SOCIO ECONOMIC INDICATORS' RELATIONSHIP WITH HOUSING CHARACTERISTICS: EVIDENCE FROM PAKISTAN

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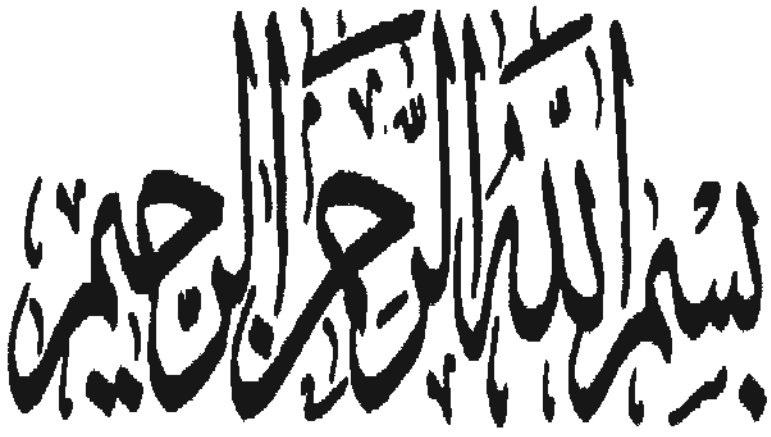

In the name of Allah,

The most Gracious, The most merciful.

APPROVAL SHEET

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"And say: My Lord increase me in knowledge."
(Qur'an, Ta-Ha 20:114)

"My Lord, put my heart at peace for me, make my task easy for me, and loose a knot from my tongue so they may understand my speech."
(Qur'an, 20:25-28)

Declaration

I hereby declare that this thesis, neither as a whole nor as a part thereof, has been copied out from any source. It is further declared that I have carried out this research by myself and have completed this thesis on the basis of my personal efforts under the guidance and help of my supervisors. If any part of this thesis is proven to be copied out or earlier submitted, I shall stand by the consequences. No portion of work presented in this thesis has been submitted in support of any application for any other degree or qualification in International Islamic University or any other university or institute of learning.

Rizwana kousar

DEDICATION

To my parents and my elder brother, M. Naeem whose prayers and encouragement are always with me.

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In the name of Allah, the Most Gracious and the Most Merciful, all praises to Allah for the strengths and His blessing in completing my research work. My humblest gratitude from the core of my heart is to our beloved prophet HAZRAT MUHAMMAD (S.A.W.W), who is the eternal fountain of knowledge and guidance for the whole mankind.

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ABSTRACT

The study has two main objectives. The first objective is to investigate the relationship between housing characteristics and household characteristics. The second objective is to examine the effect of household characteristics and housing characteristics on the children's health particularly diarrhoea. To comprehend the objectives, this study utilizes the data of Pakistan Social and Living Standards Measurement (PSLM) 2010-11. Multinomial logit model is applied to accomplish the first objective. The results show that household who live in urban area prefer better housing facilities. Higher income leads to be residing with better housing characteristics. Moreover, increase in the number of children always related to the substandard housing characteristics, holding household size constant. Increase in the age of household leads to better housing structure. Marital status of the head of household also matters. Married heads prefer better housing facilities. This study also explores the impact of housing characteristics and household characteristics on health status of the children. Results of the study also indicate that socioeconomic status of head/household, gender of the head, availability of the water sources, type of toilet, kids share in a household, mother's age and education significantly affect the health particular diarrhoea under five year children. The findings would be useful to plan housing programs which can provide the better and suitable residence to the different type of household.

Keywords: Housing characteristics; Household characteristics; Multinomial logit model; Health; Diarrhoea.

CHAPTER 1

INTRODUCTION

1.1 Background

Socio economic status (SES) of a person, group or a family is actually the combined measure of both economic and sociological characteristics and it is measured by education, occupational status, residential status, income and religion etc. [1]

Housing has a significant role in our lives. It affects all walks of human life directly and indirectly such as education, health, economic, political and social aspects [Sinha (1978)][2]. House is not only the name of a physical unit but it is actually a full package consisting of all complementary services like water supply, electricity connection and gas etc. [Follain and Jimenez (1985)]. Housing and household characteristics are related to each other [Mulder and Lauster (2010)]. There are many significant differences in the characteristics of the household like marital status, education level and age of head, etc. So, in order to estimate the demand for housing, these variables should also be considered along with the conventional economic variables [(Lee, 1963)].

According to housing finance review (2005-2011)[3], Pakistan is the 6th most populated country in the world having 173.5 million population. Pakistan has been facing

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[1] Mosby's Medical Dictionary, 9th edition. © 2009, Elsevier

[2] cited in Alaghbari, Salim, Dola, and Abdullah Abang Ali (2009)

[3] The report prepared by Infrastructure, Housing & SME, Finance Department State, Bank of Pakistan

rapid urbanization but the prevailing infrastructure has not been capable to meet the requirement or to absorb this speed of rapid urbanization. It gives rise to a lot of issues like substandard living conditions and poor housing conditions etc. which are affecting the whole economy of Pakistan. Provision of shelter or standard housing to the low income group is the basic issue of the developing countries [Irfan and Pant (2007)]. In Pakistan household spend a small fraction of their income on housing. In Sindh (Pakistan), 60-70% households spend only 10-20% and less than 10% household spend more than 40% of their income on housing [Ahmad, Ahmad, and Ali (2002)]. Most of the urban households have pucca houses and rural household have katcha houses [Saddozai, Hussain, Shah, and Manan (2013)]. Urban household enjoy better housing conditions rather than rural household with respect to basic facilities [Zaki (1981)].

Every household has different preferences in the selection of housing characteristics. The main reason behind these differences in preferences is the difference in the household's life cycle stages such as income and age of the head of household. They are significantly important in determining the household's preferences [Smith and Olaru (2013)].

Household size and income are the main variables that affect the household's preferences strongly [Arimah (1992)]. Larger families demand more space (number of rooms) considering income as constant. Moreover, demand for number of rooms is higher with the higher income than lower family income [Quigley (1976)]. The demand for rooms is more sensitive with respect to household size. The average age of household also

increases the demand for housing space (number of rooms). Marital status has insignificant impact on the demand for housing space [Du Rietz (1977)].

Rich households have higher probability to live in houses with better characteristics than poor households [Shah (2012)]. Education level is another determinant of demand for housing attributes. Higher education leads to increase in the probability of living in better quality houses.

Brueckner (2013) depicts very clear picture of link between housing characteristics and household characteristics. He is of the point of view that higher income and higher education are the main factors that lead to demand for houses with better structural conditions. He also indicates that the marital status of the head, average education and age of household, income and household size are the main variables that increase the demand of rooms.

There is also strong association of housing characteristics, household characteristics and health. Housing characteristics like source of drinking water, type of toilet, housing structure etc. and household characteristics like income, mothers education, fathers education etc. significantly affect the health status specially children's health.

There are many health problems which are created by housing and household characteristics like respiratory diseases, diarrhoea, malarial infections, gastrointestinal etc. but we only consider the diarrhoea in children under five as a proxy for health[4]. Diarrhoea is defined as "having two or more times loose or watery stools per day" [UNICEF (2010)].

[4] We have only diarrhoea as indicator of health in PSLM 2010-11.

Diarrhoea is mostly related to housing characteristics such as water supply and sanitation issues and is also widespread in the developing countries like Pakistan. The children in almost all developing countries are suffering from this disease [Esrey, Potash, Roberts, and Shiff (1991)]. Diarrhoea is the second most accrued diseases in the developing countries. Every year, about 1.5 million children die all over the world due to diarrhoea. The reason behind this worse situation is less safe drinking water, poor sanitation system, poor nutritional status and worse health status. Latest evidence shows that almost 2.5 billion people live in houses that have no proper sanitation facilities and about one billion people have no access to safe drinking water [UNICEF (2010)].

Lack of mother's education is also the main reason of diarrhoea [Mumtaz, Zafar, and Mumtaz (2014)]. Poor housing structure and diarrhoea have also significant and positive relationship. Better socio economic status decreases the chances of suffering from diarrhoea [D'souza (1997)]. Quality of water, availability of toilet facility, housing condition, level of education, number of children, family income and the sanitary condition are the main factors that affect the chances of occurrence or risk of diarrhoea [Godana and Mengistie (2013), Mihrete, Alemie, and Teferra (2014)].

1.2 Gap in the Literature

There are few studies that estimate the link between housing and household characteristics on different countries [Arimah (1992), Brueckner (2013), Follain and Jimenez (1985),Quigley (1976), Shah (2012)]. Some literature is also available on association between housing characteristics, household characteristics and health [Brueckner (2013), Cattaneo, Galiani, Gertler, Martinez, and Titiunik (2009), Currie,

Shields, and Price (2007), D'souza (1997), Gasana, Morin, Ndikuyeze, and Kamoso (2002), Shah (2012), Wolff, Schroeder, and Young (2001)]. Most of the studies relate diarrhoea to the housing characteristics specially water sources and sanitation. Some studies relate it to the household characteristics particular for mothers education and income [Al-Ghamdi, Bentham, and Hunter (2009), Checkley et al. (2004), Currie et al. (2007), El-Gilany and Hammad (2005), Godana and Mengistie (2013), Jalan and Ravallion (2003), Root (2011), Wilunda and Panza (2009)] etc. But we relate health with housing and household characteristics specifically, in the context of Pakistan.

According to our best knowledge, no study has been conducted that explore the link between housing and household characteristics in the context of Pakistan. It is worth mentioned that Ahmad et al. (2002) investigated the demand for houses in the province of Sindh (Pakistan). They compare rent to income ratios and estimate the income, price and household size elasticity for this area. They compare the living condition of homeowner and renters and conclude that the homeowners are living in better condition.

To bridge the above mentioned gap, we first explore the link between housing characteristics and household's characteristics and then investigate the impact of housing and household characteristics on the health particularly for diarrhoea among children under five years.

1.3 Research Objectives

The main objective of this study is to explore the link between housing characteristics and household characteristics. The study also attempts to identify the

housing characteristics and household characteristics which increases the chances of bad health particularly diarrhoea among children under five years.

1.4 Research Questions

Research questions of this study are:

i. Do the household characteristics affect the housing characteristics?

ii. Do the housing and household characteristics affect health status particularly diarrhoea among children less than five year?

1.5 Significance of the Study

Housing is a major component of the social infrastructure and has positive impact on economic development. If majority of the households have access to adequate housing, they are more likely to participate successfully in the social, political and economic activities of the nation. Lack of adequate housing facilities adversely affects the development and health of productive society and it is the main reasons for existence/creation of slums that are big hurdle in the way of economic growth.

This study may helpful in designing housing projects which may be more appropriate with the preferences of the households. These estimates can also be used to design housing programs which provide better and more appropriate types of housing to different types of households. Moreover, it may also helpful for the government in making such type of houses unit that have positive effect on the health of children and lead to eradication of diseases, especially diarrhea in children under five year.

1.6 Scheme of the Study

Chapter 1 comprises the introduction, objectives, and the significance of the study. The remaining part of the study is planned as follows. Chapter 2 reviews the existing empirical literature related to housing characteristics and household characteristics. It also reviews the literature related to housing characteristics, household characteristics and health. Chapter 3 defines data and methodology. Results are discussed in chapter 4 and Chapter 5 presents conclusions and policy implications.

CHAPTER 2

LITERATURE REVIEW

In this chapter, existing empirical literature is reviewed. The chapter is organised into two sections. First section reviews the literature in which link between household characteristics and housing characteristics is examined. The literature that explores the relationship of health status with housing characteristics and household characteristics is reviewed in the second section.

2.1 Literature That Explore the Link between Household Characteristic and Housing Characteristics

The existing literature shows that there is a significant association between housing characteristics and household characteristics.

Arimah (1992) using the data of Ibadan (Nigeria) for the year 1987 and 1988 shows that **education of the head** does not affect the **demand for number of rooms**, whereas Brueckner (2013) utilizing the data of Indonesian Family Life Survey (IFLS) for the year 1993 concludes that there is a positive and significant relationship between literate head and demand for number of rooms.

Literature concludes that **higher income** leads to increase the demand for number of rooms [Arimah (1992), Brueckner (2013), Du Rietz (1977), Follain and Jimenez (1985), North and Griffin (1993), Quigley (1976)]. There is a significant and positive impact of the income of the head on the number of rooms [(Arimah, 1992)]. North and Griffin (1993)

classify the household that belongs to rural area of the Philippine for the year 1978, into low, middle and high income groups and concludes that the demand for the number of rooms is significant and positive for middle and high income groups whereas the lower income group has no effect on demand for number of rooms.

The existing empirical literature concludes that demand for number of rooms significantly increases as the **family size** increases [Arimah (1992), Brueckner (2013), Du Rietz (1977), Quigley (1976), Tiwari and Parikh (1998), Witte, Sumka, and Erekson (1979)]. According to the Quigley (1976) larger household have more chances to choose larger space. Du Rietz (1977) estimates the elasticities by using the census data of 1970 for the household of Stockholm. He concludes that the demand for rooms is more sensitive to household size. The household size leads to increase the demand for more space. Tiwari and Parikh (1998) estimate the relationship between number of rooms and household size for India. They use urban household survey (UHS) data for the year of 1987-88. They conclude that there is a significant and positive relationship between size of household and number of rooms. Brueckner (2013) utilizes the data of Indonesian Family Life Survey (IFLS) for the year 1993 to explore the relationship between housing characteristics and household characteristics. He concluded that as the household size increases by one person, there are 26% increase in the demand for rooms. However, he finds that there is a negative relationship between **kids share** (number of children) and demand for number of rooms.

Existing literature indicates that as the **age of the household** increases, the demand for housing space (number of rooms) increases. Therefore, there is significant and positive relationship between age and demand of number of rooms [Arimah (1992), Brueckner

(2013), Du Rietz (1977)]. Literature related to the **marital status** of the household shows that, there is insignificant impact of the marital status on the demand for housing space [Arimah (1992), Du Rietz (1977)]. However, Brueckner (2013) shows that there is positive and significant relationship between demand for number of rooms and married head.

Literature also shows that the effect of increase in **income** is very much responsive to **roof material**. As the income increases then there is less chances to use foliage leaves roof or raw material [Brueckner (2013), Follain and Jimenez (1985), Shah (2012)]. The demand for better construction material for houses increases as the income increases [North and Griffin (1993)]. There is more probability for the **rural household** to be residing in the houses whose roofs are built of foliage roof. Houses that have substandard roof material, are less demanded by the **literate head**. Moreover, with an increase in the **family size** there is less chances to be residing in a house whose roof is made of leaves [Brueckner (2013), Shah (2012)]. **Average age** of household has significant and negative impact with respect to substandard roof material [Brueckner (2013)].

Income significantly affects the **wall material**. Literature shows that as the income increases, household are more likely to be lived in a house with better wall material [Brueckner (2013), Follain and Jimenez (1985), Shah (2012)]. According to Shah (2012) income has significant and negative impact on substandard wall material. Higher income household do not prefer to live in a house that has soft or bamboo wall. **Literate head** and larger **family size** decrease the chances to live in a house having bamboo wall, however, as the **share of the children** increases then there are more chances of having bamboo wall. Brueckner (2013) point of view is that in Indonesia there is less probability to be residing

in a house that's wall are made of wood or bamboo with an increase in the income, **education**, family size and **age**.

Irrespective of the level of **income** household are more likely to live in houses that have piped [North and Griffin (1993)]. **Female headed** household have more chances of having piped water facility [Jalan and Ravallion (2003)]. Shah (2012) and Brueckner (2013) explain that in **urban area** there are more chances of having **water connection or facility**. They also find that higher income, **education** and larger **family size** have more chances of having water connection. Moreover with an increase in the **kids share** there are more chance of having no water connection.

With an Increase in the **income** the probability of having **toilet facility** is also increases [Brueckner (2013), Follain and Jimenez (1985), Shah (2012)]. In the **urban area** there are less chances of having no toilet. Low income, **education, family size**, **age** and larger **kids share** increases the probability of residing without toilet [Brueckner (2013), Shah (2012)]. Moreover, if the **head is married** then there are more chances for own toilet [Brueckner (2013)].

Existing literature shows that, there is positive and significant relationship among **higher income, education**, **household size** and **electricity** [Brueckner (2013), Shah (2012)]. According to Shah (2012) **region** has significant and positive effect for the housing characteristics. There is higher probability for the urban household to be residing in a house where electricity is available. He also finds that as the **share of the children** increases then there are more chances of having other fuel for light than electricity. Brueckner (2013) explains that with an increase in the average **age of household** and **share**

of kids there are more chances of having electricity. **Married headed** household prefer those houses that have electricity connection.

The review of literature made above shows that there is a significant association between housing characteristics and household characteristics. The review also shows that if the household reside in the rural area then there is more chances of using foliage leaves as roof material, bamboo wall material, no proper piped water, no toilet facility and also have no electricity connection. With an increase in the education of head or education of household there are more chances of residing in a better housing structure. Literature concludes that with an increase in the income of head or income of household there are more chances of having piped connection, flush system, and better housing material for wall and roof and electricity connection. The review of the literature also helps us to conclude that with an increase in the household size, the demand of rooms, better housing roof and wall material, piped water facility, toilet facility and electricity increases. We also conclude from literature that gender of the head, age of the household or head and marital status of the head have significant association with housing characteristics.

The above reviewed literature is carried out on different countries like Indonesia, Nigeria, Philippine. This type of study was not conducted for Pakistan. Hence in this study we attempt to explore the link between housing characteristics and household characteristics for Pakistan.

2.2 Literature Related To Housing, Household Characteristics and Health (Diarrhoea)

There is a significant relationship among housing structure or characteristics and health of the children [Bbaale (2011), Brueckner (2013), Cattaneo et al. (2009), Du Rietz (1977), Gasana et al. (2002), Godana and Mengistie (2013), Shah (2012), Wolff et al. (2001)]. Wolff et al. (2001) analyse the data of two surveys which were conducted in rural communities of northern Malawi town of Ekwendeni in the months of March and August of 1997. They find the evidence that housing conditions have significant impact on the health of the children. They observe that the improvement in the housing conditions improve the health of the children who are under 5 years. Cattaneo et al. (2009) concluded that there is significant improvement in the health of the 5 years old children, by replacing the dirt floor to the cement floor in Mexico.

There are more chances of illness or bad health in those areas where income level is low [Brueckner (2013), Du Rietz (1977)]. Education level of parents also significantly affects the health of children. There is a positive relationship between education and health of children [Brueckner (2013), Currie et al. (2007), Shah (2012), Wolff et al. (2001)]. Currie et al. (2007) use the data of Health Surveys of England (HSE) for the period 1997-2002. They conclude that family income is not the only determinant of child's heath in England. Mother's education is also a factor of the child's health.

Better socio economic status decrease the chances of **diarrhoea** [D'souza (1997), El-Gilany and Hammad (2005), Gasana et al. (2002), Root (2011), S Siziya, Muula, and Rudatsikira (2013), Seter Siziya, Muula, and Rudatsikira (2009)]. Socio economic factors

such as education, income, housing standard etc. significantly affect the diarrhoea [Gasana et al. (2002), Root (2011)]. Brueckner (2013) and Shah (2012) study the effect of **electricity** and **family size** on the health of children. They conclude that presence of electricity and small family size also improves the health of children. Therefore, Gross, Schell, Molina, Leão, and Strack (1989) also examine that electricity is also an important factor in the context of health. They conclude that presence of electricity reduces the duration of diarrhoea.

The research is also conducted about the association between **region** of residence and **diarrhoea** in children. Some studies conclude that there are more chances of diarrhoea in urban areas [(G. Arif & Ibrahim, 1998), Mock, Sellers, Abdoh, and Franklin (1993), Seter Siziya et al. (2009)]. Mock et al. (1993) using the data of a cross sectional survey that was conducted in the Republic of Congo during the time period of Jun- October 1981. They show that children of the urban area have more chances of diarrhoea as compared to children of rural area. G. Arif and Ibrahim (1998) analysing the data of Pakistan Integrated Household Survey (PIHS) for 1996-97, suggest there are more chances of dirrhoea in the large urban cities like Karachi, Lahore and Rawalpindi due to the poor sanitation.

Some studies show that there is less or minimum chances of the diarrhoea in the children of urban areas [A. Arif and Naheed (2012), Bbaale (2011), El-Gilany and Hammad (2005), Gul and Amin (2011), Mamo and Hailu (2014), S Siziya et al. (2013)]. Mamo and Hailu (2014) analyse the data of a cross sectional facility based survey that is conducted in a Debrebirehan Referral Hospital which is located in a Amhara National Regional State in Ethiopia during the time period of February – Jun 2013 for the 483

children. They conclude that in rural areas there are 2 times more chances of diarrhoea under five year of children as compared to urban areas. Wilunda and Panza (2009) show insignificant association between diarrhoea and region of residence of household.

A significant association between diarrhoea and **housing construction material** is found in the literature. Bbaale (2011) analyze the data of nationally representative Uganda Demographic and Health Survey (UDHS) for 2006. He come up with the conclusion that there are less chances of diarrhoea under five years children, when the **house's wall, roof or floor** are constructed with bricks rather than mud [Bbaale (2011), Gross et al. (1989)]. A. Arif and Naheed (2012) using the data of Pakistan Social and Living Standards Measurement Survey (PSLM) 2004-05. Conclude that there are more chances of illness or bad health when the walls or roof of the houses are made of other type of material (wood/bamboo etc.) rather than RCC/RBC.

Literature does not find consensus about relationship between the water supply or **source of drinking water** and diarrhoea. Some of the existing empirical literature shows that improvement in the water supply significantly reduces the frequencies of dirrhoea [Checkley et al. (2004), Esrey et al. (1991), Gasana et al. (2002), Gross et al. (1989), Jalan and Ravallion (2003), Karki, Srivanichhakorn, and Chompikul (2010), Mekasha and Tesfahun (2003), Mihrete et al. (2014), Plate, Strassmann, and Wilson (2004), Root (2011), Seter Siziya et al. (2009), Wolff et al. (2001)]. Esrey et al. (1991) review 144 studies and conclude that improvement in the water supply significantly and negatively related to diarrhoea.

Mekasha and Tesfahun (2003) study the data of cross –sectional community based survey that is conducted from the month of February- march in 1994 for Jimma town (urban south western Ethiopia). They conclude that well (source of drinking water) significantly associated with diarrhoea. Seter Siziya et al. (2009) used the data of 14,676 children, from Iraqi Multiple Indicator Cluster Survey (IMICS) that is collected by United Nations Children's Fund (UNICEF) for the Iraq. They conclude that as compare to piped water, unprotected well and river water increases the chances of diarrhoea. Root (2011), using the data of rural Zimbabwe for the time period of October 1996 to august 1997, shows that children of household who have borehole water facility have less chances of diarrhoea than those children of household who have well or river as a source of drinking water. Mihrete et al. (2014) use the data of Demographic and Health Survey (DHS) for the year 2011 of Ethiopia and they observe that sources of drinking water significantly affect the risk of diarrhoea whether the sources are improved or not improved. On the other hand some studies suggest that there is no significant association between source of drinking water and diarrhoea [G. Arif and Ibrahim (1998), Bbaale (2011), El-Gilany and Hammad (2005), Godana and Mengistie (2013), Kakakhel et al. (2011), Tetteh (2013), Wilunda and Panza (2009)]. Kakakhel et al. (2011) conclude that water supply is not only the reason of diarrhoea.

Existing studies show that sanitation or **type of toilet** significantly reduces the frequencies of diarrhoea [G. Arif and Ibrahim (1998), Dessalegn, Kumie, and Tefera (2012), El-Gilany and Hammad (2005), Esrey et al. (1991), Gasana et al. (2002), Godana and Mengistie (2013), Gross et al. (1989), Kakakhel et al. (2011), Mihrete et al. (2014), Mock et al. (1993), Root (2011), Tetteh (2013)]. According to Mock et al. (1993) presence

of toilet significantly reduces the chances of diarrhoea. Mihrete et al. (2014) suggest that children, who live in a house where toilet is not available, have more chances of having diarrhoea. Wilunda and Panza (2009), A. Arif and Naheed (2012), Mekasha and Tesfahun (2003) and Bbaale (2011) are of the point of view that type of toilet insignificantly affect the dirrhoea under five year children.

Literature show that there is a significant relationship between **source of fuel for cooking** and chances of diarrhoea [Bbaale (2011), El-Gilany and Hammad (2005)]. According to Bbaale (2011) there are more chances of diarrhoea if wood and charcoal used as fuel for cooking as compared to gas. Literature also reveal that there is a significant association between electricity and chances of diarrhoea [Bbaale (2011),Gross et al. (1989)]. Gross et al. (1989) observe that **electricity** is the significant determinant of diarrhoea.

The existing body of literature reveal that association between dirrhoea and **education of parents** is positive. More the parents educated, less the chances of prevalence of diarrhoea [El-Gilany and Hammad (2005), Gasana et al. (2002), Godana and Mengistie (2013), Gross et al. (1989), Gul and Amin (2011), Mihrete et al. (2014), Mock et al. (1993), Mumtaz et al. (2014), Seter Siziya et al. (2009)]. According to El-Gilany and Hammad (2005) and Gul and Amin (2011) education of parents has strong association with diarrhoea. The risk of diarrhoea is lower if the parents are more educated. Seter Siziya et al. (2009), A. Arif and Naheed (2012), G. Arif and Ibrahim (1998), Bbaale (2011),Zeleke and Zewdie Aderaw Alemu (2014) and Dessalegn et al., (2012) observes that **mother's education** significantly reduces the risk of diarrhoea under five years children. According

to G. Arif and Ibrahim (1998) level of education of mothers is significantly reduces the risk of diarrhoea. Dessalegn et al. (2012) use a cross sectional community based survey. The survey is conducted in Mecha District, West Gojjam Ethiopia in February 2009. They conclude that children of higher educated mother have 5 time less chances of diarrhoea than those children who have less educated mother. Mumtaz et al. (2014) using the data of survey conducted during July - August 2011 in the Pediatrics ward and OPD Civil Hospital Karachi, Pakistan, observe that the main reason of diarrhoea is the lack of mother's education about diarrhoea. Some studies show that there is no impact of education on diarrhoea [D'souza (1997), Karki et al. (2010), Kolahi, Nabavi, and Sohrabi (2008), Mekasha and Tesfahun (2003), Wilunda and Panza (2009)]. According to Karki et al. (2010) level of education of caregiver /mothers are not statistically significant because less knowledge is enough for diarrhoea.

Some studies indicate that **income** has significant and negative association with diarrhoea and some other studies suggest that there is a no relationship between income and diarrhoea. According to D'souza (1997) and Karki et al. (2010) income of the household or head's income insignificantly affects the risk of diarrhoea. On the other hand, El-Gilany and Hammad (2005), Godana and Mengistie (2013), Wilunda and Panza (2009), G. Arif and Ibrahim (1998), Bbaale (2011) and S Siziya et al. (2013) conclude that income have negative and significant impact on the chances of suffering from diarrhoea under five year children.

The research on the relationship between **number of children** and chances of occurrence of diarrhoea is also concluded that there is a positive association between

number of children and chances of diarrhoea [Al-Ghamdi et al. (2009), A. Arif and Naheed (2012), D'souza (1997), El-Gilany and Hammad (2005), Godana and Mengistie (2013), Mihrete et al. (2014),Mock et al. (1993)]. Al-Ghamdi et al. (2009) uses the survey data, that was conducted from October 2004 to February 2005, for the Jeddah city, Saudi Arabia. They suggest that, as the number of children increases in the same house, the risk of diarrhoea also increases. Mock et al. (1993) use the survey data of 612 women. This survey was conducted in the five regions of the republic of Congo. They find that there are positive relationship between diarrhoea and number of children. Moreover, El-Gilany and Hammad (2005) suggest that as the household size increases the chances of diarrhoea is also increases. However, according to Godana and Mengistie (2013) there is an insignificant association between diarrhoea and **household size**.

Existing literature shows that **Mother's age** is also an important determinant of diarrhoea. As the mother grows older (40 or above) there are more chances of having diarrhoea [Mock et al. (1993)]. According to El-Gilany and Hammad (2005), Bbaale (2011) and A. Arif and Naheed (2012) as the age of the mother increases the frequency of diarrhoea under five year children decreases. They also suggest that if the age of the mother is less than 25 year then chances of diarrhoea are greater [El-Gilany and Hammad (2005)]. Karki et al. (2010), G. Arif and Ibrahim (1998) and Kolahi et al. (2008) suggest that majority of caregiver's or mother's age is not statistically significant for diarrhoea. Kolahi et al. (2008) analyse a cross sectional data collected from 2095 children of southern districts Tehran, Iran. This survey was conducted in May 2005. They conclude that there was no association between mother's age and chances of occurrence of diarrhoea.

Literature also show that if the caretaker is male then there are more chances of dirrhoea [Mock et al. (1993)]. On the other side according to Wilunda and Panza (2009) show that **gender** of caretaker insignificantly affect the diarrhoea.

The review of literature related to housing structure, household characteristics and health particularly diarrhoea show that housing construction material has significant relationship with diarrhoea. The literature concludes that Source of drinking water has contradictory association with diarrhoea. Some studies conclude that improved sources of drinking water significantly reduce the chances of diarrhoea and some studies evidence that there is no significant relationship between source of drinking water and chances of occurrence of diarrhoea. The studies on sanitation system or type of toilet also show mix results. Some studies indicate that there is a significant relationship between type of toilet and occurrence of diarrhoea and some studies conclude that type of toilet have no association with probability of occurrence of diarrhoea. Household characteristics also show the mix results with diarrhoea such as household size, number of children or kids share, income, mother's age and mother's education. Some studies conclude that they have significantly affect the diarrhoea under five year children while other show that they have no impact on diarrhoea.

By review of the literature made above we come to know that large number of studies are conducted on the determinants of diarrhoea. Some studies focus only on source of drinking water and sanitation and some focus only on mother's education etc. in different countries including Pakistan, but no attempt has been made to explore the link between

housing characteristics (housing environmental condition) and household characteristics with diarrhoea simultaneously in the context of Pakistan.

CHAPTER 3

DATA AND METHODOLOGY

This chapter is divided into four sections. First section develops the model which is used to analyse the data to accomplish the objectives of the study. Second section explains the estimation technique. Third section contains data and its sources and fourth section defines variables and their categories related to housing characteristics, household characteristics and health.

3.1 Model Specification

This section is divided into two subsections according to the objectives of the study. The first subsection develops the model to accomplish first and main objective of the study that examine the link between housing characteristics and household characteristics. Multinomial logit model is specified to explore the relationship between housing and household characteristics. Second subsection develops the model to examine the relationship of health status of children under five with housing and household characteristics. For this purpose logit model is utilized.

3.1.1 Multinomial Logit Model (MLM)

To accomplish our first objective we use multinomial logit model (MLM). Multinomial logit model is widely used in social sciences to analyse the unordered categories. It is very popular model. Its popularity stems from the fact that it is simply the extension of binomial logit model and the software that estimates the MLM is easily

available [Powers and Xie (2008)]. The multinomial logit model is firstly proposed by Luce in 1959 [Cameron and Trivedi (2005)]. The idea behind this model is to compare more than two categories at one time [Powers and Xie (2008)]. This model is used by Quigley (1976) and Smith and Olaru (2013).

In our analysis we use housing characteristics as dependent variable, which have more than two unordered categories. Therefore, in our study multinomial logit model is appropriate model for the analysis.

MLM is actually the extension form of the binomial logit model. The general form of logit model is

$$P(Y_i = 1) = \frac{exp(\beta_1 + \beta_2 x_i)}{1 + exp(\beta_1 + \beta_2 x_i)} \quad (1)$$

The extension form of logit model is

$$p(Y_i = j) = \frac{exp(\beta_{jo} + \beta_{j1} x_i)}{\sum_{k=0}^{k} exp(\beta_{ko} + \beta_{k1} x_i)} \quad j = 0, \ldots\ldots, k \quad (2)$$

Eq (2) is called the multinomial logit model where $Y_i \epsilon$ (0, 1, 2,..., k). In eq (2), "i" shows the households, "j" shows the housing alternatives or categories, "x" shows the household characteristics and "β_k" is the covariate effects of response category with reference to base category. One category is set to be zero to solve the issue of identification and make the probabilities equal to one [Cameron and Trivedi (2005)]. Response probability must equal to unity.

$$p(y_i = 0) = \frac{1}{1 + \sum_{k=1}^{k} ex\,p(\beta_{ko} + \beta_{k1} x_i)} \qquad j = 0 \quad (3)$$

$$p(y_i = j) = \frac{exp(\beta_{jo} + \beta_{j1}x_i)}{1 + \sum_{k=1}^{k} exp(\beta_{ko} + \beta_{k1}x_i)} \qquad j \neq 0 \tag{4}$$

We can express the coefficients of multinomial logit model only in terms of relative probabilities. To calculate the actual probabilities, we need to calculate marginal effects. For the categorical variables discrete change can be measured, whereas for the continuous variables instantaneous rate of change is measured.

To calculate the marginal effect eq (5) is used [Long and Freese (2006)].

$$\frac{\partial p(y_i = k)}{\partial x_i} = p(y_i = k)\left\{\beta_{k1} - \sum_{j=0}^{k} p(y_i = j)\beta_{j1}\right\}$$

Or

$$\frac{\partial p(y_i = k)}{\partial x_i} = p(y_i = k)\left\{\frac{\beta_{k1} - \left[\sum_{j=0}^{k} \beta_{j1} \exp(\beta_{jo} + \beta_{j1}x_i)\right]}{1 + \sum_{k=1}^{k} \exp(\beta_{ko} + \beta_{k1}x_i)}\right\} \tag{5}$$

Here the marginal effects show the effect of change in "x" on the probability of the alternatives that household can choose, keeping all other variables constant at their average value.

To estimate the impact of household characteristics on housing characteristics, we estimate following equation;

$$\text{Housing characteristics} = \alpha + \beta_1(\text{Region}) + \beta_2(\text{Heducation}) + \beta_3(\text{heducation}) + \beta_4(\text{Tincome}) + \beta_5(\text{Hsize}) + \beta_6(\text{kidshare}) + \beta_7(\text{Hgender}) + \beta_8(\text{Avrgage}) + \beta_9(\text{Hmaritalstatus}) + \varepsilon \quad (6)$$

In eq (6) housing characteristics are used as a dependent variable. We use six categorical variables as a representative of housing characteristics

1= Roof material

2= Wall material

3=Source of drinking water

4=Type of toilet

5= Source of fuel for cooking

6= Source of fuel for lighting

Each variable is divided into different unordered categories. For instance roof material is categorized into three categories: RCC/RBC, wood/bamboo and other roof material.

Household characteristics are used as independent variables. Which are defined below

Region = The region means that whether household belongs to rural or urban area. It is a dummy variable.

Heducation = Head is literate or not. It is dummy variable.

heducation = Maximum years of education of head of household.

Tincome = Total income of household.

Hsize = Number of members above 10 years in the household.

Kidshare = Number of children up to 10 years in the household.

Hgender = Gender of the head of household. It is dummy variable.

Avrgage = Average age of household

Hmaritalstatus = Marital status of head of household.

The number of rooms in the housing characteristics is the only dependent variable which is not a categorical variable. Multinomial logit model for this variable is not applicable. So we use following equation to analyse the effect of household characteristics on number of rooms.

$$\text{Number of rooms} = \alpha + \beta_1 (\text{Region}) + \beta_2 (\text{Heducation}) + \beta_3 (\text{heducation}) + \beta_4 (\text{Tincome}) + \beta_5 (\text{Hsize}) + \beta_6 (\text{kidshare}) + \beta_7 (\text{Hgender}) + \beta_8 (\text{Avrgage}) + \beta_9 (\text{Hmaritalstatus}) + \varepsilon \quad (7)$$

3.1.1a Testing the Assumptions of Multinomial Logit Model

Multinomial logit model is mostly used in research because it has no complicated assumptions like normality, linearity or homoscedasticity. However, it has some other assumptions like large sample size, Independence of Irrelevant Alternatives (IIA) etc.

We use some tests to check the validity of multinomial logit model (MLM) which are discussed below.

Tests of Independent Variables;

To check the significance of each independent variable we can perform Wald and likelihood-ratio (LR) test [Long and Freese (2006)]. Since the results of Wald test and LR test are same that's why we use only Wald test to check the significance of each independent variable.

Tests for Combining Categories of Dependent Variable;

We also check whether the alternatives of dependent variable are different from each other or not. If the alternatives are same, then by combing categories we can get more efficient estimates. In order to decide whether we can combine the categories or not, we can use Wald or likelihood-ratio LR test [Long and Freese (2006)].

Test for Independence of Irrelevant Alternatives (IIA)

It is very important assumption of the multinomial logit model. If this assumption does not hold then we cannot apply this model. Therefore, IIA assumption means including or excluding of some alternatives (categories) does not affect the outcome of other

alternatives. The model will also be best when the alternatives or categories are different from each other but not substitutable. Long and Freese (2006) explain that to test the independence of irrelevant alternatives (IIA) assumption, there are two tests; that are Hausman and Small-Hsiao test. In 1984 Hausman and McFadden proposed Hausman test. In 1976 Tye and Train proposed another test that was likelihood ratio test and later in 1985 this test was upgraded by Small and Hsiao.

Moreover, the results of the test of all the assumptions of the multinomial logit model are reported in appendix A.

3.1.2 Logit Model (LM)

To accomplish our second objective that is relationship of health status of children under five year with housing characteristics and household characteristics we use binary logit model. The logit model is widely used in social, business and health sciences. The reason behind is the easy interpretation of the coefficients of logit model [Hosmer, Taber, and Lemeshow (1991)].

The dependent variable that indicates the health of the children is binary variable. It takes the value 1 if child suffers from diarrhoea otherwise zero. Therefore, we cannot use the simple ordinary least square (OLS) method for estimation. To empirically estimate the relationship among health, housing and household characteristics we use logit model. In existing literature, logit model is already used to explore the link between health, housing and household characteristics by Al-Ghamdi et al. (2009), A. Arif and Naheed (2012), Dessalegn et al. (2012), Godana and Mengistie (2013), Mihrete et al. (2014), Wilunda and Panza (2009) and Seter Siziya et al. (2009).

The general form of logit model is reported in eq (8);

$$P(Y_i = 1) = \frac{exp(\beta_1 + \beta_2 x_i)}{1 + exp(\beta_1 + \beta_2 x_i)} \quad (8)$$

In eq (8) "x_i" shows vector of independent variable, "β" shows all the coefficients. The eq (8) is known as the logistic distribution function.

The probability when Y_i=0 is written as

$$P(Y_i = 0) = \frac{1}{1 + exp(\beta_1 + \beta_2 x_i)} \quad (9)$$

We also calculate marginal effects to reach the actual probabilities. To calculate the marginal effects we take the derivative of eq (8) with respect to "x"

$$\frac{\partial p(Y_i = 1)}{\partial x} = \frac{exp(\beta_1 + \beta_2 x_i)}{1 + exp(\beta_1 + \beta_2 x_i)} \beta \quad (10)$$

In eq (10) the marginal effects show the effect of change in independent variable, holding all other variables constant at their average. "β" is the coefficient of housing and household characteristics.

To estimate the effect of housing and household characteristics on health, the following equation is used;

$$Y_i = \alpha + \beta_1 (\text{Region}) + \beta_2 (\text{Rooms}) + \beta_3 (\text{Roof material}) + \beta_4 (\text{Wall material}) + \beta_5 (\text{Drinking water}) + \beta_6 (\text{Type of toilet}) + \beta_7 (\text{Fuel for coking}) + \beta_8 (\text{Fuel for lighting}) + \beta_9 (\text{Hgender}) + \beta_{10} (\text{Hsize}) + \beta_{11} (\text{kidshare}) + \beta_{12} (\text{Tincom}) + \beta_{13} (\text{Age}) + \beta_{14} (\text{Mother's education}) + \beta_{15} (\text{Mother's level of education}) + \varepsilon \quad (11)$$

Here Y_i is use as dependent variable.

$$y = \begin{cases} 1 \; children\ had\ diarrhoea & p \\ 0 \; children\ had\ not\ diarrhoea & 1-p \end{cases}$$

Independent variables are defined below

Rooms = Number of rooms in a house

Roof material = Material that is used to build roof of a house. It is dummy variable.

Wall material = Material that is used to build walls of a house. It is dummy variable.

Drinking water = Source of drinking water. It is dummy variable.

Type of toilet = Type of toilet facility available to a household. It is dummy variable.

Fuel for coking = Source of fuel to cook food. It is dummy variable.

Fuel for lighting = Source of fuel for lighting used by household. It is dummy variable.

Age = Age of the mother.

Mother's education = Mother is literate or not.

Level of education = Maximum number of years of education of mothers.

3.1.2a Assumptions of Logit Model

Although logit model does not assume linearity, normality or heteroscedasticity but it has some assumptions which are as follows:

i. Dependent variable should be binary. It means dependent variable can take only two values 0 and 1.
ii. In the logistic regression P(Y=1) shows the occurrence of an event.
iii. There should be no specification error. Model neither be over specified nor under specified. In other words model should be correctly fitted.
iv. There should be no multicollinearity among independent variables.
v. Logit model is estimated by maximum likelihood (ML) technique. It needs more cases per independent variable for estimation. So Logit model needs large sample size.

Moreover, the results of tests of assumption iii and assumption IV of the logit model are reported in appendix B.

3.2 Estimation Technique

The study has two main objectives. First objective of the study is to explore the link between housing characteristics and household characteristics. To accomplish this objective we use maximum likelihood technique that is also used by Brueckner (2013) and

Shah (2012). Moreover, to explore the link between demand for number of rooms and household characteristics ordinary least square (OLS) is employed. This technique is also used by Brueckner (2013) and Shah (2012). Second objective of our study is to find the relationship of health of children under five with housing characteristics and household characteristics. In order to achieve this objective we use maximum likelihood technique. It is also used by A. Arif and Naheed (2012). Maximum likelihood technique (MLT) was firstly purposed by Fisher in (1912). This technique is about the maximization of the likelihood function. It is very common and powerful technique when the sample size is very large.

3.3 Data and Data Sources

Data is taken from the Pakistan Social and Living Standards Measurement (PSLM) for the year 2010-11. This survey was planned to collect information about the social, demographic and economic indicators of household in Pakistan for a particular year. The first survey was carried out in 2004 and will be continued up to 2015. This survey provides the information about the social indicators as well as household size, employment status, sources of income, consumption and saving etc. Total sample size of 2010-11 PSLM survey is 16,341 households. The proportion of sample size drawn from Punjab, Sindh, Khyber Pakhtunkhwa (KPK) and Baluchistan is 42.56%, 25.08%, 18.08% and 14.29% respectively. In addition to it, the PSLM also categorize the households into rural and urban areas. Therefore, 40.32% and 59.68% sampled household are taken from urban and rural households respectively. This study uses three types of variables which relate to housing

characteristics, household characteristics and health. Moreover, Health indicator is also present in PSLM.

3.4 Variables[5]

The table 3.3.1 reports the housing characteristics and their categories. The variable rooms mean the number of room in a house. It is one of the dependent variable which is a continuous variable.

All other variables are categorical and have three categories. The variable 'roof material' shows the material of the house's roof it contains RCC (reinforce concrete and cement) /RBC (reinforce bricks and cement), wood/bamboo and other than that. The variable 'wall material' has also three categories which are Burnt bricks/blocks, raw bricks/blocks and other wall material e.g. stone and wood/bamboo etc. The variable 'source of drinking water' includes piped water (both inside and outside the home), hand pump and other sources like motor pump, well (both covered and open well), river, stream, pond, tanker truck, water fetcher, mineral water etc.

The variable 'type of toilet' consists of no toilet and Flush system. The flush system further includes three types, flush system linked to sewerage, connected with open drain, linked to septic tank. Third category is others type of toilet like privy seat, digged ditch etc. The variable 'source of fuel for cooking' means the fuel that is used by a household to cook food. It contains fire wood, gas and other sources that include kerosene oil, cow-dung

[5] It is worth stated that number of categories of housing and household characteristics reported and used in the analysis are different from PSLM's (2010-11) categories. We have reduced these categories keeping in view the percentage/ frequencies of responses under any categories.

cakes, electricity, coal and wooden coal etc. The variable 'fuel for light' consists of also three categories that are electricity, kerosene oil and other fuel for light e.g. gas, fire wood and candle etc.

Table 3.3.1 Housing characteristics and their categories

Housing characteristics	Description/categories
Rooms	Number of rooms in a house.
Roof material	1. RCC/RBC 2. Wood/bamboo 3. Other
Wall material	1. Burnt bricks/blocks 2. Raw bricks/mud 3. Other (stone and wood/bamboo etc.)
Source of drinking water	1.Piped water (both inside and outside the home) 2. Hand pump 3. Other [motor pump, well (both covered and open well), river, stream, pond, tanker truck, Water fetcher etc.]
Type of toilet	1. Facility not available 2. Flush system (flush system linked to sewerage, connected with open drain, linked to septic tank) 3. Other (privy seat, digged ditch etc.)
Source of fuel to cook food	1. Fire-wood

	2. Gas 3. Other (kerosene oil, cow-dung cakes, electricity, coal and wooden coal etc.)
Source of fuel for light	1. Electricity 2. Kerosene oil 3. Other (gas, fire wood and candle etc.)

Household characteristics and their categories which act as independent variables in the analysis are reported in table 3.3.2. Head's literacy status and level of education mean whether the head of household is literate or illiterate and maximum number of years of education got by head of household. 'Tincome' represent the total income of the household (in 10,000 rupiahs). 'Household size' means number of members in the household. The variable 'share of kids' indicates the number of children up to 10 years in the household. 'Head's gender' means whether the head of the household is male or female. 'Average age' represent the average age of household. The variable 'marital status show the marital status of the head of household. It has two categories. First is married and second is others that includes unmarried, widow / widower, divorced and Nikkah solemnised but rukhsati has not taken place.

To find out the relationship of health status with housing and household characteristics we also consider the mother's literacy status her level of education, age and diarrhoea. Diarrhoea is used an indicator of health status of children under five years.

Table 3.3.2 Household characteristics and their description/categories

Household characteristics	Description / categories
Region	1.Urban 2.Rural
Head's literacy status	Can the head read or write in any language? 1.Yes 2.No
Head's level of education	Maximum years of education of the head of Household
Tincome	Total income of a household. (in 10,000 rupees)
Size	The number of member/persons in the household (above 10 years) in the household
Kids share	The number of the children (up to 10 years) in the household
Gender	The gender of the head of household 1.Male 2.Female
Average age	Average of sum of the ages of household/members (above 10 years)
Marital status	Marital status of the head of household 1.Marreied 2.Others (unmarried, widow / widower, divorced and Nikkah solemnised but rukhsati not taken place.

For health objective

Diarrhea	**Has the child suffered from diarrhoea during last 30 days?** **1.No** **2.Yes**
Mother's literacy Status	Can the mother read or write in any language? 1.Yes 2.No
Mother's Level of education	**The maximum year of education of the mother**
Mother's age	Age of mothers

CHAPTER 4

RESULTS AND THEIR DISCUSSION

This chapter is divided into two main parts. First part contains descriptive analysis. Mean values of all the variables and their categories are discussed in the descriptive analysis. The results are interpreted in second part which is further divided into two sub sections according to the research objectives. The first subsection explains the results which are related to our first objective. Our first objective is to explore the link between housing and household characteristics by applying multinomial logit model which we developed in chapter 3. The second subsection interprets the results of relationship of health status of children under five with housing and household characteristics by using logit model. It is worth mentioning that PSLM (2010-11) provides only one indicator of health status that is diarrhoea in children under five year. So only diarrhoea is use as an indicator of health status of children.

4.1. Descriptive Analysis

All the percentage/mean values and frequencies of housing characteristics are reported in table 4.1.1. Thc table indicates that on average each household has 2.58 (almost 3) and 2.29 (almost 2) rooms in urban and rural area respectively. 49.31% urban and 11.70% rural household are residing in those houses whose roofs are built of RCC /RBC. It means that in urban area most common roof material is RCC /RBC. The table also indicates that 54.63% and 20.06% household use wood/bamboo in rural and urban area respectively. Whereas 30.63% and 33.66% household in urban and rural area respectively

live in those houses which are made of other type of roof material. The table also reveals that the most common wall material is burned bricks/blocks. 52.02% rural households and 86.13% urban households used burned bricks/blocks in their construction of houses. In rural area 36.97% and in urban area 12.16% households live in houses where wall are built of raw bricks or mud bricks. We can conclude that most of the urban households residing in those houses whose roof and wall are made of better material.

47.94% and 15.19% urban households and rural households respectively have piped water, 34.54% and 8.12% in rural and urban area respectively have hand pump facility as a source of drinking water. This table also reveals that most of the people in Pakistan about 43.94% in urban and 50.28% in rural areas, uses other sources of drinking water like motor pump, well (both covered and open well), river, stream, pond, tanker truck, water fetcher, mineral water etc. urban households also have accesses to better source of drinking water as compared to rural households.

The table also make it clear that most of the urban households (91.52%) have flush system facility in their houses, whereas only 46.61% rural households have facility of flush system. 21.92% households in rural area and only 2.41% households in urban area in which toilet facility is not available. In rural area 31.47% and in urban area only 6.07% household use other types of toilet.

Table 4.1.1 Housing characteristics and their summary statistics

Housing characteristics	Description / categories	Percentage/mean	
		Urban	Rural
Rooms	Number of rooms in a house.	2.58	2.29
Roof material	1. RCC/RBC	49.31	11.70
		(3,249)	(1,141)
	2. Wood/Bamboo	20.06	54.63
		(1,322)	(5,328)
	3. Other	30.63	33.66
		(2,018)	(3,283)
Wall material	1. Burned bricks/blocks	86.13	52.02
		(5,675)	(5,073)
	2. Raw bricks/mud	12.16	36.97
		(801)	(3,605)
	3. Other (stone and wood/bamboo etc.)	1.71	11.01
		(113)	(1,074)
Source for drinking water	1.piped water (both inside and outside the home)	47.94	15.19
		(3,159)	(1,481)
	2. Hand pump	8.12	34.54
		(535)	(3,368)
	3. Other [motor pump, well (both covered and open well), river, stream, pond, tanker truck, water Fetcher etc.]	43.94	50.28
		(2,895)	(4,903)

Type of toilet	1. Facility not available	2.41	21.92
		(159)	(2,138)
	2. Flush system (flush system linked to sewerage, connected with open drain, linked to septic tank)	91.52	46.61
		(6,030)	(4,545)
	3. Other (privy seat, digged ditch etc.)	6.07	31.47
		(400)	(3,069)
Source of fuel to cook food	1. Fire-wood	21.14	65.47
		(1,393)	(6,385)
	2. Gas	74.85	11.37
		(4,932)	(1,109)
	3. Other (kerosene oil, cow-dung cakes, electricity, coal and wooden Coal etc.)	4.01	23.15
		(264)	(2,258)
Source of fuel for light	1.Electricity	97.78	85.50
		(6,443)	(8,338)
	2. Kerosene oil	0.62	11.43
		(41)	(1,115)
	3.Other (gas, fire wood and candle etc.)	1.59	3.07
		(105)	(299)

Source: computed by the authors from the data available in PSLM 2010-11
Figure in brackets shows frequencies.

The table also shows that in rural area fire wood and in urban area gas is the most common source of fuel for cooking. Gas is considered as the best source of fuel for cooking. 65.47% rural and 21.14% urban households use fire wood for cooking. Gas facility for

cooking is available to 11.37% and 74.85% rural and urban households respectively. Only 4.01% in urban and 23.37% in rural area household use other source of fuel for cooking other than fire-wood and gas. The table shows that electricity is the most common fuel for light in both rural and urban area. 85.50% in rural area and 97.78% in urban area households have electricity facility. In rural area 11.43% and 3.07% households uses kerosene oil and other sources of fuel for cooking. In urban area only 0.62% and 1.59% households uses these sources.

The mean values/percentage of households characteristics are reported in table 4.1.2. The table shows that about 55% household in both rural and urban areas headed are literate. Maximum years of education of head are about 5 in both regions. The total income of the households in Rs.10, 000 is Rs.23.72 in urban and Rs.14.84 in rural areas. The mean household size in rural and urban area is about 5 members. The average age of a household above 11 years is almost same in both urban and rural area that is 33 years. Most of the head of households are married. The figure in the table reveals that 91.06% in rural and 89.10% in urban areas heads of household are married.

Table 4.1.2 Household characteristics and their summary statistics

Household characteristics	Description / categories	Percentage/Mean	
		Urban	Rural
Region		40.32 (6,589)	59.68 (9,752)
Head's literacy status	1.Yes 2.No	55.11 (3,631) 44.89 (2,958)	55.86 (5,447) 44.14 (4,305)
Head's level of education		5.11	5.06
Tincome		23.72	14.84
Size		4.69	4.46
Kids share		1.73	2.19
Gender	1.Male 2.Female	92.11 (6,069) 7.89 (520)	91.58 (8,931) 8.42 (821)
Age		33.01	33.29
Marital status	1.Marreied 2.Other (unmarried, widow /widower, divorced and Nikkah solemnised but Rukhsati not taken place).	89.10 (5,871) 10.90 (718)	91.06 (8,880) 8.94 (872)

Table 4.1.3 Summary statistics for health objective

For the health objective			
Diarrhea	1.No	79.85	79.05
		(4,442)	(7,779)
	2.Yes	20.15	20.95
		(1,121)	(2,062)
Mother's literacy status	1.Yes	47.87	20.98
		(2,663)	(2,065)
	2.No	52.13	79.02
		(2,900)	(7,776)
Mother's Level of education		4.48	1.56
Mother's age		33.2	33.1

Source: computed by the authors from the data available in PSLM 2010-11.
Figure in brackets shows frequencies.

For the health objective we also take data on Pakistan Social and Living Standards Measurement (PSLM) for the year 2010-11. The table also reveals that almost 20% children suffer from diarrhoea. 47.87% mothers in urban and 20.98% mothers in rural areas are literate and average years of education are almost 5 in urban and 2 years in rural areas. It means that more than half of the mothers in urban and 80% mothers in rural area are illiterate which may be one of the obstacle in the achievement of MDG (The Millennium Development Goals) of literacy.

4.2 Empirical Results

4.2.1.1 Link between Number of Rooms and Household Characteristics

The OLS estimates of number of rooms and household characteristics are reported in the table 4.2.1.1. The table reveals that rural household's consumption is 8% less as compared to urban households. Education of the head does not affect the consumption of rooms. The result of our study are consistent with the study of Arimah (1992). A one unit (10,000)[6] increase in the total income of the households increase the consumption for rooms more than 2 %. These results are in line with the results of Arimah (1992), Brueckner (2013), Du Rietz (1977), Follain and Jimenez (1985), North and Griffin (1993) and Quigley (1976).

Table 4.2.1.1 OLS estimates of link between number of rooms and households characteristics

Household characteristics	Number of rooms
Region	-0.080**
	(3.43)
Heducation	-0.020
	(0.58)
Heducation	-0.003
	(1.01)
Tincome	0.022**
	13.29
Hsize	0.194**

[6] We take total income of household in 10,000 rupees.

	29.93
Kidshare	**0.041****
	7.04
Hgender	0.534**
	12.16
Avrgage	0.019**
	15.04
Hmaritalstatus	-0.007
	(0.18)
Cons	**0.443****
	7.06
N	16,309
R2	0.27
Adj R-squared	0.2739

t statistics in parentheses

*** Shows significant at 1 percent level of significance**

**** Shows significant at 5 percent level of significance**

***** Shows significant at 10 percent level of significance**

Base categories

Urban region, Head literate, Male and married

One person increase in the household size as well as in kids' shares in households increase the consumption of rooms by 19% and 4% respectively. These results are supported by the findings of Arimah (1992), Brueckner (2013), Du Rietz (1977), Quigley (1976), Tiwari and Parikh (1998) and Witte et al. (1979). It means that effect of increase in household size is higher than increase in kids share. The reason behind is that kids can share rooms easily. Female headed household's consumption of rooms is 53% more as

compared to male headed households. One year increase in the average age of the households is also significantly and positively affects the consumption of number of rooms. These findings are consistent with Arimah (1992), Brueckner (2013) and Du Rietz (1977). Marital status of head of households does not affect the consumption of rooms as concluded by Arimah (1992) and Du Rietz (1977).

4.2.1.2 Link between Roof Material and Household Characteristics

The multinomial logit estimates of roof material and household characteristics at their average are presented in the table 4.2.1.2. The results show that households in the rural areas have 31% less chances to be residing in a house whose roof is made of RCC/RBC. These findings are in line with the findings of Brueckner (2013) and Shah (2012). Moreover, there are 2% more chances of rural household to use other roof material as compared to urban household. One year increase in the head's level of education increase the chances to live in a house whose roof is made of RCC/RBC with reference to wood/bamboo as concluded by Brueckner (2013). An increase in the total income also increases the chances to use RCC/RBC and other roof material as compared to wood/bamboo. These results are consistent with the results of Brueckner (2013), Follain and Jimenez (1985) and Shah (2012).

The table 4.2.1.2 shows that there is less probability for a household to live in a house that's roof is made of RCC/RBC due to significant rising share of the household size and kids as concluded by Brueckner (2013) and Shah (2012). Female headed of households have 18% more chances to live in a house whose roofs are built of RCC/RBC. A one year increase in the average age of the household is also significantly increases the probability

to use RCC/RBC. This result is consistent with the finding of Brueckner (2013). The results also indicate that if marital status of the head of household is other than married then there chances decrease by 5% to reside in a house whose roof are made of RCC/RBC.

Table 4.2.1.2 Multinomial Logit Estimates of link between roof material and households characteristics

Roof material → **Household characteristics ↓**	**RCC/RBC**	**Other**
Region	-0.314*** (0.0072)	0.0265*** (0.0078)
Heducation	0.012 (0.0133)	-0.0022 (0.0111)
heducation	0.0022* (0.0009)	-0.0016 (0.0012)
Tincome	0.0052*** (0.0002)	0.0018*** (0.0003)
Hsize	-0.0033* (0.0014)	0.0023 (0.0017)
Kidshare	-0.0235*** (0.0017)	-0.0002 (0.0020)
Hgender	0.182*** (0.0142)	-0.0270 (0.0142)
Avrgage	0.0019*** (0.0003)	0.0002 (0.0004)
Hmaritalstatus	-0.0507***	0.0146

	(0.0101)	(0.0137)
Number of obs	16309	
Prob > chi2	0.0000	
Pseudo R^2	0.1301	

All multinomial logit estimates give the marginal effects at their average
t statistics in parentheses

* Shows significant at 1 percent level of significance

** Shows significant at 5 percent level of significance

*** Shows significant at 10 percent level of significance

Base categories

Wood/bamboo, Urban region, Head literate, Male and married.

4.2.1.3 Link between Wall Material and Household Characteristics

Table 4.2.1.3 represents the link between wall material and household characteristics. House's walls in rural areas as compared to urban areas have more chances to be made of raw bricks and other wall material by 20% and 8% respectively with reference to burnt bricks. The table also shows that an increase in the total income of the household decreases the chances to live in a house whose walls are made of mud bricks and also other wall material. These results are in line with the studies of Brueckner (2013), Follain and Jimenez (1985) and Shah (2012). The results also reveal that a one person increase in the household size significantly decreases the probability to be reside in the mud bricks/blocks and increase the chances to be reside in a house whose wall is made of other wall material rather than burnt bricks/block as concluded by Brueckner (2013) and Shah (2012). In addition to it, increase in the kids share in the household, increases the probability to live in a house whose wall is made of mud bricks and other wall material as

concluded by Shah (2012). Female headed households have less chances to live in those houses that have walls of raw bricks and other wall material by 18% and 1% respectively as compared to burnt bricks/blocks.

Table 4.2.1.3 Multinomial Logit Estimates of link between wall material and households characteristics

Wall material → **Household characteristics ↓**	**Mud bricks**	**Others**
Region	0.209*** (0.006)	0.0828*** (0.003)
Heducation	0.0117 (0.011)	0.00289 (0.00729)
heducation	0.0021 (0.0010)	-0.0000 (0.0006)
Tincome	-0.0047*** (0.0003)	-0.0015*** (0.0002)
Hsize	-0.0044** (0.0016)	0.0021* (0.0009)
Kidshare	0.0240*** (0.0017)	0.0058*** (0.0010)
Hgender	-0.183*** (0.0086)	-0.0141* (0.0068)
Avrgage	-0.0033*** (0.0004)	-0.000** (0.0002)
Hmaritalstatus	0.0167	-0.0222***

	(0.0130)	(0.0066)
Number of obs	16309	
Prob > chi2	0.0000	
Pseudo R^2	0.1228	

All multinomial logit estimates give the marginal effects at their average
t statistics in parentheses
* Shows significant at 1 percent level of significance
** Shows significant at 5 percent level of significance
*** Shows significant at 10 percent level of significance

Base categories;

Burnt bricks/blocks, Urban region, Head literate, Male and married

Table 4.2.1.3 represent that one year increase in the average age of the household significantly decreases the chances to live in raw bricks and other wall material as reported in Brueckner (2013). If the marital status of the head is other than married then there is 2% less chances to live in a house whose walls are made of other wall material as compared to married head.

4.2.1.4 Link between Source of Drinking Water and Household Characteristics

Table 4.2.1.4 reports the estimates of source of drinking water and household characteristics. The results show that rural households have 22% more chances to use hand pump water and 30% less chances to use piped water as compared to urban households. These results are supported by Brueckner (2013) and Shah (2012). As compared to illiterate headed household, literate headed household have 2% more chances to use piped water than other sources of drinking water. This result is also concluded by Brueckner (2013)

and Shah (2012). Moreover, an increase in the total income of the household decreases the chances to use hand pump facility and increases the chances to use piped water. The results of our study are in line with Brueckner (2013), North and Griffin (1993) and Shah (2012). Increase in the household size and kids share decrease the chances to use piped water and increase the probability to use hand pump as a source of drinking water as compared to other sources of drinking water. Gender of the head of household has also significant impact on source of drinking water. Female headed households have 4% more chances to use piped water and 13% less chances to use hand pump as concluded by Jalan and Ravallion (2003). There is 5% more chances to use hand pump and 2% less chances to use piped water as compared to other sources if the marital status of the head is other than married.

Table 4.2.1.4 Multinomial Logit Estimates of link between source of drinking water and households characteristics

Source of drinking water → **Household characteristics ↓**	**Piped water**	**Hand pump**
Region	-0.306*** (0.007)	0.226*** (0.0061)
Heducation	-0.0244* (0.0121)	-0.0118 (0.0113)
heducation	0.0006 (0.0010)	-0.00064 (0.0010)
Tincome	0.0020*** (0.0001)	-0.0068*** (0.0003)

Hsize	-0.0002 (0.0015)	0.005*** (0.001)
Kidshare	-0.0093*** (0.0018)	0.0114*** (0.0017)
Hgender	0.0471** (0.0144)	-0.134*** (0.0088)
Avrgage	-0.0001 (0.0004)	-0.0000 (0.0003)
Hmaritalstatus	-0.0239* (0.0116)	0.0538*** (0.0125)
Number of obs	16309	
Prob > chi2	0.0000	
Pseudo R^2	0.0987	

All multinomial logit estimates give the marginal effects at their average
t statistics in parentheses
* Shows significant at 1 percent level of significance
** Shows significant at 5 percent level of significance
*** Shows significant at 10 percent level of significance

Base categories

Other sources of drinking water, Urban, Head literate, male and married

4.2.1.5 Link between Type of Toilet and Household Characteristics

The results of the link between type of toilet and household characteristics are reported in table 4.2.1.5. As compared to urban households, rural households have 17% more chances to live in a house where no toilet facility is available and 23% more chances to use other type of toilet, as compared to flush system. This result is in line with Brueckner (2013) and Shah (2012). The table also reveals that as the level of education of head of household increases, he does not prefer to live in a house which has no toilet facility as

indicated by Brueckner (2013) and Shah (2012). Total income of the households has significant impact on the type of toilet as well. As the income increases there is less chances to be residing in a house that has no toilet facility or other types of toilet rather than flush system. Our results are consistent with the study of Brueckner (2013), Follain and Jimenez (1985) and Shah (2012).

Table 4.2.1.5 Multinomial Logit Estimates of link between type of toilet and households characteristics

Type of toilet → **Household characteristics ↓**	**No toilet**	**Others**
Region	0.172*** (0.0045)	0.230*** (0.0057)
Heducation	-0.0159 (0.0092)	0.0131 (0.0109)
heducation	-0.0018* (0.0008)	0.0018 (0.0009)
Tincome	-0.0047*** (0.0003)	-0.0023*** (0.0003)
Hsize	-0.0043** (0.0014)	-0.0058*** (0.001)
kidshare	0.0029* (0.0014)	0.0169*** (0.0016)
Hgender	-0.0423*** (0.0079)	-0.166*** (0.0070)
Avrgage	0.000	-0.0035***

	(0.0003)	(0.0003)
Hmaritalstatus	0.0182	-0.0136
	(0.0101)	(0.0120)
Number of obs	16309	
Prob > chi2	0.0000	
Pseudo R^2	0.1794	

All multinomial logit estimates give the marginal effects at their average
t statistics in parentheses
* Shows significant at 1 percent level of significance
** Shows significant at 5 percent level of significance
*** Shows significant at 10 percent level of significance

Base categories

Flush system, Urban, Head literate, Male and married

The results also indicate that one person increase in the household's size decreases the chances to live in a house that have no toilet or other type of toilet facilities. Moreover, increase in the kids share increases the chances to be residing in a house that have no toilet facility or the other type of toilet as compared to flush system as concluded by Brueckner (2013) and Shah (2012). In addition to it increase in the average age of the households decreases the chances to use other type of toilet. These results are in line with the results of Brueckner (2013)and Shah (2012).

4.2.1.6 Link between Source of Fuel for Cooking and Household Characteristics

Table 4.2.1.6 report the estimates of source of fuel to cook food and household characteristics. The table indicates that rural households have 59% less chances to use gas and 18% more chances to use other sources of fuel to cook food as compared to wood as a

source of fuel to cook food. If the head is illiterate then there are 3% less chances to use other fuel sources. With an increase in the income of household there are more chances to use gas and less chances to use other fuel sources to cook food.

Table 4.2.1.6 Multinomial Logit Estimates of link between source of fuel for cooking and households characteristics

Fuel for cooking → Household characteristics ↓	**Gas**	**Other**
Region	-0.590***	0.183***
	(0.0069)	(0.0051)
Heducation	0.0164	-0.0282**
	(0.010)	(0.0096)
heducation	0.0012	-0.0023*
	(0.0009)	(0.0009)
Tincome	0.0036***	-0.0007**
	(0.0002)	(0.0002)
Hsize	-0.0023	-0.0023
	(0.0013)	(0.0013)
Kidshare	-0.0176***	-0.000631
	(0.0016)	(0.001)
Hgender	0.0701***	-0.0138
	(0.0119)	(0.0101)
Avrgage	0.000654	0.000741
	(0.0003)	(0.0003)
Hmaritalstatus	-0.0214*	0.0188

	(0.0103)	(0.0106)
Number of obs	16309	
Prob > chi2	0.0000	
Pseudo R^2	0.2374	

All multinomial logit estimates give the marginal effects at their average
t statistics in parentheses
* Shows significant at 1 percent level of significance
** Shows significant at 5 percent level of significance
*** Shows significant at 10 percent level of significance

Base categories

Wood, Urban, Head literate, Male and married

Table 4.2.1.6 also reveal that if there is increase in the kid's share, the chances to use gas decreases by 2%. If the head is female, the probability to use gas increases by 7% as compared to wood to cook food. Married headed households have 2% more chances to use gas as a source of fuel for cooking.

4.2.1.7 Link between Source of Fuel for Lighting and Household Characteristics

Table 4.2.1.7 report the results of the link between source of fuel for lighting and household characteristics. The table indicates that rural households have more chances to use kerosene oil and other fuel sources by 1% and 10% respectively as compared to electricity as a source of fuel for lighting as concluded by Shah (2012). The table also shows that literate head have less chances to use kerosene oil and others fuel because electricity is available in most of the areas. An increase in the total income of household decreases the probability to use other fuel as a source of lighting. These results are in line

with the results of Brueckner (2013) and Shah (2012). One person increase in the household size decreases the probability to use kerosene oil and other sources as compared to electricity. This result is supported by Brueckner (2013) and Shah (2012). Increase in the kids share increases the probability to use other fuel sources as already concluded by Shah (2012).

Table 4.2.1.7 Multinomial Logit Estimates of link between source of fuel for lighting and households characteristics

Fuel for light → **Household characteristics ↓**	**Kerosene oil**	**Other**
Region	0.0141*** (0.0024)	0.100*** (0.0033)
Heducation	0.0119** (0.0041)	-0.0118 (0.0068)
heducation	-0.0006 (0.0003)	-0.0008 (0.0006)
Tincome	-0.0000 (0.000)	-0.0012*** (0.0002)
Hsize	-0.0012* (0.0006)	-0.0094*** (0.0011)
Kidshare	-0.0005 (0.0007)	0.0036*** (0.0010)
Hgender	-0.0079* (0.0039)	-0.0609*** (0.0038)

Avrgage	0.0000 (0.0001)	-0.0007** (0.0002)
Hmaritalstatus	0.0001 (0.0045)	-0.0232*** (0.006)
Number of obs	16309	
Prob > chi2	0.0000	
Pseudo R^2	0.1072	

All multinomial logit estimates give the marginal effects at their average
t statistics in parentheses
* Shows significant at 1 percent level of significance
** Shows significant at 5 percent level of significance
*** Shows significant at 10 percent level of significance

Base categories

Electricity, Urban, Head literate, Male and married

The results also reveal that female headed household have less chances to use kerosene oil and others fuel as source of fuel for lighting. A one year increase in the average age of the household decreases the chances to use kerosene oil. These results are in lined with Brueckner (2013). The chances to use kerosene oil as a source of lighting decreases when the marital status of head is other than married.

Table 4.2.1.8a and table 4.2.1.8b depict very clear picture of the relationship between housing characteristics and household characteristics. In these tables 0 indicates the insignificant relationship between housing characteristics and household charaeteristics. Whereas, + and _ sign shows the positive and negative relationship between housing and household characteristics respectively.

By examining the table 4.2.1.8a and table 4.2.1.8b, we can say that in rural areas there is less consumption of rooms, less chances to be residing in houses whose roofs are built of RCC/RBC and more chances to use other roof material as compared to wood/bamboo. Rural households have more chances to live in a house whose walls are made of raw/mud bricks and other material rather than burnt bricks. More chances to use hand pumps and less chances to use piped water as a source of drinking water. More chances to be residing at the house that have no toilet facility and also have other types of toilet as compared to flush system. As a fuel for cooking there is less probability to use gas and more probability to use other sources of fuels. Moreover, there are also more chances to use kerosene oil and other fuels for lighting as compared to urban area. The reason may be that urban households enjoy better basic facilities rather than rural households [Zaki (1981)]. Or reason may be that rural households have different preferences than urban households.

If the head of household is educated then there are more chances of residing in houses whose roofs are made of RCC/RBC, have piped water facility, flush system and electricity facility because education of head/households leads to be residing with better housing structure/ characteristics as explained by Brueckner (2013) and Shah (2012).

The income also affects the preferences of household about housing characteristics. An increase in the total income of households increases the probability of consumption of more rooms, also increases the chances to live in a house whose roof is made of RCC/RBC and others as a roof material, decrease the chances to reside in houses whose walls are constructed with mud bricks and other wall material, use hand pump as a source of drinking

water, no toilet facility and other type of toilet and also other sources of fuel for lighting because as the income of the households increases, households demand better facilities. An increase in the household size decrease the chances to live in a house that has roof and walls made of RCC/RBC and mud bricks respectively, piped water , no toilet facility and other types of toilet, gas as fuel for cooking as well as kerosene oil as a fuel for light. The reason was that larger household's may not be able to enjoy better facilities for given level of income.

The results regarding increase in the kids share indicate that there is more probability to live in a house whose walls are made of mud bricks, have hand pump as a source of drinking water, without toilet and other type of toilet and also other sources as a fuel for lighting. The reason behind is that an increase in the number of children always related to the substandard housing characteristics, holding household size constant as noted by Brueckner (2013). Female headed households consume more rooms, RCC/RBC as a roof material, piped water as a source of drinking water and gas for cooking.

Average age of the household is also an important factor for demanding houses with different characteristics. Increase in the average age of the households increases the consumption of rooms; the chances to live in a house whose roof are made of RCC/RBC and other roof material. Because difference in the age of the households shows the difference in taste and also the needs of the households as noted by Lee (1963). According to Smith and Olaru (2013) the individuals who are above 35 years are able to get all facilities because this is the age when households are stable in their profession as well as their income.

The marital status of the head of household also affects the preferences about housing characteristics. If the marital status of the head is other than married, there are less chances to live in a house which has RCC/RBC as a roof material, other wall material, piped water, and gas for cooking because married head of households demand better housing characteristics as noticed by Brueckner (2013).

Table 4.2.1.8 b

Link between housing characteristics and households characteristics

Housing characteristics → Household characteristics ↓	Type of toilet		Source of Fuel for cooking		Source of Fuel for lighting	
	No toilet facility	Others	Gas	Others	Kerosene oil	Others
Region (rural area)	+	+	_	+	+	+
Heducation	0	0	0	_	_	0
Heducation	_	0	0	_	0	0
Tincome	_	_	+	_	0	_
Hsize	_	_	0	0	_	_
Kidshare	+	+	_	0	0	+
Hgender	_	_	+	0	_	_
Avrgage	0	_	0	0	0	_
Hmaritalstatus	0	0	_	0	0	_

0 shows the insignificant relationship between housing and household characteristics.

+ shows the positive relationship between housing and household characteristics.

_ shows the negative relationship between housing and household characteristics.

Base categories;

Urban region, Wood/bamboo (roof material), Burnt bricks/blocks (wall material), Others (source of drinking water), Flush system (type of toilet), Wood (source of fuel for cooking), Electricity (source of fuel for lighting), Head literate, Male and married.

4.2.2 Impact of Housing and Household Characteristics on Health

The results of the effect of housing and household characteristics on health are reported in table 4.2.2.1. It is worth mentioned that diarrhoea in children under five year used as a proxy for health status because data is not available on other measures of health indicators in PSLM.

It is clear from the table that region appears as significant variable of health status of children. The results show that rural children have 34% less chances to suffer from diarrhoea. Our results are in line with the study of G. Arif and Ibrahim (1998), Mock et al. (1993) and Seter Siziya et al. (2009). The reason might be the sanitation issues in large urban areas. Health of children is affected by wall material as well. If the wall material is other than mud bricks then there are more chances that children under five year suffer from diarrhoea as compared to burnt bricks because diarrhoea has significant association with housing construction material. our findings are consistent with the findings of Gross et al. (1989), Bbaale (2011), A. Arif and Naheed (2012). According to D'souza (1997) there is a positive and significant association between poor housing structure and diarrhoea.

Results indicate that drinking water is also an important determinant of diarrhoea. If sources of drinking water are well (both covered and open well), river, stream, pond, tanker truck, water fetcher etc. then there are 2% more chances that children suffer from diarrhoea with reference to piped water. Our results are in line with results of many other studies such as Checkley et al. (2004), Esrey et al. (1991), Gasana et al. (2002), Gross et al. (1989), Jalan and Ravallion (2003), Karki et al. (2010), Mekasha and Tesfahun (2003),

Mihrete et al. (2014), Plate et al. (2004), Root (2011), Seter Siziya et al. (2009) and Wolff et al. (2001).

It is also clear from the table that there is a significant association between type of toilet and diarrhoea. If house has toilets without flush system then chances of suffering from diarrhoea increases by 25%. Our results are in line with results of G. Arif and Ibrahim (1998), Dessalegn et al. (2012), El-Gilany and Hammad (2005), Esrey et al. (1991), Gasana et al. (2002), Godana and Mengistie (2013), Gross et al. (1989), Kakakhel et al. (2011), Mihrete et al. (2014) , Mock et al. (1993), Root (2011) and Tetteh (2013). The reason behind high prevalence of diarrhoea is improper toilet as pit toilet is always a permanent source of infection.

It is also clear from the table that there is a significant association between source of fuel for cooking and diarrhoea. There are less chances of diarrhoea if households use gas as a fuel for cooking as compared to wood. Our results are consistent with the results of Bbaale (2011) and El-Gilany and Hammad (2005). Better source of light is also essential for health. It affects the duration of diarrhoea. The results show that children who reside in houses where kerosene oil and other fuels are used for lighting, have 3% and 4% more chances of diarrhoea respectively. Better environmental factors decrease the chances of diarrhoea. Our results do not contradict with the studies of Bbaale (2011) and Gross et al. (1989).

Table 4.2.2.1

Impact of housing and household characteristics on health (diarrhoea)

Housing and Household characteristics	Diarrhoea
Region	-0.349*** (-3.62)
Rooms	0.004 (0.29)
Roof material	
Wood/bamboo	-0.185 (-1.56)
Other	-0.004 (-0.47)
Wall material	
Mud bricks	0.012 (1.25)
Other	0.029* (2.06)
Sources of drinking water	
Hand pump	0.001 (0.18)
Motor pump	0.013 (-1.40)
Other	0.029** (2.78)

Types of toilet	
Flush system	0.005 (0.51)
Other	0.252* (2.33)
Fuel for cooking	
Gas	-0.018* (-1.93)
Other	-0.010 (-1.04)
Fuel for light	
kerosene oil	0.033* (2.43)
Other	0.041* (1.87)
Household characteristics	
Hgender	-0.056*** (-4.49)
Hsize	-0.001 (-1.00)
Kidshare	0.017*** (9.69)
Tincome	0.0007 (0.40)
Age	0.001*** (-5.93)

Mother's education	0.033* (2.21)
Level of education	0.0005 (-0.34)
Number of obs	15380
Prob > chi2	0.0000
Pseudo R^2	0.0194

All logit estimates give the marginal effects at their average
t statistics in parentheses
* Shows significant at 1 percent level of significance
** Shows significant at 5 percent level of significance
*** Shows significant at 10 percent level of significance

Base categories

Urban region, RCC/RBC (roof material), Burned bricks (wall material), Piped water (source of drinking water), No toilet (type of toilet), Wood (source of fuel for cooking), Electricity (source of fuel for lighting), Male, Married, Mother literate and head literate.

On the household characteristics side, the results show that there is a significant relationship between gender of head of household and chances of diarrhoea. If the head is female then there are 5% less chances of diarrhoea. This result is in line with Mock et al. (1993) and Wilunda and Panza (2009) because females are more involved in health care of children than males. The results show that household size has no significant effect on the frequency of diarrhoea. The same as suggested by Godana and Mengistie (2013). The results also indicate that there is a significant and positive relationship between number of children and diarrhoea. With an increase in the kids share in the household the chances of getting diarrhoea is increases by 1%. Our results are in line with the results of Al-Ghamdi et al. (2009), A. Arif and Naheed (2012), D'souza (1997), El-Gilany and Hammad (2005), Godana and Mengistie (2013), Mihrete et al. (2014) and Mock et al. (1993). The reason

behind this association is that care and intension of mother decreases as the number of children increases.

The table 4.2.2.1 shows that there is insignificant relationship between diarrhoea and income. These results are in line with the results of D'souza (1997) and Karki et al. (2010). Results also indicate that age of the mother negatively and significantly affects the diarrhoea under five year children. With an increase in age of mother there is less probability of diarrhoea. These findings are consistent with the findings of El-Gilany and Hammad (2005) and Bbaale (2011) because increase in the age of the mother makes the mother more experienced. If the mother is under 25 and above 40 years then the chances of getting diarrhoea increases according to El-Gilany and Hammad (2005) and Mock et al. (1993).

The table also reveals that mother's education significantly and negatively affects the diarrhoea. If the mother is illiterate there are 3% more chances that the children suffer from diarrhoea because in the developing countries like Pakistan the care of children is the responsibility of mothers. If mother is educated then she can look after their children in a better way and also easily follow the instructions of doctor to control the frequency of diarrhoea. Our results are in line with the results of A. Arif and Naheed (2012), G. Arif and Ibrahim (1998), Bbaale (2011), Dessalegn et al. (2012), El-Gilany and Hammad (2005), Gasana et al. (2002), Godana and Mengistie (2013), Gross et al. (1989), Mihrete et al. (2014), Mock et al. (1993), Mumtaz et al. (2014), Seter Siziya et al. (2009) and Zeleke and Zewdie Aderaw Alemu (2014). Level of education of mother appear as insignificant

variable because a proper knowledge about hygiene is enough to control the risk of diarrhoea [Karki et al. (2010)].

Table 4.2.2.1a depicts the whole picture of relationship of housing structure/characteristics and household characteristics with health particular diarrhoea under five year children. In this table "0" sign indicates insignificant effect of housing structure and household characteristics on diarrhoea under five year of children. "+" and "_" sign shows positive and negative relationship respectively between housing structure, household characteristics and diarrhoea under five year of children.

Table 4.2.2.1a

Impact of housing and household characteristics on health (diarrhoea)

Housing and Household characteristics	Diarrhoea
Region	–
Rooms	0
Roof material	
Wood/bamboo	0
Other	0
Wall material	
Mud bricks	0
Other	+
Sources of drinking water	
Hand pump	0
Motor pump	0

Other	+
Types of toilet	
Flush system	0
Other	+
Fuel for cooking	
Gas	–
Other	0
Fuel for light	
kerosene oil	+
Other	+
Household characteristics	
Hgender	–
Hsize	0
Kidshare	+
Tincome	0
Age	–
Mother's education	+
Level of education	0

0 shows the insignificant relationship between housing, household characteristics and diarrhoea.

+ shows the positive relationship between housing, household characteristics and diarrhoea.

_ shows the negative relationship between housing, household characteristics and diarrhoea.

Base categories:

Urban region, RCC/RBC (roof material), Burnt bricks (wall material), Piped water (source of drinking water), No toilet (type of toilet), Wood (source of fuel for cooking), Electricity (source of fuel for lighting), Male, Married, Mother literate and head literate.

We can conclude that housing structure, water sources, type of toilet, source of fuel for cooking, source of fuel for lighting and household characteristics such as gender of the head of household, kids share in a household, mother's age and education significantly affect the health particular diarrhoea under five year children.

CHAPTER 5

CONCLUSION AND POLICY IMPLICATION

5.1 Key Findings

The study has two main objectives. First objective is to explore the link between housing characteristics and household characteristics. Second objective is to investigate the relationship between housing characteristics, household characteristics and health. To accomplish these objectives multinomial logit model and logit model are employed respectively. The data used in the study is derived from Pakistan Social and Living Standards Measurement (PSLM) 2010-11. Number of rooms, roof material, wall material, source of drinking water, fuel for cooking and fuel for light are taken as housing characteristics which are act as dependent variables. Head's education, gender, marital status, total income of household, household size, kids share in the household and average age of the household are taken as household characteristics. All the variables are chosen on the bases of data availability.

The result shows that if the household belongs to urban area then there are more chances of consumption of rooms. There are more chances of using RCC/RBC as a roof material, having piped water, using better toilet facility, using gas as a sources of fuel for cooking and electricity as a source of fuel for lighting. However, there are less chances of using mud bricks as a wall material and hand pump as a source of drinking water.

Head's education has insignificant effect on consumption of rooms, type of roof, wall material and toilet facility. An increase in the total income of the household increases the consumption for rooms, the probability to use RCC/RBC as a roof material, burnt bricks as a wall material, piped water as a source of drinking water, flush system as a type of toilet, gas and electricity as a fuel for cooking and lighting respectively. There are less of chances of using RCC/RBC as a roof material, mud bricks as a wall material, piped water as a source of drinking water, no toilet facility and other types of toilet, gas as fuel for cooking as well as kerosene oil as a fuel for light as the family size increases.

The result also indicates that increase in the number of children in the household lead to the household to live with substandard housing characteristics. Increase in the kid's share in household size increases the chances to be residing in a house whose roofs are made of wood/bamboo, walls are made of mud bricks, hand pump is used as a source of drinking water, having no toilet facility and wood is used as a fuel for cooking. Female headed households have more chances of using RCC/RBC, burnt bricks, piped water, flush system, gas and electricity as a roof material, wall material, source of drinking water, type of toilet, fuel for cooking and electricity respectively. With an increase in the average age of the households always related to the better housing characteristics. For instance increase in the consumption of rooms, more chances of using RCC/RBC as a roof material and less chances of using mud bricks for wall etc. Moreover, married headed household prefer RCC/RBC for roof material, piped water for drinking purpose and also gas for cooking.

The second objective of this study is to explore the relationship of health status of children under five year with housing and household characteristics. . The results indicate

that socioeconomic status of household/head, sources of drinking water, type of toilet, gender of the head, kids share in a household, mother's age and education significantly affect the health of the children.

5.2 Policy Implication

The results of the study can be used in many ways. Firstly in planning housing programs which can provide better and suitable residence for different household's type. Secondly it is helpful for housing planners and policy makers in designing and appraising housing policy. Thirdly helpful to control the diarrhoea under five year of children by constructing standard houses. Moreover, results also show the significant relationship between health, water supply and sanitation system. To improve the health of the children under five, government should take action to improve the facilities of water supply and sanitation system. Water supply system or plant should be installed as close as possible to the houses. Mother's education is also appearing as important factor to control the diarrhoea. So encourage the female education and also educate the people about the health.

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APPENDIX A

Testing the Assumptions of Multinomial Logit Model (Roof Material)

1.1 Hausman test for independence of irrelevant alternatives (IIA) (N=16309);

Ho: IIA is valid

Table 1.1

Roof material	chi2	Df	P>chi2	evidence
RCC/RBC	-14.637	10	.	for Ho
Wood/bamboo	-32.098	10	.	for Ho
Others	37.660	10	0.000	Against Ho

Table 1.1 shows that IIA assumption is not violated. According to Long & Freese (2006)[7] negative value of chi_2 indicates that the assumption of independent of irrelevant alternatives is not violated.

[7] Long, J. S., & Freese, J. (2006). Regression models for categorical dependent variables using Stata: Stata press.

1.2 Wald test for independent variables;

Ho: All coefficients associated with given variable(s) are zero

Table 1.2

	chi2	Df	P>chi2
Region	2095.902	2	0.000
Heducation	1.363	2	0.506
Heducation	5.434	2	0.066
Tincome	617.817	2	0.000
Hsize	5.236	2	0.073
Kidshare	221.753	2	0.000
Hgender	229.851	2	0.000
Avrgage	37.954	2	0.000
Hmaritalstatus	23.627	2	0.000

Base categories; Wood/ bamboo, Urban region, Head literate, Male and married

Table 1.2 shows that all the coefficients related to roof material are significant except head education.

1.3 Wald tests for combining alternatives;

Ho: All coefficients except intercept associated with a given pair of alternatives are 0 (i.e., alternatives can be combined)

Table 1.3

	chi2	Df	P>chi2
RCC/RBC and wood/bamboo	3152.109	9	0.000
RCC/RBC and others	1438.962	9	0.000
Wood/bamboo and others	723.082	9	0.000

Table 1.3 indicates that we can reject the null hypothesis that alternatives can be combined.

Testing the assumptions of multinomial logit model (wall material)

2.1 Hausman test for independence of irrelevant alternatives (IIA) (N=16309);

Ho: IIA is valid

Table 2.1

Wall material	chi2	Df	P>chi2	evidence
burnt bricks	6.101	10	0.807	for Ho
mud bricks	3.918	10	0.951	for Ho
Others	0.738	10	1.000	for Ho

Table 2.1 indicates that independence of irrelevant alternatives (IIA) assumption is not violated.

2.2 Wald test for independent variables;

Ho: All coefficients associated with given variable(s) are zero

Table 2.2

	chi2	Df	P>chi2
Region	1334.372	2	0.000
Heducation	1.420	2	0.492
Heducation	4.049	2	0.132
Tincome	301.090	2	0.000
Hsize	9.687	2	0.008
Kidshare	254.826	2	0.000
Hgender	247.526	2	0.000
Avrgage	92.518	2	0.000
Hmaritalstatus	8.604	2	0.014

Base categories; **Burnt** bricks/blocks, **Urban region, Head literate, Male and married**

Table 2.2 shows that variables associated with wall material are significant. Only head's education and their level of education show insignificant association.

2.3 Wald test for combining alternatives;

Ho: All coefficients except intercepts associated with a given pair of alternatives are zero (i.e., alternatives can be combined)

Table 2.3

	chi2	df	P>chi2
Burnt and mud bricks	1884.020	9	0.000
Burnt bricks and others	731.066	9	0.000
Mud bricks and others	92.024	9	0.000

The inspection of table 2.3 helps us to conclude that we can reject the hypothesis that outcomes burnt and mud bricks, burnt bricks and other, and mud bricks and other are indistinguishable.

Testing the assumptions of multinomial logit model (source of drinking water)

3.1 Hausman test for independence of irrelevant alternatives (IIA) (N=16309);

Ho: IIA is valid

Table 3.1

Drinking water	chi2	Df	P>chi2	Evidence
Piped water	-288.003	10	.	for Ho
Hand pump	-13.339	10	.	for Ho
Others	-330.162	10	.	for Ho

In table 3.1 negative value of chi_2 indicate that IIA assumption is not violated.

3.2 Wald test for independent variables;

Ho: All coefficients associated with given variable(s) are zero

Table 3.2

	chi2	df	P>chi2
Region	1876.756	2	0.000
Heducation	4.352	2	0.113
Heducation	0.606	2	0.739
Tincome	322.512	2	0.000
Hsize	12.917	2	0.002
Kidshare	54.524	2	0.000
Hgender	141.846	2	0.000
Avrgage	0.221	2	0.895
Hmaritalstatus	20.521	2	0.000

Base categories; Other sources of drinking water, Urban region, Head literate, Male and married

Table 3.2 shows that average age of households, head's education and his level of education have insignificant association with source of drinking water.

3.3 Wald tests for combining alternatives;

Ho: All coefficients except intercepts associated with a given pair of alternatives are zero (i.e., alternatives can be combined)

Table 3.3

	chi2	df	P>chi2
Piped water and hand pump	2347.001	9	0.000
Piped water and others	1094.146	9	0.000
Hand pump and others	930.961	9	0.000

Table 3.3 indicates that outcomes are indistinguishable.

Testing the assumptions of multinomial logit model (type of toilet)

4.1 Hausman test for independence of irrelevant alternatives (IIA) (N=16309);

Ho: IIA is valid

Table 4.1

Type of toilet	chi2	df	P>chi2	Evidence
No toilet	1.348	10	0.999	for Ho
Flush system	-347.637	10	.	for Ho
Others	-269.676	10	.	for Ho

Table 4.1 indicates that the assumption of IIA is not violated.

4.2 Wald test for independent variables;

Ho: All coefficients associated with given variable(s) are zero

Table 4.2

	chi2	df	P>chi2
Region	2180.131	2	0.000
Heducation	3.363	2	0.186
Heducation	5.763	2	0.056
Tincome	376.553	2	0.000
Hsize	37.984	2	0.000
Kidshare	144.429	2	0.000
Hgender	289.062	2	0.000
Avrgage	94.342	2	0.000
Hmaritalstatus	3.668	2	0.160

Base categories; Flush system, Urban region, Head literate, Male and married

Table 4.2 shows that head's marital status and his education have no significant association.

4.3 Wald tests for combining alternatives;

Ho: All coefficients except intercepts associated with a given pair of alternatives are zero (i.e., alternatives can be combined)

Table 4.3

	chi2	df	P>chi2
No toilet and flush system	1479.200	9	0.000
No toilet and others	255.038	9	0.000
Flush system and others	2130.298	9	0.000

Table 4.3 shows that outcomes cannot be collapsed.

Testing the assumptions of multinomial logit model (fuel for cooking)

5.1 Hausman test for independence of irrelevant alternatives (IIA) (N=16309);

Ho: IIA is valid

Table 5.1

Fuel for cooking	chi2	Df	P>chi2	Evidence
Wood	-85.084	10	.	for Ho
Gas	-2.943	10	.	for Ho
Others	-69.303	10	.	for Ho

It is clear from the table 5.1 that the assumption of IIA is not violated.

5.2 Wald test for independent variables;

Ho: All coefficients associated with given variable(s) are zero

Table 5.2

	chi2	Df	P>chi2
Region	4714.440	2	0.000
Heducation	9.394	2	0.009
Heducation	6.998	2	0.030
Tincome	288.929	2	0.000
Hsize	7.412	2	0.025
Kidshare	126.130	2	0.000
Hgender	36.003	2	0.000
Avrgage	10.804	2	0.005
Hmaritalstatus	6.380	2	0.041

Base categories: Wood, Urban region, Head literate, Male and married

Table 5.2 indicates that each variable has significant association with source of fuel for cooking.

5.3 Wald tests for combining alternatives;

Ho: All coefficients except intercept associated with a given pair of alternatives are zero (i.e., alternatives can be combined)

Table 5.3

	chi2	df	P>chi2
Wood and gas	4493.507	9	0.000
Wood and others	116.357	9	0.000
Gas and others	2535.312	9	0.000

Table 5.3 indicates that we can reject the null hypothesis that alternatives can be combined

Testing the assumptions of multinomial logit model (fuel for lighting)

6.1 Hausman test for independence of irrelevant alternatives (IIA) (N=16309);

Ho: IIA is valid

Table 6.1

Fuel for light	chi2	Df	P>chi2	Evidence
Electricity	-86.761	10	.	for Ho
Kerosene oil	0.139	10	1.000	for Ho
Others	2.270	10	0.994	for Ho

Table 6.1 indicates that the assumption of IIA is not violated.

6.2 Wald test for independent variables;

Ho: All coefficients associated with given variable(s) are zero

Table 6.2

	chi2	Df	P>chi2
Region	358.716	2	0.000
Heducation	11.646	2	0.003
Heducation	4.417	2	0.110
Tincome	28.108	2	0.000
Hsize	80.740	2	0.000
Kidshare	11.486	2	0.003
Hgender	73.245	2	0.000
Avrgage	9.275	2	0.010
Hmaritalstatus	8.422	2	0.015

Base categories: Electricity, Urban region, Head literate, Male and married

Table 6.2 shows that all variable associated with fuel for lighting are significant except head's level of education show insignificant association.

6.3 Wald tests for combining alternatives;

Ho: All coefficients except intercepts associated with a given pair of alternatives are zero (i.e., alternatives can be combined)

Table 6.3

	chi2	df	P>chi2
Electricity and kerosene oil	586.696	9	0.000
Electricity and others	72.132	9	0.000
Kerosene oil and others	189.552	9	0.000

Table 1.3 indicates that we can reject the null hypothesis that alternatives can be collapsed.

APPENDIX B

Testing the Assumptions of the Binary Logit Model

7.1 link test for specification Error;

Table 7.1

Diareah	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
_hat	1.357397	.2984635	4.55	0.000	.7724197	1.942375
_hatsq	.1377024	.112663	1.22	0.222	-.083113	.3585178
_cons	.2152053	.1931088	1.11	0.265	-.163281	.5936917

The p- value of hatsq (0.22) is statistically insignificant. It shows that link test is insignificant and model is correctly specified. Which mean that we do not exclude the variables consider in the model.

7.2 Hosmer and Lemeshow's goodness-of-fit test;

Table 7.2

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.1398	194	186.1	1344	1351.9	1538
2	0.1584	247	230.7	1292	1308.3	1539
3	0.1728	249	254.7	1288	1282.3	1537
4	0.1858	277	275.8	1262	1263.2	1539
5	0.1995	263	296.0	1274	1241.0	1537
6	0.2144	310	318.2	1228	1219.8	1538
7	0.2306	334	342.1	1204	1195.9	1538
8	0.2527	381	371.1	1157	1166.9	1538
9	0.2837	425	410.7	1114	1128.3	1539
10	0.5506	498	492.6	1039	1044.4	1537

number of observations = 15380
number of groups = 10
Hosmer-Lemeshow chi2(8) = 8.08
Prob > chi2 = 0.4257

According to Hosmer and Lemeshow's goodness-of-fit test, we conclude that our model fits the data well by considering the p-value (.426).