y_i = X_i\beta + V_i\gamma + C_i\delta + u_i$$

factors that affect the cost of illness. To identify the factors affecting the total cost of illness and direct cost of illness, we applied ordinary least squares (OLS) regressions of the form:

where Y_i denotes the total cost of illness, or direct cost of illness for ith household in PKR; X_i represents household characteristics including water cost, sanitation cost, hygiene cost, average age of patients, education of household head, household size, illness days for the members, and incidence of illness; V_i represents dummy variables capturing the income status of the household; C_i denotes a set of dummy variables controlling for the provinces, and urban versus rural location of the households; and u_i is a random disturbance term added to the linear regression to capture the effects of other factors affecting cost, which were not included in the regression.

5.1—Variables Used in the Econometric Analysis

Table 11 presents the definitions of the variables affecting the cost of illness. The dependent variables are the total and directs cost incurred on the illness by the household in the reference period, that is, a quarter. Household water, sanitation, and hygiene costs are key variables included in the regression to investigate the effects of WASH spending on the cost of illness.

For more than one patient per household, the age of the patients was averaged to make it tractable for the regression analysis. The education level of household head may determine how households adopt coping strategies for illness episodes. Household size may be correlated with the cost of illness in ways that are unknown. The total number of illness days for household members measures

Table 11. Variables for the cost of illness regressions

Variable	Definition
Total cost of illness PKR)	Quarterly direct and indirect cost of illness incurred by the household.
Direct cost of illness (PKR)	Quarterly direct cost of illness incurred by the household.
Water cost (PKR)	Quarterly cost of drinking water, and water treatment cost.
Sanitation cost (PKR)	Quarterly cost of water for sanitation cost.
Hygiene cost (PKR)	Quarterly cost of personal hygiene, domestic hygiene, and MHM.
Average age of patients (years)	Average age of all household members who had illness.
Education of head (years)	Completed years of education of the head of household.
Household size (numbers)	Total number of members of the household.
Illness days for members	Total days of illness for all members of household who fell ill.
Incidence of illness	Number of household members who had disease.
Income groups: Poorest	Dummy equals 1 if household falls in lowest income quantile, 0 otherwise.
Poor	Dummy equals 1, if household falls in second income quintile, 0 otherwise.
Middle	Dummy equals 1, if household falls in middle income quintile, 0 otherwise.
Rich	Dummy equals 1, if household falls in fourth income quintile, 0 otherwise.
Richest	Dummy equals 1, if household falls in highest income quintile, 0 otherwise.
Region: Urban	Dummy equals 1, if household is in urban area, 0 otherwise.
Rural	Dummy equals 1, if household is in rural area, 0 otherwise.
Province:	Four dummy variables for four provinces.
Khyber Pakhtunkhwa	Dummy equals 1, if household residence is Khyber Pakhtunkhwa, 0 otherwise.
Punjab	Dummy equals 1, if household resides in Punjab, 0 otherwise.
Sindh	Dummy equals 1, if household resides in Sindh, 0 otherwise.
Balochistan	Dummy equals 1, if household resides in Balochistan, 0 otherwise.

Shama, has to walk several kilometers from her roadside shelter to get clean drinking water after unprecedented monsoon flooding destroyed her home in Badin, Sindh, Pakistan. (October 2022)

the severity of illness, which is expected to be positively correlated with the cost of illness. Incidence of illness captures the number of household members who fell ill during the study period. Finally, the regression models include control variables for income quintiles, regions, and provinces.

5.2—Descriptive Statistics

Table 12 presents the descriptive statistics of the factors affecting the cost of illness. The mean total and direct costs of illness were highest for typhoid and lowest for diarrhea. The average age of the patients was 34 years for malaria and typhoid, and 28 years for diarrhea. The education level or completed years of education of the head of the household was approximately five years . The size of the household that fell ill was roughly 7-members, which closely reflects the national average household size. The mean number of days of illness was the highest for typhoid (16 days), followed by malaria (8.6 days), and diarrhea (3.45 days). The incidence of illness was highest for malaria (1.12 members, followed by diarrhea and typhoid). WASH spending was similar across households with malaria, diarrhea, and typhoid. Dummy variables for income quintiles, urban areas, and provinces indicate the proportion of households in each category.

5.3—Estimation of the Determinants of Cost of Illness

Table 13 presents the Pearson's correlations between WASH spending and the direct costs of malaria, diarrhea, and typhoid. This shows that an increase in water cost decreases the direct cost of malaria, whereas an increase in sanitation cost decreases the direct cost of typhoid; however, the correlation coefficients are low and statistically insignificant. An increase in hygiene costs significantly increased the direct cost of malaria and diarrhea, but these results are counterintuitive. In the following, we control other effects on the cost of illness to obtain more meaningful results.

Table 14 presents the results of the estimated equations. The R2 value measures the goodness of fit of the estimated equations, which typically lies between 0 and 1, where 0 is no fit and 1 is a perfect

Shama, has developed a skin disease due to using flood water to wash and bathe after unprecedented monsoon flooding destroyed her home in Badin, Sindh, Pakistan. (October 2022)

Table 12. Descriptive statistics of factors affecting the cost of illness

Variables	Malaria			
	Mean	Std. dev.	Min	Max
Total cost of illness (PKR)	6375	5983	102	88249
Direct cost of illness (PKR)	2992	3181	54	87740
Water cost (PKR)	176	609	0	10500
Sanitation cost (PKR)	212	652	0	10500
Hygiene cost (PKR)	850	1011	0	37650
Average age of patients (years)	34.2	18.9	0	96
Education of head (years)	5.0	5.10	0	17
Household size (numbers)	6.94	3.56	1	36
Illness days of members (days)	8.64	3.88	0	50
Incidence of illness (number)	1.12	0.4	1	5
Poorest (yes=1, no=0)	0.16	0.37	0	1
Poor (yes=1, no=0)	0.18	0.38	0	1
Middle (yes=1, no=0)	0.22	0.42	0	1
Rich (yes=1, no=0)	0.21	0.41	0	1
Richest (yes=1, no=0)	0.22	0.42	0	1
Urban (yes=1, no=0)	0.36	0.48	0	1
Khyber Pakhtunkhwa (yes=1, no=0)	0.18	0.39	0	1
Punjab (yes=1, no=0)	0.49	0.50	0	1
Sindh (yes=1, no=0)	0.26	0.44	0	1
Balochistan (yes=1, no=0)	0.06	0.24	0	1
Number of observations	1,746	--	--	--

Diarrhea				Typhoid			
Mean	Std. dev.	Min	Max	Mean	Std. dev.	Min	Max
1866	3406	84	68635	8160	7060	654	84715
1260	3120	32	67410	3775	5180	32	78645
179	664	0	12000	194	633	0	12000
230	863	0	15600	221	635	0	12600
756	794	0	8250	767	836	0	8100
28.48	22.21	0	99	34.02	17.99	0	85
4.94	5.03	0	18	5.41	5.03	0	17
6.66	3.37	1	29	6.48	3.33	1	55
3.45	2.27	1	15	16.00	4.88	10	42
1.06	0.25	1	3	1.04	0.20	1	2
0.93	0.26	0	1	0.92	0.28	0	1
0.24	0.42	0	1	0.17	0.38	0	1
0.19	0.40	0	1	0.20	0.40	0	1
0.21	0.40	0	1	0.19	0.39	0	1
0.17	0.38	0	1	0.20	0.40	0	1
0.35	0.48	0	1	0.36	0.48	0	1
0.11	0.32	0	1	0.20	0.40	0	1
0.54	0.50	0	1	0.61	0.49	0	1
0.28	0.45	0	1	0.14	0.34	0	1
0.07	0.26	0	1	0.06	0.23	0	1
2047	--	--	--	805	--	--	--

Table 13. Correlation between WASH spending and cost of illness, in the reference period

	Direct cost of malaria	Direct cost of diarrhea	Direct cost of typhoid
1. Direct cost	1	1	1
2. Water cost	-0.001 (0.953)	0.012 (0.592)	0.005 (0.896)
3. Sanitation cost	0.009 (0.716)	0.012 (0.597)	-0.012 (0.735)
4. Hygiene cost	0.059*** (0.013)	0.114*** (0.000)	0.018 (0.616)
5. WASH services (sum 2 to 4)	0.009 (0.719)	0.003 (0.899)	0.006 (0.858)

Note: Standard errors are in parenthesis. * and * indicate statistically significant at the 10%, and 99% levels, respectively.**

excluded from the regression analysis because of a lack of statistical significance.

5.3.1—Factors affecting the cost of malaria illness

Malaria is usually caused by the bites of infected female Anopheles mosquitoes. Plasmodium falciparum and Plasmodium vivax pose the greatest threat, with P. vivax representing more than 80% of the most prominent parasites reported in Pakistan [27]. Survey data from HIES 2018 revealed little variation in the overall incidence of malaria across the four quarters, ranging between 6% and 7%.

As expected, the expenditure on WASH services (water, sanitation, and hygiene costs) by households had no statistically significant association with the cost of malaria (both total and direct costs), possibly because malaria is attributed to inadequate sanitation facilities leading to standing water near human settlements. The estimated coefficient of the average age of patients was positive and highly significant. This shows that, on average, an increase in patient age by one year increased the cost of illness by PKR 35. As older individuals contribute more to household production, it appears that households allocate more resources to treat more productive individuals.

The completed years of education of the household head was also positively associated with the cost of illness. The cost of illness increased by PKR 133 as the average education of the head increased by one year, indicating that more educated heads spend more by relying on better quality of treatment at more expensive private health facilities than public sector health facilities. These results were consistent with the findings of Haq et al. (2007) and Ali et al. (2021).

The incidence of malaria is expected to be higher in households where large families sleep together in one room. Moreover, household size has been associated with the successful eradication of malaria in many countries. For example, Hulden (2010) used cross-country data on malaria frequency to show that malaria disappeared with a threshold household size of fewer than four members. Likewise, Shcherbacheva and Haario (2017) use a "discrete agent-based model of mosquito host-seeking behavior" to show that the transmission of malaria decreases with the household size.

However, these results assumed that households sleep together in a single room. A different outcome was expected in the absence of this assumption. For example, our results indicate that household size is negatively and significantly correlated with the cost of illness. The results revealed that an increase in household size

[27] Malaria – Pakistan (who.int) retrieved from "https://www.who.int/emergencies/disease-outbreak-news/item/2022-DON413"

decreased the cost of illness. A one-unit increase in household size decreased the cost of illness by approximately PKR 140. This indicates that households with larger family members have fewer chances of becoming infected with malaria than do smaller households .

The average duration of illness in the sample was 8.6, with a standard deviation of 3.9. The total number of days of illness among the household members who fell ill was positively and significantly associated with the cost of illness. A one-unit increase in the number of days of malaria increased the total cost of illness by PKR 614 and the direct cost by PKR 205. In other words, the direct and indirect costs of malaria increase with the severity of the illness, which is in line with our expectations.

The incidence of illness is positively associated with its direct cost. In our sample, on average, 1.1 household members were infected with the disease, with a standard deviation of 0.4, whereas a maximum of five household members were infected. The cost of illness increases significantly with an increase in the number of patients in the household . A unit increase in the number of patients increased the direct cost of illness by PKR 606.

The results also show that, as households move from lower-to upper-income quintiles, they spend more on malaria costs than those in lower-income brackets. Malaria costs monotonically increase with the household income quintiles. The richest income quintile spent at least PKR 2000 more than the poorest, poor, and middle-income households, whereas the richest quintile spent at least PKR 1600 more than the richer households. These results were consistent with those reported by Ali et al., 2021. However, the direct costs of malaria are uniform.

Malaria is generally associated with people living in rural areas. However, unplanned urban growth often leads to a malaria disease burden that is disproportionately higher among the urban poor who have a greater risk of becoming infected. Our results showed that the household cost of malaria is significantly higher in urban households than in rural households. The cost of illness in urban households was PKR 578 more than in rural households. Malaria is a socioeconomic disease, which is attributed to inadequate sanitation facilities leading to standing water. It prevails in regions with high levels of poverty, poor housing quality, and high average household size. These results suggest that malaria prevention in urban areas is important and should be based on the better management of urban environments . Holding all else constant, the cost of illness did not vary across the provinces.

5.3.2—Factors affecting the cost of diarrhea illness

Diarrhea related illnesses can lead to malnutrition and high wasting rates, especially among under-five children. Frequent episodes of diarrhea can make patients vulnerable to other diseases, which increases their risk of death. The survey data revealed that the overall incidence of diarrhea in the country was highest during 1st quarter (July – September) with an incidence of malaria at the 10% level , followed during 4th quarter (April – June) at the 8% level, and lowest during 2nd and 3rd quarters (i.e., October – December, and January – March) at the 7% level. However, the seasonal variation in the overall incidence of diarrhea was not statistically correlated with the cost of illness; hence, it was excluded from regression analysis.

The results showed that increased spending on sanitation leads to better protection from diarrhea. Every PKR 100 spent on sanitation leads to a PKR 16 reduction in the total diarrhea cost to households. The cost of diarrhea was positively correlated with the average age of patients in the household. A one -unit increase in the average age of the patients increased the total cost of diarrhea by PKR 27 and the direct cost of diarrhea by PKR 11. This makes sense because the opportunity cost for older patients is higher than that for younger ones. This also indicates that households allocate more resources for the treatment of more productive individuals.

The education of the household head was also positively associated with the cost of illness, as the

Table 14. Factors affecting the cost of illness, by type of illness

Explanatory variable	Malaria		Diarrhea		Typhoid	
	Total cost of illness	Direct cost of illness	Total cost of illness	Direct cost of illness	Total cost of illness	Direct cost of illness
Water cost (PKR)	-2.214	-0.116	0.247	0.190	-0.182	0.0352
	(2.055)	(0.246)	(0.234)	(0.230)	(0.808)	(0.542)
Sanitation cost (PKR)	2.798	0.116	-0.159*	-0.0772	0.259	-0.152
	(2.375)	(0.224)	(0.0896)	(0.0771)	(0.895)	(0.581)
Hygiene cost (PKR)	0.0211	0.0331	0.503**	0.275	-0.141	-0.252
	(0.103)	(0.0575)	(0.224)	(0.189)	(0.247)	(0.202)
Average age of patients (years)	45.03***	-0.0146	26.83***	11.09***	59.10***	-5.541
	(7.470)	(4.920)	(4.580)	(4.195)	(8.233)	(6.773)
Education of head (years)	133.0***	-7.474	46.66***	14.47	276.5***	72.30
	(25.30)	(14.66)	(14.35)	(14.19)	(56.11)	(44.66)
Household size (numbers)	-140.1***	-16.90	2.033	45.36	-136.5	65.04
	(42.18)	(21.56)	(65.34)	(63.88)	(89.22)	(80.59)
Illness days for members	614.4***	205.5***	631.0***	493.6***	1,245***	918.0***
	(33.64)	(20.46)	(77.71)	(71.73)	(97.29)	(75.99)
Incidence of illness	139.6	606.5**	1,227***	879.2**	-11,602***	-10,092***
	(435.6)	(260.2)	(441.1)	(422.1)	(1,655)	(1,471)
Income groups: Poorest	-2,815***	-678.8**	180.8	489.5	-2,355***	-374.5
	(461.3)	(288.0)	(421.3)	(413.0)	(840.2)	(743.4)
Poor	-2,445***	-740.2***	140.0	425.9	-1,325	123.8
	(423.0)	(250.9)	(395.2)	(388.1)	(1,037)	(957.5)
Middle	-2,002***	-295.6	-122.2	126.9	-1,932***	-729.4
	(438.6)	(237.7)	(235.3)	(222.8)	(571.0)	(445.9)
Rich	-1,622***	-1.217	-296.2	-47.89	-1,621***	-517.2
	(511.9)	(244.7)	(191.4)	(193.3)	(607.7)	(458.6)
Rural	-577.9**	143.6	292.9*	-252.6*	403.9	188.4
	(281.1)	(162.3)	(169.5)	(152.2)	(412.3)	(253.9)
Khyber Pakhtunkhwa	-397.8	-259.0	545.7**	488.1**	-1,872**	-822.7
	(311.9)	(228.9)	(215.4)	(196.6)	(729.4)	(639.1)
Punjab	358.2	59.44	415.5**	420.7**	-1,270***	-694.8**
	(279.6)	(195.3)	(211.1)	(205.8)	(413.0)	(312.1)
Sindh	-436.1	27.30	97.24	237.5	-1,499***	-375.1
	(307.4)	(249.9)	(233.3)	(225.4)	(383.2)	(273.3)
Constant	1,522**	895.6*	-3,383**	-2,648**	352.7	-10.06
	(753.4)	(473.8)	(1,321)	(1,251)	(1,849)	(1,261)
R-squared	0.409	0.162	0.144	0.144	0.495	0.439
Observations	1,746	1,746	2,046	2,046	805	805

Note: Robust standard errors corrected for clustering at the primary sampling units are in parenthesis. *, **, and * indicate statistical significance at the 1%, 5%, and 10% levels.**

cost increased by PKR 47 as the average education of the household head increased by one year. The total number of days of illness was also positivelymand significantly associated with cost of illness. We found that one additional day of diarrhea increased the total cost of diarrhea by PKR 631 and the direct cost of diarrhea by PKR 494, indicating that direct and indirect costs increased with the gravity of the illness. The total number of household members who had an illness episode during the quarter, or the incidence of disease, also increased the cost of illness.

When an additional member of the household suffered from the illness, it significantly increased the total cost of diarrhea by PKR 1227 and the direct cost by PKR 879. As one might have expected, the cost of illness significantly increased as more than one household member suffered from the illness. The cost of diarrhea varies across provinces where patients in Khyber Pakhtunkhwa and Punjab incurred significantly higher total and direct costs of illness than those in Sindh and Balochistan.

No statistical difference exists in the cost of illness between households in Balochistan and Sindh. The cost of diarrhea was not associated with income quintiles, as there was no significant difference between the upper and lower quintiles. However, the total cost of diarrhea was higher, but the direct cost was lower in rural households than in urban households.

5.3.3—Factors affecting the cost of typhoid illness

The survey data showed that typhoid illness remained at the 3% level in all four quarters of the survey, indicating a lack of seasonal variation in the incidence of the disease. The estimation results indicate that household spending on water, sanitation, and hygiene had no significant impact on reducing typhoid costs. The average age of the patients in the household, education of the household head, and patients' days of illness were positively and significantly correlated with the total cost of typhoid, whereas days of illness also increased the direct cost of typhoid.

Aleena, washing her hands at the school's outdoor hand washing facilities, Lahore, Punjab Province, Pakistan. (March 2020)

The incidence of illness was negatively and significantly correlated with the total and direct costs of illness. A one-unit increase in the number of patients in the household lowered the total cost by PKR 11602 and the direct cost by PKR 10092. Income was also positively associated with the total cost of typhoid. We find that the richest households spent at least PKR 1600 more than other income quintiles. Older patients spend significantly more on treatment than younger patients. A unit increase in the average age of patients increased the total cost of typhoid by PKR 59; however, there was no such association with the direct cost of typhoid. Finally, households in Balochistan spent significantly more on the cost of illness than households in other provinces.

Health Profile of Selected Districts — A Case Study

The burden of WASH diseases and childhood undernutrition varies significantly across regions, depending on the state of the WASH infrastructure in these regions. Some districts in Punjab and Sindh were particularly vulnerable to WASH diseases owing to a lack of spending in WASH services. This chapter presents the health profile of the selected districts of Punjab and the nutritional profile of children under five in Punjab and Sindh.

6.1— Case Profile of WASH diseases in Selected Districts of Punjab

WASH is a significant public health concern in Pakistan. Households that lack access to clean drinking water and sanitation facilities and suffer from poor hygiene practices and inadequate health education are most vulnerable to these diseases. The most common WASH diseases in Pakistan are diarrhea, malaria, typhoid, cholera, and urinary tract infections. People in South Punjab are most vulnerable to these diseases because they lack access to safe drinking water and sanitation and hygiene facilities.

Table 15 presents the case profile of WASH diseases for the ten selected districts of Punjab. This reveals that Bahawalnagar, Bahawalpur, Muzaffargarh, and Rajanpur are some of the most affected districts in terms of reported cases. We found that Bahawalpur, Muzaffargarh, and Rajanpur districts had the highest number of reported cases of malaria, followed by Bahawalnagar and D.G. Khan districts. Moreover, the Bahawalpur district also has the highest number of cases of diarrhea, followed by the Muzaffargarh and Lodhran districts.

Similarly, Muzaffargarh, Multan, Rajanpur, Bahawalpur, and Bahawalnagar have reported the highest number of cases of typhoid fever. Of all the diseases, the highest number of reported cases were those of urinary tract infections, in which Multan district was at the top, followed by Muzaffargarh, Bahawalpur, and Khushab districts. The Chiniot District reported the highest number of cholera cases. Other districts with a high case profile for cholera were Bahawalnagar and Muzaffargarh.

6.2 — Childhood Undernutrition in Punjab and Sindh

Stunting, underweight, and wasting rates were measured using height-for-age, weight-for-age, and weight-for-height z-scores. Children with z-score of two standard deviations below the median (-2SD) of the reference populations were classified as stunted, underweight, and wasted.

Table 15. Case profile of WASH diseases in selected districts of Punjab, 2022

District	Malaria	Diarrhea	Typhoid	Urinary tract infection	Cholera
Bahawalnagar	15367	7148	8048	38663	6701
Bahawalpur	37671	17706	8072	60861	4405
Chiniot	10641	5012	7458	20794	30552
D.G Khan	15173	2133	4624	53037	56
Khushab	2555	2967	5023	59312	5116
Lodhran	3520	6608	7155	35807	3409
Multan	4326	429	14083	108571	40
Muzaffargarh	28165	7737	17793	69298	5896
Pakpattan	4420	2942	9719	32735	3866
Rajanpur	24459	3100	14868	27234	1346

The results from MICS 2018 revealed that every third child under the age of five was stunted in Punjab. In addition, 21.2% of the under-five children were classified as underweight, and 7.5% of the children suffered from wasting. The data from Sindh MICS 2019 suggest that every second child under the age of five was stunted, indicating that the stunting rates were 18 percentage points higher than the prevailing rates in Punjab. Similarly, 41% of the children in Sindh were underweight and 15% were wasted, which was almost double the corresponding rates in Punjab.

6.3 — Trend Analysis in Punjab

Figure 10 presents the trends in childhood undernutrition in Punjab. Over the past decade, stunting rates have sharply declined from 42% in 2007 to 31.5% in 2018, that is, a 10.5 percentage point decrease [28]. However, the prevalence in underweight children has not changed significantly. In contrast, the prevalence of wasting increased from 13% in 2007 to 17.5% in 2014 before a sharp decline in 2018.

Figure 11 shows that the stunting rates were relatively higher in South Punjab. The prevalence of stunting declined at a faster rate in Central-North Punjab than in South Punjab, by 11.53 percentage points in the former and 10.1 percentage points in the latter.

A trend analysis of selected districts of Punjab suggests that Multan, Lodhran, Chiniot, and Bahawalpur districts have recorded higher stunting

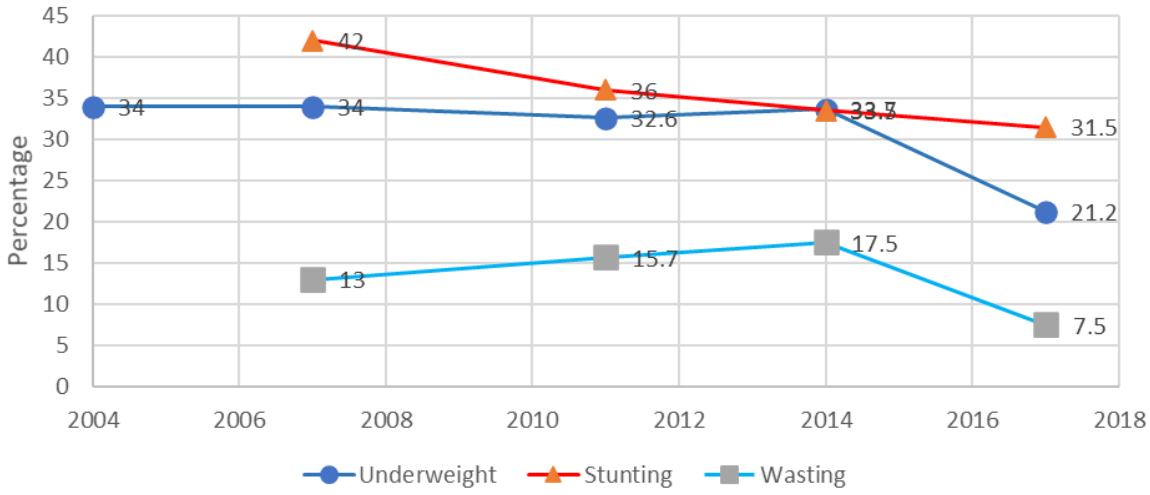


Figure 10. Trends of stunting, underweight, and wasting in Punjab

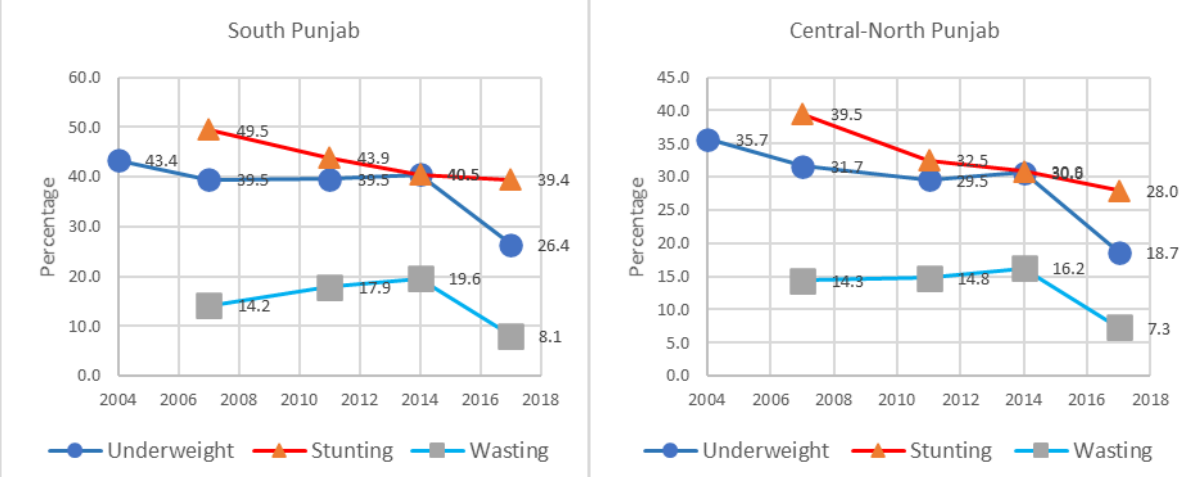


Figure 11. Trends of stunting, underweight, and wasting in South, and Central-North Punjab

[28] The trend analysis of Punjab is based on the MICS survey rounds conducted in 2004, 2007, 2011, 2014, and 2018. However, the MICS survey conducted in 2004 did not report the stunting and wasting rates.

rates in 2018 over 2014, while the stunting rates have remained stagnant in Bahawalnagar, Khushab, and Rajanpur districts (Figure 12). These results suggest that the intervention strategies were not equally successful in all the districts.

Figure 11 also reveals that the prevalence of underweight children stagnated until 2014, but there was a dramatic decline in the rate from 34% in 2014 to 21.2% in 2018, which may be attributed to Vision 2025, under pillar IV relating to energy, water, and food security [29]. If the current trend continues, further improvements can be anticipated over the next decade. The region-specific disaggregated data presented in Figure 11 mimics the aggregate trend; however, the prevalence of underweight children in South Punjab (26.4%) was still higher than that of the other Punjab (18.7%).

Figure 12 shows that, compared with other districts, the prevalence of underweight children in 2018 was highest in Rajanpur and D.G. Khan districts. The wasting rates in Punjab increased between 2007 and 2014 but saw a dramatic decrease in the next four years, falling from 17% in 2014 to less than 8% in 2018, halving the number of wasted children in the province. The decline in wasting rates may be attributed to government policies under Vision 2025 [29]. If these trends continue, greater improvement in the wasting rate will be expected in the next decade. Unlike the stunting and underweight rates, the wasting rates for the South and other Punjab are roughly in a similar range. In summary, comprehensive strategies are required to promote investment in nutrition-specific programs to improve child malnutrition in lagging districts.

6.4 — Trend Analysis in Sindh

Trend Analysis of Childhood Undernutrition in Sindh:

Figure 13 presents a trend analysis of childhood

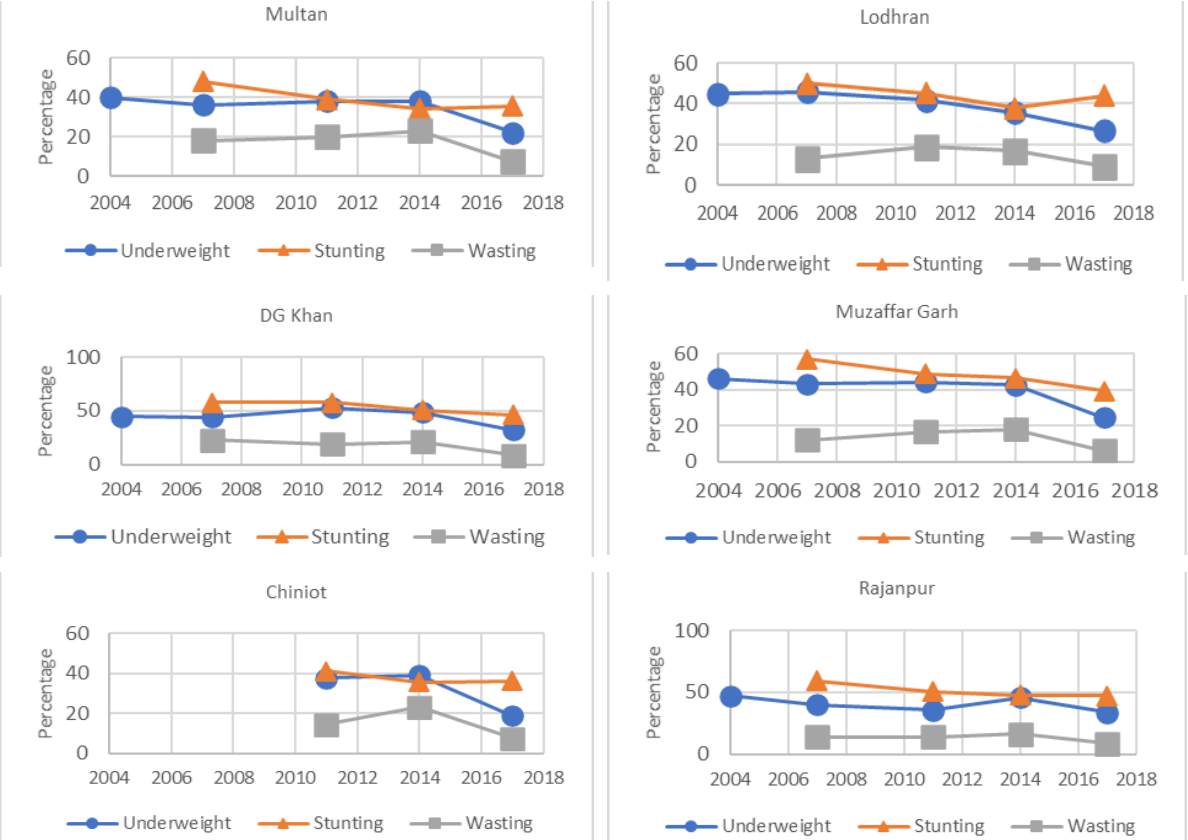


Figure 12. Trends of stunting, underweight, and wasting in selected districts of Punjab (continued on next page...)

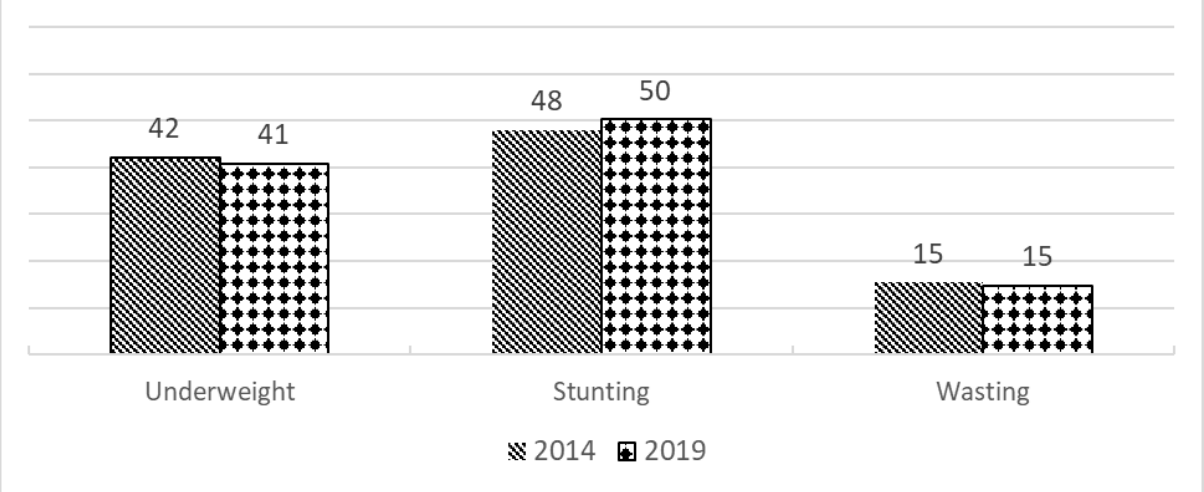
[29] Vision brochure rev (pc.gov.pk) retrieved from "https://www.pc.gov.pk/uploads/vision2025/Vision-2025-Executive-Summary.pdf"

Figure 12. (Continued from previous page) - Trends of stunting, underweight, and wasting in selected districts of Punjab

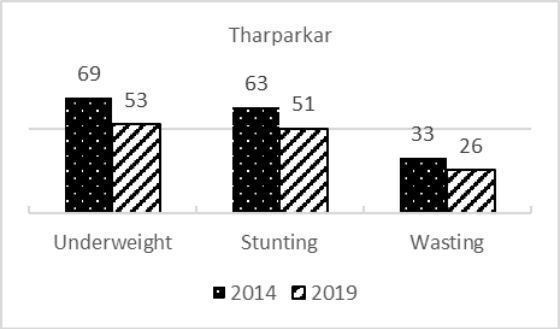
undernutrition in Sindh. It is concerning that childhood undernutrition in Sindh has either increased or remained constant over the past few years [29].

Figure 14 presents the trend analysis of selected districts of Sindh, which shows that Sujawal, Tando Mohammad Khan, and Thatta recorded higher stunting rates in 2019 than in 2014. Similarly, Sujawal and Badin districts have higher underweight rates and Kambar Shahdad Kot and Badin have higher wasting rates in 2019 over 2014.

The highest incidence of stunting prevailed in Sujawal (73%), Jacobabad (62%), Thatha (62%), Tando Mohammad Khan (60%), Badin (60%), and Umberkot (59%) districts. These results suggest that the intervention strategies in Sindh were not equally successful in all districts. These results warrant further effective interventions to address this issue.



[29] The trend analysis of Sindh was based on the MICS survey rounds conducted in 2014 and 2019. Another Sindh MICS survey was conducted in 2004, but the data have not been released for public use and were hence excluded from this analysis.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Underweight
Stunting
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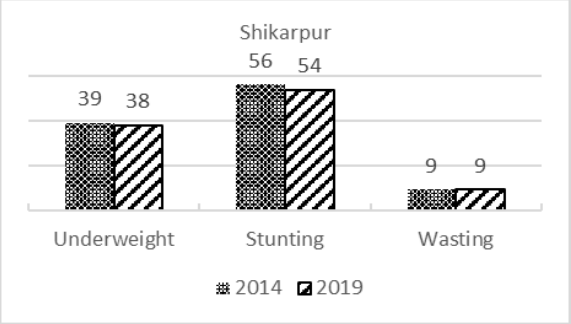
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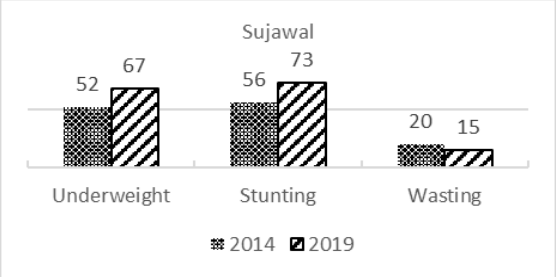
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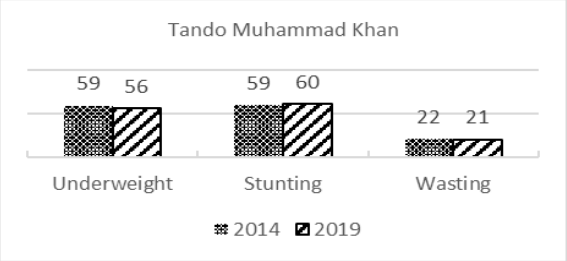
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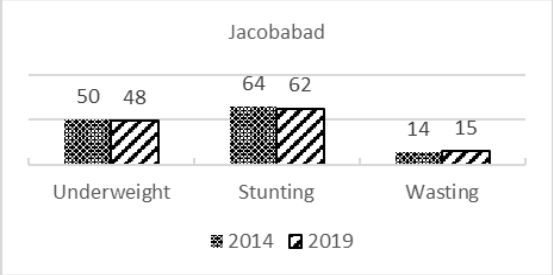
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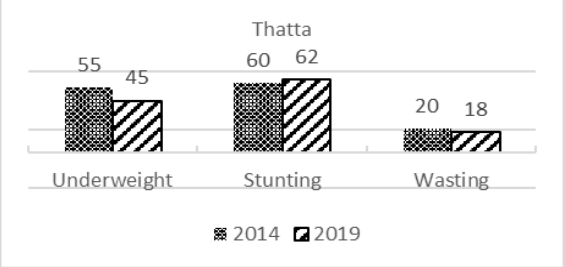
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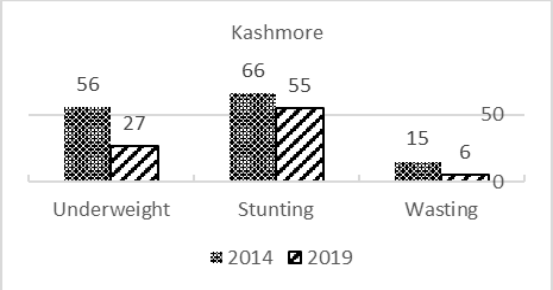
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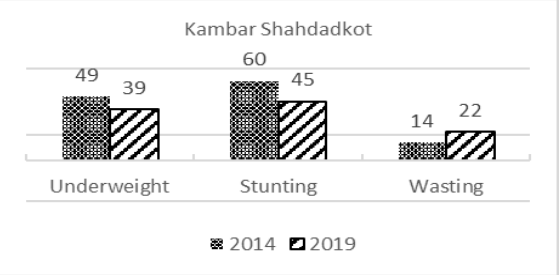
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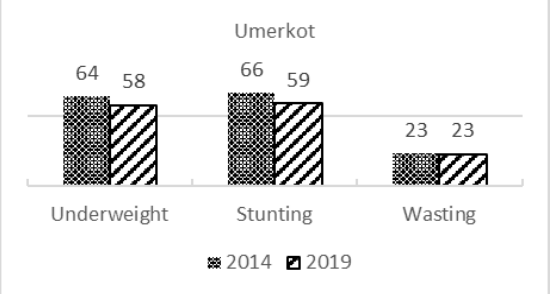
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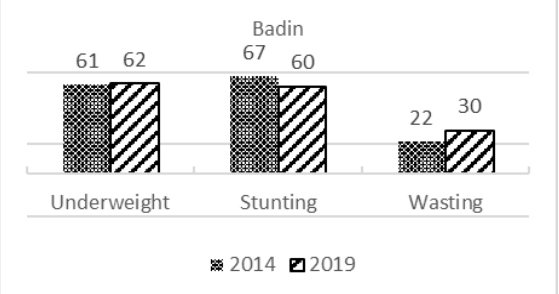
Badin
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Conclusion

Shahnaz Baksh, WASH club leader delivering a session on Hygiene in her school. District, Thatta, Sindh Province, Pakistan. (July 2022)

This report is the first of its kind on the cost of malaria, diarrhea, and typhoid in Pakistan. The report calculated the cost of illness from the perspective of households to measure the economic burden of WASH-related diseases. It calculates nationally representative direct and indirect costs of the three diseases using the human capital method by employing retrospective data from the latest round of HIES 2018-19. The analysis was conducted using a disease prevalence-based approach. The report introduced new methods for imputing disease days from out-of-pocket costs and applied wage equation models to predict the opportunity cost of lost disease days for patients. The report also examined how households in Pakistan used WASH services to prevent the incidence of WASH diseases and deaths from complications arising from these diseases.

The premise of this report is that lack of access to WASH services is a key challenge for a large proportion of the population, particularly in rural areas. Improved WASH services can protect households from potential productivity losses caused by illness and caregiving. The basic premise of the report comes from the aggregation of the direct and indirect costs of malaria, diarrhea, and typhoid to the affected households by applying the household weights to the cost of illness measured in the reference period of three-months.

We find that the households in Pakistan lose 32 million days due to these illnesses, which incurs an annual economic burden of PKR 116.13 billion in 2018 -19 prices, which comes to PKR 209.23 billion in March 2023 prices. The National Health Accounts Pakistan 2019-20 also calculates the direct cost of illnesses; it does not calculate the indirect cost to households, which is the main contribution of this report.

Overall, the economic burden is 53% due to direct costs and 47% due to indirect costs; however, households in Sindh pay a higher proportion in the form of direct costs than households in Punjab. We also found that the health burden is significant for those who are already facing hardships in the country, which highlights the need for interventions to prevent the incidence of diseases in vulnerable groups to mitigate negative impacts on households.

The report also found that the average cost of illness per episode of malaria, diarrhea, and typhoid was PKR 5688, PKR 1757, and PKR 7817 in 2018-19 prices. The health burden to households by type of disease was PKR 6375, PKR 1866, and PKR 8160 for malaria, diarrhea, and typhoid, respectively, in the reference period of three months. Moreover, the aggregate cost of the three diseases for households in the reference period was PKR 4905. The cost of illness is disproportionately borne by the poorest and poorer income quintiles who paid 16.8% of their household income, compared with 7.6% borne by the richest and richer income quintiles. The aggregate cost is the highest for adults and lowest for children aged less than five years.

Inadequate sanitation facilities force households to practice open defecation or to use shared toilets. The

report estimates that 53.8 million people in the country either defecate in the open or use shared toilets, consuming 3.56 million hours to access these facilities, of which 90% of the time is spent in rural areas. The report also estimated that the value of time spent accessing open defecation sites and shared toilets was PKR 215 billion in 2018-19 prices. This is a deadweight loss to households, as this practice augments the incidence of WASH disease.

Households in Pakistan spend PKR 168.3 billion on WASH services in 2018-19 prices. Most of the spending goes to hygiene services (64%), followed by water (19%) and sanitation (17%). The lack of water and sanitation infrastructure in parts of the country, particularly in Sindh and Balochistan, makes access to water and sanitation extremely challenging for affected households who spend disproportionately more than households from other regions. We found that an average household in Pakistan annually spends PKR 5048 on WASH services. However, households in Sindh and Balochistan faced severe hardships, as safe water and sanitation were not accessible to a sizable population. Spending on WASH services monotonically increases, revealing a significant gap in access to basic services, particularly for lower-income groups who are most vulnerable.

Multivariate analysis indicated that increased household spending on sanitation lowered the cost of diarrhea. For example, every PKR 1000 increase in sanitation expenditure lowered the cost of illness to households by PKR 159; however, no other WASH spending had a statistically significant correlation with the cost of malaria, diarrhea, and typhoid. These results may help inform strategies for reducing the economic burden of diseases. The report found that the cost of illness in Pakistan is positively affected by the average age of patients, head's education, days of illness, incidence of illness in the household, and the socioeconomic status of the household. Moreover, household size negatively affected the cost of malaria .

Finally, the report investigates the health profiles of selected districts of Punjab and explores the nutritional status of children under five years of age in Punjab and Sindh. The case profiles of the selected districts of Punjab indicate that Muzaffargarh, Rajanpur, Bahawalpur, and Bahawalpur are the most affected districts in terms of the WASH disease caseload. These districts require significant investment to mitigate the negative consequences of WASH. Moreover, there has been a remarkable decline in recent years in the stunting, wasting, and underweight rates in Punjab, but there is no such evidence from Sindh, where not only are the rates almost double those prevailing in Punjab but there are also no signs of improvement. The intervention strategies were not equally successful in all districts of the two provinces.

7.1 — Study Assumptions and Limitations

This study has some assumptions and limitations. Indirect cost calculations for the productivity loss of patients were based on the number of severe disease days. Following other studies (Khan et al., 2019; Sultana et al., 2021; Rheingans et al., 2012; Poulos et al., 2011), we assumed that the lost workdays were 70% of the total number of days for malaria, 40% for diarrhea, and 50% for typhoid disease days. Moreover, following other studies, caregiver time is assumed to be one-third of the total time lost by patients, which is valued at the average wage of other adults in the household. If the assumed values deviate from the true values, indirect cost calculations may be underestimated or overestimated.

In addition to indirect costs, expenditures on WASH services are based on several assumptions. First, the cost of fetching the surface water was calculated, assuming that the water was hauled by women and girls. This assumption could lead to an underestimation of costs if the imputed average wages of men and children, who also hauled water, were higher than the average wages of women [30]. Second, the HIES did not report the extra time spent accessing open defecation sites and shared toilets. In estimating the cost of sanitation, following the background data collected for UNICEF (2018) in India,

[30] For example, some estimates suggest that 72% of household water is hauled by female. See, Opinion: Women bear the brunt of Pakistan's water crisis | The Third Pole.

the report assumed that each household member spent 40 extra minutes per day accessing open defecation sites and 15 extra minutes accessing shared toilets. Third, this study assumed that spending on menstrual hygiene management was 80% of the reported expenditure on pampers, sanitary towels, cotton, toilet paper rolls, and tissue papers if there were four or more girls and women in the household; 70% if there were three girls and women; 60% if there were two girls and women; 50% if there was one girl or woman, and zero if there were no girls and women in the household who were menstruating. Therefore, the estimation of household spending on WASH services may be sensitive to these assumptions.

This study had some limitations. First, this report calculates the cost of illness for malaria, diarrhea, and typhoid from the patients and their families' perspective, which this report terms as the household perspective. The cost of illness may also be carried out from other perspectives, such as society, government, healthcare system, third-party payers, and business sector, which affect the type of costs included in the cost of illness calculations.

Second, the cost of illness due to urinary tract infections, Hepatitis A cholera, and other diseases, which are also associated with unsafe WASH, was not covered. Moreover, it does not include the health costs associated with other risks, such as the impact on pregnant women, low birth weight, infections, non -communicable diseases due to exposure to contaminated drinking water, and other diseases that are influenced by unsafe WASH.

Third, the indirect cost of illness does not estimate productivity losses borne by households associated with premature mortality because there is insufficient information in HIES 2018-19 regarding the causes of death. Hence, it was not possible to precisely label the deaths due to specific diseases.

Finally, the HIES 2018-19 data are representative at the national, provincial, and rural-urban levels. Therefore, caution should be exercised when interpreting the disaggregated numbers below these levels.

Asma, Kainat, and Falak, students at a middle school, are showing their clean hands after the hygiene session conducted by WaterAid Pakistan in District Muzaffargarh, Punjab Province, Pakistan. (March 2022)

References

Afroz, A., M.J. Alramadan, M.N. Hossain, L. Romero, K. Alam, D.J. Magliano, B. Billah (2018). Cost-of-illness of type 2 diabetes mellitus in low and lower-middle income countries: a systematic review, BMC Health Services Research, 18, 972.

Attanayake, N., J. Fox-Rushby, A. Mills (2000). Household costs of 'malaria' morbidity: a study in Matale district, Sri Lanka Household costs of 'malaria' morbidity: a study in Matale district, Sri Lanka, Tropical Medicine, and International Health, 5(9), 595–606.

Azizullah, A., M.N. Khan Khattak, P. Richter, D.-P. Hader (2011). Water pollution in Pakistan and its impact on public health: A review. Environmental International, 37(2), 479 – 497.

Butt, M. Daoud, S.C. Ong, M.U. Wahab, M.F. Rasool, F. Saleem, A. Hashmi, A. Sajjad, F.A. Chaudhry, Z-U. Babar (2022). Cost of Illness Analysis of Type 2 Diabetes Mellitus: The Findings from a Lower-Middle Income Country, International Journal of Environmental Research and Public Health, 19, 12611.

Chima, R.I., C.A. Goodman, A. Mills (2003). The economic impact of malaria in Africa: A critical review of the evidence, Health Policy, 63, 17 – 36.

Choi, Hyeon-Jin, Run-Whan Lee (2019). Methodology of estimating socioeconomic burden of disease using NHI data. In S. Reddy & A.I. Tavares (eds.), Evaluation of Health Services, IntecOpen. http://doi.org/10.5772/intechopen.89895

Cropper ML, et al. (1999). The value of preventing malaria in Tigray, Ethiopia. Washington DC: The World Bank, 1-75.

GoP (2020). Household Integrated Economic Survey (HIES), 2018-19. Pakistan Bureau of Statistics, Ministry of Planning, Development and Special Initiatives, Islamabad.

GoP (2022). Pakistan Economic Survey 2021-22, Economic Adviser's Wing, Ministry of Finance, Government of Pakistan, Islamabad.

Haq, M., U. Mustafa, I. Ahmad (2007). Household's willingness to pay for safe drinking water: A case study of Abbottabad district. Pakistan Development Review, Papers and Proceedings, 46(4), 1137–1153.

Heckman, James J., Lance J. Lochner, Petra E. Todd (2008). Earnings Functions and Rates of Return, Journal of Human Capital, 2(1), 1 – 31.

Houghton, J., S.R. Khandker (2009). Handbook of Poverty and Inequality, The World Bank, Washington, D.C.

Hulden, L. (2010). Household size explains successful malaria eradication, Malaria Journal, 9(Suppl 2): O18.

Jo, C. (2014). Cost-of-illness studies: concepts, scopes, and methods, Clinical and Molecular Hepatology, 20, 327-337.

Khan, M., H.Z. Mahmood, S. Noureen, K. Muhmood, M.I. Husnain, K. Hameed (2019). The health burden of malaria and household choices regarding treatment and prevention in Pakistan, Tropical Biomedicine 36(3), 664–676.

Khowaja, L.A., A.K. Khuwaja, P. Cosgrove (2007). Cost of diabetes care in out-patient clinics of Karachi, Pakistan. BMC Health Services Research, 7(1), 189.

Malik, M. Ashar, Murad M. Khan (2017). Economic Burden of Mental Illnesses in Pakistan, Journal of Mental Health Policy, and Economics, 19(3), 155 – 166.

Mara, D. (2017). The elimination of open defecation and its adverse health effects: a moral imperative for governments and development professionals, Journal of Water, Sanitation, and Hygiene for Development, 7(1), 1 – 12.

Mejia, N., F. Qamar, M.T. Yousafzai, J. Raza, D.O. Garrett, K. Date, T. Abimbola, S.W. Pallas (2020), Typhoid and Paratyphoid Cost of Illness in Pakistan: Patient and Health Facility Costs from the Surveillance for Enteric Fever in Asia Project II, Clinical Infectious Diseases, 71 (Suppl.3), S319.

Polachek, Solomon W. (2007). Earnings Over the Lifecycle: The Mincer Earnings Function and Its Applications. IZA Discussion Paper No. 3181.

Poulos, C., A. Riewpaiboon, John F. Stewart, J. Clemens, S. Guh, M. Agtini, D.D. Anh, D. Baiqing, Z. Bhutta, D. Sur, D. Whittington (2011). Cost of illness due to typhoid fever in five Asian countries, Tropical Medicine, and International Health, 16(3), 314–323.

Psacharopoulos, G. (1987). Earnings Functions. In G. Psacharopoulos (ed.), Economics of Education: Research and Studies, Pergamon, 218 – 223. https://doi.org/10.1016/B978-0-08-033379-3.50042-5

Riewpaiboon, A., M. Piatti, B. Ley, J. Deen, K. Thriemer, Lorenz von Seidlein, M. SalehJiddawi, C. Jana-Lui Busch, Wolfgang H. Schmied, S. M. Ali, The Typhoid Economic Study Group (2014). Cost of Illness Due to Typhoid Fever in Pemba, Zanzibar, East Africa, Journal of Health Population, and Nutrition, 32(3), 377 – 385.

Saba, N. (2016). Estimating cost of illness and factors affecting non-communicable chronic diseases among employees of working age: A Case of Pakistan, MPhil Health Economics Thesis, Pakistan Institute of Development Economics, Islamabad.

Sarker, A.R., Z. Islam, I.A. Khan, A. Saha, F. Chowdhury, A.I. Khan, F. Qadri, J.A.M. Khan (2013). Cost of illness for cholera in a high-risk urban area in Bangladesh: an analysis from household perspective. BMC Infectious Diseases, 13, 518.

Shcherbacheva, A., H. Haario (2017). The Impact of Household Size on Malaria Reduction in Relation with Alterations in Mosquito Behavior by Malaria Parasite, Journal of Multiple-Valued Logic, and Soft Computing, 29, 455–468.

Shepard, D.S., M.B. Ettling, U. Brinkmann, R. Sauerborn (1991). The economic cost of malaria in Africa. Tropical Medicine and Parasitology, 42, S1/199–S1/203.

Singh, M.P., K.B. Sahab, S.K. Chanda, L.L. Sabin (2019). The economic cost of malaria at the household level in high and low transmission areas of central India, Acta Tropica, 190, 344 – 349.

Sultana, R., S. P. Luby, Emily S. Gurley, Nadia A. Rimi, Sayeda T. Swarna, Jahangir A. M. Khan, N. Nahar, Probir K. Ghosh, Sushil R. Howlader, H. Kabir, S. Khan, Peter K. M. Jensen (2021). Cost of illness for severe and non-severe diarrhea borne by households in a low-income urban community of Bangladesh: A cross-sectional study, PLOS Neglected Tropical Diseases, June. https://doi.org/10.1371/journal.pntd.0009439

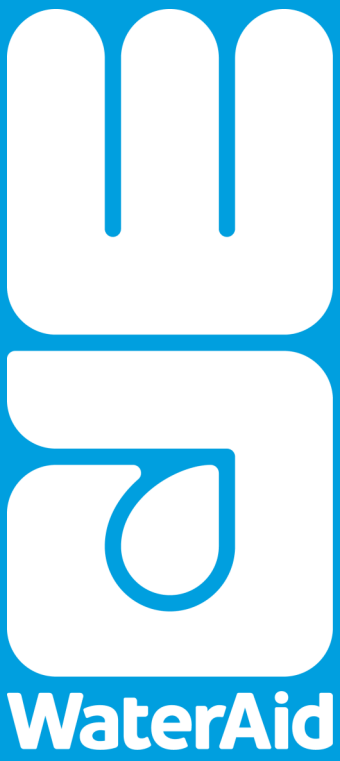
UNICEF (2018). Financial and Economic Impacts of the Swachh Bharat Mission in India, United National Children's Fund.

WHO (2009). WHO Guide to Identifying the Economic Consequences of Disease and Injury. Geneva.

World Bank (2010). The Economic Impacts of Inadequate Sanitation in Pakistan, World Bank, Washington, DC.

World Bank (2018). When Water Becomes a Hazard: A Diagnostic Report on The State of Water Supply, Sanitation and Poverty in Pakistan and Its Impact on Child Stunting, The World Bank, Washington, D.C.

WSP (2011). Economic Impacts of Inadequate Sanitation in India, Water and Sanitation Program, Flagship Report 68159.



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