House ownership, frequency of illness, fathers’ education: the most significant socio-demographic determinants of poor nutritional status in adolescent girls from low income households of Lahore, Pakistan

Fatima Hassan1*, Muhammad Asim2, Shafya Salim3 and Ayesha Humayun4

Abstract

Background: Socio demographic factors besides dietary factors play important role in determining the health status of an individual. Health and nutritional Intervention programs stand a greater chance of success if planned, keeping the socio demographic characteristics of a certain population in focus. The present study was conducted to identify those socio demographic determinants which have a significant association with poor nutritional status in adolescent girls belonging to economically deprived households of Lahore.

Methods: A cross-sectional analytical study of 140 adolescent girls living in the peri urban communities of Lahore was conducted. Socioeconomic and demographic data of the participants was recorded through a pretested questionnaire. Body mass index (BMI), a commonly used anthropometric measurement was taken as an indicator of nutritional status. Below normal (<18.5 m²) BMI was considered a benchmark of malnutrition in adolescent girls. Frequencies and percentages for socio demographic variables were calculated and Fisher Exact test was used to find out the association of nutritional status with socio-demographic predictors. Stepwise backward logistic regression analysis was then run to identify the most significant determinants associated with poor nutritional status in the adolescents. P < 0.05 was considered statistically significant.

Results: Chronic energy deficiency was highly prevalent among adolescent girls, 58% had BMI < 18.5 m². Binary regression analysis result showed that the participants who lived in rented houses (AOR = 3.513; 95% CI = 1.366 to 9.031) who fell ill frequently (AOR = 2.996; 95% CI = 1.198 to 7.491) whose fathers were illiterate (AOR = 2.941; 95% CI = 1.187 to 7.287) were at greater odds of having poor nutritional status. Interestingly, the participants who lived in joint families (AOR = 0.411; 95% CI = 0.145 to 1.168) and were more frequently food insecure (AOR = 0.431; 95% CI = 0.164 to 1.133) had lesser odds of having poor nutritional status than those who lived in nuclear families and were food secure.

Conclusion: Frequency of illness, house ownership and fathers’ education are the determinants positively associated with poor nutritional status of adolescent girls. Food insecurity and joint family structure were negatively associated with poor nutritional status. The study will help in planning interventions for improving nutritional status of adolescent girls by targeting the significant socio demographic determinants of poor nutritional status among this group.

Keywords: Nutritional status, Adolescent girls, BMI, Socio demographic factors

* Correspondence: fatimahassan788@gmail.com
1Department of Higher Education, Punjab, Pakistan
Full list of author information is available at the end of the article
Background
Socioeconomic status (SES) can be broadly conceptualized as one’s position in the social structure. Sociologists emphasize a Weberian approach that encompasses the notions of class, status, and power [1]. Socio economic status is determined by certain socio demographic factors such as housing characteristics, number of persons living in a room, food security, household income, occupation of the family, education level, and employment status of the person and access to health facilities and hygiene practices. The studies carried out in the past have used these predictors to determine the SES of a person. The influence of SES on health and consequently nutritional status is assumed to begin early in life, perhaps even in the prenatal environment, and continue to accumulate throughout life. SES is thus more than financial well-being or educational achievement; it encompasses a lifetime of access to knowledge, resources, and opportunities [2, 3]. A large and growing body of evidence shows those socio demographic factors – age, race, ethnicity, and language, for example – and socioeconomic status (SES), such as income and education, can influence health and nutritional outcomes [4]. Ever-increasing evidence suggests that the health and nutritional status of a population is greatly determined by the social and economic circumstances of that population, as well as its access to health care services [5–7].

Housing and family characteristics
The type of dwelling also to a large extent determines socio economic status one belongs to. It has generally been seen that poor people tend to live in overcrowded dwellings or more people are sharing a single room as compared their more affluent counterparts. Previous studies have also shown that poverty is associated with poor and crowded housing and stressful working conditions [5, 8].

Food security and gender equality
Another area where people with Low SES compromise a lot is food. Low income not only reduces purchasing power of a family but it also limits the food choices one can make, especially resulting in cutting down on nutritionally high quality food such as meat, milk and fruits. This leads to food insecurity. Food security not only means “to have enough to eat” but also “to have nutritionally adequate diet”. Most people belonging to low socio economic status families face the problem of not eating quality diet which is also inadequate in terms of nutrients while a few also experience the issue of quantity as well. Being food secure also means the excess of population to food markets and food stores [9]. Similarly gender issues are quite common in South Asia where people still give preference to boys and male members of the family and women are supposed to eat later than men. Sometimes the girls in the family are also served comparatively lesser portion, quantity and quality wise as compared to their brothers. Physical growth of adolescent girls’ is related to their dietary intake which is determined by availability of food in terms of quality and quantity and the ability to digest absorb and utilize food. Food availability is influenced by dietary practices, cultural traditions, family structure, birth intervals, meal patterns, and food allocation.

One of the most important factors which determine the food choices one can make is the purchasing power of that person. It in a way also determines how much can one spend on buying food. A financial survey carried out in the recent past reported that per capita income has increased from $1513 in 2014–15 [10]. The report does not take into account the inflation which has increased multifold thus reducing the purchasing power of a person and as reported in previous studies that with chronic poverty, a process called with chronic poverty “Engel’s phenomenon” occurs. Food selection narrows down to those items providing the most energy at lowest cost.

“Over time, micronutrients disappear from the diet, and specific nutrient deficiencies follow. For families living well below the poverty level, increasing income does increase discretionary spending. Any money received is used to pay the cost of necessities- food, rent, heat and the expenses such as clothes and transportation”. Nothing is left to improve the nutritional quality of diet. Impoverishment increases the micro nutrient deficiencies. Discretionary income refers to the fund available after obtaining necessities. These costs include food, housing, health care, clothes and transportation [11]. Furthermore it was found in a study that, women who are socio economically disadvantaged experience more stressful life events and more chronic stress as compare to socially and economically well placed women [12, 13].

Education and health behavior
Education and income as important socio demographic variable have always been a focus of researchers investigating association of important demographic factors with health outcomes. Previous studies have also shown considerable international evidence that education is strongly linked to health and to determinants of health such as health behaviors which also includes making healthier eating choices [4]. Level of education also seems to be an important predictor of nutritional status possibly because of two reasons. First with a higher level of education one tends to get a better paid job hence also enhancing the purchasing power of that person so that one can spend more on buying quality food. Secondly, better education might also mean making
nutritionally wise choices hence improving the nutritional status. The studies in the past have found a significant association between education level and literacy of the fathers and adolescent girls as the teenagers whose father had a higher level of education had better nutritional status than the girls whose fathers were illiterate or had lower level of education [2]. Higher education provides explicit facts, and leads to attitudes and behaviors that are conducive to better health as well as a willingness to delay gratification in order to achieve desired goals. Persons of higher status smoke less, eat better, and exercise more than persons with fewer resources [14, 15].

Health and hygiene
The economists have marked the availability of health facility to population as an important determinant of socio economic status. Poor public and private health services may have direct and indirect impacts on an individual’s health by limiting access to quality health care, healthy foods, and recreational opportunities [16, 17].

While access to health facilities such as hospitals and medical care centers might be seen as a state responsibility, there are certain other criteria which determine one’s access to health and hygiene at individual level. Availability of water and sanitation facilities such as toilets and washrooms come under such criteria. It determines to a large extent, one’s access towards basic personal hygiene such as bathing.

Working status of the adolescent girls
One of the major predictor of socio economic status is the working status of the adolescent girls of a family as usually it is a norm in South Asia that children are financially supported by their parents even well into their early adult life until they get a job. This also holds true with the adolescents especially the girls, belonging to high or middle income groups as they do not work, to support their education or families. The adolescent girls who belong to low socio economic status often have to step outside their homes to economically support their families. A study carried out in 40 countries around the world on adolescent girls found out the higher prevalence rates of moderate and severe thinness in Asia [18]. The studies carried out in the past have found that adolescent girls were mostly illiterate as they had to leave school to financially support their families [19]. This usually results in compromised health and nutritional status of these working adolescent girls and they are more likely to suffer from different nutritional deficiency diseases especially iron deficiency anemia. A study carried out on female garment factory workers in Bangladesh found out that these working girls suffered from different nutritional deficiencies especially a high prevalence of anemia was observed [20].

In similar studies carried out in the past high work participation by the young teenage girls was reported to be one of the contributing factor towards higher under nutrition in these girls [2].

Health according to WHO is been defined as a state of complete well being of an individual and not mere absence or presence of disease [21]. Similarly nutritional status of an individual depends on a lot of food and nonfood factors, eating healthy, staying active, having good health, access to education, hygiene habits, state of food security, household budget etc.

Scenario in Pakistan’s perspective
Pakistan is a densely populated country with 5th largest population of 20 billion in the world. With largely unequal distribution of wealth, and lack of priority given to health sector on the part of government, malnourishment is rampant among those who are poor. A vicious cycle of poverty and malnourishment often results in poor health and nutritional status of the population. Whereas nearly all population groups are affected by this state of affair, the situation becomes more worrisome when this malnutrition is masked behind a growth spurt of adolescent years and only manifests itself when these chronically malnourished adolescent girls enter into womanhood and start bearing children. The result is, Pakistan has one of the highest maternal mortality and Low Birth Weight [LBW] ratios in the world [22]. National Nutrition Survey [NNS] 2011 has also shown that nearly half of Pakistani women are suffering from chronic malnutrition. Thus malnutrition must be addressed in adolescence, taking the life cycle approach, before the vicious cycle is repeated in children [23].

Whereas a lot of effort on the part of government in particular and community in general is required to realize the importance of adolescent girl nutrition as a future investment into healthier mothers and nation, the steps also need to be taken to identify those socio demographic determinants which are most significantly associated with poor nutritional status of adolescent girls belonging to low income families. Therefore this study was undertaken to identify those socio demographic factors which are significantly associated with poor nutritional status of adolescent girls.

Methods
A cross sectional analytical study was conducted between August 2013 to February 2014 at Shah di Khoee and Mochipura, both are urban slum communities in Lahore. These communities were selected through convenience sampling (geographical accessibility). All adolescent girls residing in these urban slums were our...
study population and the participants were recruited with the help of Lady Health workers of both areas. As no prevalence study in context to BMI of adolescent girls was available, sample size was calculated on the basis of anemia prevalence among adolescent girls belonging to low income group in Pakistan which was found to be above 93% in early adolescents (14 years to 16 years) and 60% in late adolescents (17 years to 19 years), taking mean of these two groups, prevalence among adolescent girls was taken as 76.5% [24]. Using single proportion estimation, confidence level at 0.95 and margin of error at 7%, a sample size of 140 was calculated.

BMI was taken as a benchmark of nutritional status indicator. BMI less than 18.5 m² was judged as under weight whereas 18.5 to 24.9 m² was considered as normal. Similarly girls having BMI more than 24.9 m² were identified as overweight or obese. Adolescent girls who had BMI below or above normal (18.5–24.9 m²) were identified as having poor nutritional status.

The research was conducted in compliance with the ethical principles for medical research involving human subjects of the Helsinki Declaration. Verbal informed consent for interview was taken from all participants and their parents as well, in front of a witness. The right to privacy, anonymity, voluntary participation and confidentiality were observed.

Data collection

**Anthropometric measurements**

Height and weight of the girls were measured. Height was taken in cm using a wooden board fixed with a plastic tape to the nearest 0.1 cm. Beurer scale was used to measure Weight in kilograms. BMI was calculated as the weight in kg divided by the square of the height in meter and cutoff point of 18.5–24.9 m² was used to distinguish normal BMI from below and above normal.

**Socioeconomic, demographic and health data**

Data was collected using a structured pre-tested interview guide. Socioeconomic, demographic and health information was collected on family and housing characteristics, age, participants working status and education, parental education, health status and hygiene practices, food security and gender equality.

Descriptive statistics were used along with fisher exact test and Independent sample t-test for comparison of means in two groups. Final analysis was done on 112 forms due to incomplete information in 18 forms and damage to 10 forms. Statistical analysis was carried out using Statistical Package for the Social Sciences (SPSS v.17).

**Results**

**Housing and family characteristics**

The frequencies and percentages were calculated for these determinants and the results showed that 59 (52.7%) families were living in a single room house and 82 (73.2%) of the girls’ families were using only one washroom. About 59 (52%) of the participants were living in family owned houses as opposed to 45 (40.2%) who were living in rented accommodation. Sixty five (58%) participants’ fathers were working as laborers or on daily wages.

All the subjects belonged to low income group. Eighty four (77%) participants’ family comprised of 5–8 family members and 24 participants were first born (24.1%). The study might be seeing pointing towards a big cultural change in urban and semi urban areas with 81 (72.3%) reporting to be living in nuclear families as compared to just31 (27.7%) living in joint family system.

**Family income and expenditures**

In most of the households 91 (81.3%) 1–3 family members were contributing towards total family income. More than 40% of the girls’ families had income below ten thousands rupees whereas 33% had monthly income between eleven to fifteen thousand rupees. A mere 5% had income above thirty thousand as around three or four people were working in these households. Almost a quarter of families (25%) had per capita income below half a dollar that is 55 rupees in local currency. Household bills, mainly the electricity bills constituted the main expenditure 73 (65.2%) followed by the rent 24 (21.43%). (Table 1).

**Personal and Educational characteristics of the participants**

51 (45.5%) participants were between the ages of 13–15 whereas 61 (54.5%) were between the ages of 16–19. Similarly 48 (42.9%) were currently in education as opposed to 64 (57.1%) of which 29 (25.9%) had never been to a school and were illiterate. Most of the participants’ father 50 (44.6%) were illiterate and 27 (24.1%) had education up to primary level. Similarly 73 (65.2%) mothers of the participants were not educated and 24 (21.4%) had education up to primary level (Table 2).

**Health status and hygiene practices of the participants**

A majority 65 (58%) of the adolescents had low BMI than normal and only a small number of 9(8%) were found to be overweight. Eighty seven participants (77.7%) reported to be born healthy as opposed to 25 (22.3%) who were born weak. Sixty five (58%) participant reported a history of illness in the past 6 months with chest and throat infection being the main reason at 24 (21.4%). General health of the participants was found to be poor with 60 (53.6%) of the participants reporting a
| Variable                     | Level | Frequency | Percentage | Fisher Exact value | P-value |
|------------------------------|-------|-----------|------------|--------------------|---------|
| No. of rooms in the house    | 1     | 59        | 52.7       | 2.668              | .085    |
|                              | 2     | 25        | 22.3       |                    |         |
|                              | 3–4   | 28        | 25         |                    |         |
| No of washrooms              | 1     | 82        | 73.2       | 2.859              | .083    |
|                              | 2     | 26        | 23.2       |                    |         |
|                              | 3     | 4         | 3.6        |                    |         |
| Ownership of the home        | Owned by the family | 59 | 52.7 | 6.683 | .007 |
|                              | Rented | 45 | 40.2 |                    |         |
|                              | other  | 8 | 7.1 |                    |         |
| Occupation of the head of family | Laborer | 65 | 58 | 3.435 | .053 |
|                              | Office Worker | 14 | 12.5 |            |         |
|                              | Salesman | 11 | 9.8 |            |         |
|                              | Driver   | 11 | 9.8 |            |         |
|                              | Other     | 11 | 9.8 |            |         |
| No. of family members at home| Upto4    | 3 | 2.7 | 1.772 | .153 |
|                              | 5–8      | 84 | 77 |            |         |
|                              | 9–12     | 22 | 21.3|            |         |
| Ordinal position among siblings | 1       | 27 | 24.1| -       | -      |
|                              | 2       | 22 | 19.6|            |         |
|                              | 3       | 18 | 16.1|            |         |
|                              | 4       | 22 | 19.6|            |         |
|                              | 5       | 11 | 9.8 |            |         |
|                              | 6       | 6 | 5.4 |            |         |
|                              | 7       | 4 | 3.6 |            |         |
| Type of family structure     | Nuclear | 81 | 72.3% | .417 | .521 |
|                              | Joint    | 31 | 27.7%|            |         |
| Number Of Working Family Members | 1        | 29 | 25.9 | 1.038 | .275 |
|                              | 2        | 32 | 28.6|            |         |
|                              | 3        | 30 | 26.8|            |         |
|                              | 4        | 16 | 14.3|            |         |
| Average household income/month | Rs 4000–12,000 | 31 | 27.7% | 2.480 | .092 |
|                              | Rs13000–15,000 | 32 | 30.3%|            |         |
|                              | Rs16,000–20,000 | 25 | 22.4%|            |         |
|                              | Rs25,000–60,000 | 22 | 19.6%|            |         |
| Per capita income            | Up to Rs54/day | 27 | 25 | .157 | .684 |
|                              | Up to Rs80/day | 24 | 22.3|            |         |
|                              | Up to Rs100/day | 32 | 28.6|            |         |
|                              | Up to Rs167/day | 27 | 24.1|            |         |
| Expenditure other than food  | Bills    | 73 | 65.2 | .121 | .689 |
|                              | Rent     | 24 | 21.4|            |         |
|                              | Medicines | 6 | 5.4 |            |         |
|                              | Education fees | 2 | 1.8 |            |         |
|                              | Other    | 7 | 6.3 |            |         |
shortness of breath and lethargy both. Thirty eight (33.9%) adolescent girls also reported to be weekly falling ill.

Similarly 28 (25%) reported to take baths weekly as compared to 44 (39.35) and 39 (34.8%) adolescents who reported of taking baths twice and thrice a week respectively. (It must be kept in mind that the data was collected during winters). There seemed to be a healthy reproductive health with 103 (92%) reporting to have regular menstruation cycle.

Eighty six (76.8%) reported using cloth as a sanitary napkin during special days (menstruation period) of the month with 50 (44.6%) reporting of reuse of cloth napkin after washing with soap and water (Table 3).

Food security and gender equality
A vast majority 81 (72.3%) girls reported that food they bought did not last the whole month. Thirty eight (33.9%) reported that their families experience food shortage every month. Society remained mostly patriarchal with 83 (74.1%) reporting fathers to be the main figure who are first served meals. Gender bias was not found with an overwhelming majority of 106 (94.6%) reported to be served the same food as that of their brothers. Similarly 89 (79.5%) reported that their families saved food for them when they were at work or tuition (Table 4).

Binary logistic regression results identified house ownership (AOR = 3.513), frequency of illness (AOR = 2.996) and fathers’ education of the participants (AOR = 2.941) as the most significantly associated social determinants of poor nutritional status among these girls. Whereas, frequency of food shortage (AOR = 0.431) and living in a joint family (AOR = 0.411) were negatively associated with poor nutritional status with odds of having poor nutritional status (Tables 5 and 6).

Discussion
Housing and family characteristics
Economists have often used the factor of crowding as an indicator of wealth status. Those who belong to poor households or have less income tend to have more crowding factor than those who are economically better. Past studies also identify household size, persons/room and land holding are significant determinants of socio economic status [2, 25].

Same was found in the present study as it was observed that 52.7% of the adolescents were living in one room house and moreover 73.2% had one washroom for the whole family. In South Asian culture, a great importance is placed on material assets such as

| Variable                                | Level | Frequency | Percentage | Fisher Exact value | P- value |
|-----------------------------------------|-------|-----------|------------|--------------------|----------|
| Age of Participant                      | 13–15 | 51        | 45.5       | 1.245              | .249     |
|                                         | 16–19 | 61        | 54.5       |                    |          |
| Currently in education                  | Yes   | 48        | 42.9       | 2.542              | .087     |
|                                         | No    | 64        | 57.1       |                    |          |
| Highest level of education of participant| Class 5 | 31        | 27.7       | 6.078              | .009     |
|                                         | Class 8 | 25        | 22.3       |                    |          |
|                                         | Class 10 | 20       | 17.9       |                    |          |
|                                         | Intermediate | 6       | 5.4         |                    |          |
|                                         | Masters | 1         | .9          |                    |          |
|                                         | Not educated | 29     | 25.9       |                    |          |
| Highest level of participant’s father’s education | Class 5 | 27       | 24.1       | 8.305              | .002     |
|                                         | Class 8 | 14       | 12.5       |                    |          |
|                                         | Class 10 | 19      | 17.0       |                    |          |
|                                         | Intermediate | 1     | .9          |                    |          |
|                                         | Masters | 1         | .9          |                    |          |
|                                         | Not educated | 50    | 44.6       |                    |          |
| Highest level of participant’s mother’s education | Class 5 | 24       | 21.4       | 6.078              | .009     |
|                                         | Class 8 | 8        | 7.1         |                    |          |
|                                         | Class 10 | 4        | 3.6         |                    |          |
|                                         | Bachelors | 3       | 2.7         |                    |          |
|                                         | Not educated | 73    | 65.2       |                    |          |
land and cattle ownership. Whereas land and cattle ownership is given importance in rural settings, in cities it is usually ownership of the house, along with the locality it is situated which determines one’s social status. A family who does not own a house is generally considered poor. Physical assets are given importance throughout the world but in some cultures a great importance is placed on land and cattle ownership as they are considered a status of wealth and respect [26]. In the present study it was found that around 40% of the adolescent families were living in rented houses and further analysis found house ownership as one of the most significant determinant of poor nutritional status. It might be due to the fact that as major part of income is gone on paying rent, compromise has to be sought on buying nutritious food. The present study is in consistent with the results of a Canadian study which also identified not having house ownership as a reason of being food insecure [27]. However, the present study showed no significant association between family size and nutritional status. This finding again is in line with findings of previous studies which showed no significant association between family size and nutritional status [2].

| Variable                          | Level          | Frequency | Percentage | Fisher Exact value | P-value |
|-----------------------------------|----------------|-----------|------------|--------------------|---------|
| BMI                               | Normal         | 38        | 33.9       | 2.8                | .26     |
|                                   | Underweight    | 65        | 58.0       |                    |         |
|                                   | Overweight     | 9         | 8.0        |                    |         |
| Health status at birth            | Healthy        | 87        | 77.7       | .208               | .646    |
|                                   | Weak           | 25        | 22.3       |                    |         |
| History of illness over the past 6 months | Yes     | 65        | 58.0       | .475               | .440    |
|                                   | No             | 47        | 42.0       |                    |         |
| Details of illness that occurred in the past 6 months | Dengue  | 12        | 10.7       |                    |         |
|                                   | Gastro Intestinal Tract | 12 | 10.7 | | |
|                                   | Throat and Chest | 24 | 21.4 | | |
|                                   | Other          | 17        | 15.1       |                    |         |
|                                   | not fallen ill | 47        | 42.0       |                    |         |
| Frequency of illness              | Weekly         | 38        | 33.9       | 7.024              | .005    |
|                                   | Monthly        | 36        | 32.1       |                    |         |
|                                   | Twice a year   | 38        | 33.9       |                    |         |
| General health                    | Lethargy       | 23        | 20.5       | .475               | .440    |
|                                   | Shortness of breath | 12 | 10.7 | | |
|                                   | Both           | 60        | 53.6       |                    |         |
|                                   | Neither        | 17        | 15.2       |                    |         |
| Frequency of baths                | Weekly         | 28        | 25.0       | 3.549              | .047    |
|                                   | Twice a week   | 44        | 39.3       |                    |         |
|                                   | Thrice a week  | 39        | 34.8       |                    |         |
|                                   | Daily          | 1         | .9         |                    |         |
| Regularity of periods             | Yes            | 103       | 92.0       | .000               | 1.000   |
|                                   | No             | 9         | 8.0        |                    |         |
| Type of sanitary napkin usage     | Cloth          | 86        | 76.8       | .885               | .255    |
|                                   | Pad            | 14        | 12.5       |                    |         |
|                                   | Both           | 12        | 10.7       |                    |         |
| Reuse of sanitary napkin          | No             | 62        | 55.4       | 6.233              | .012    |
|                                   | Yes            | 50        | 44.6       |                    |         |
| How sanitary napkin is cleaned    | Wash with Soap | 50        | 44.6       |                    |         |
|                                   | Wash without soap | 3 | 2.7 | | |
|                                   | Does not reuse | 59        | 52.7       |                    |         |

Table 3 Health Status and Hygiene Practices of the Participants
Family income and expenditures
As the study participants also included working adoles-
cents, number of family members who were employed
ranged from 1 to 5, with 25% families having one
employed member to 28.6% and 26.8% families having 2
and 3 employed members respectively. Average house-
hold income showed more than a one fourth (27.7%)
adolescent families as having income that ranged be-
tween 4000 to 12,000 rupees/month($1 = Rs 100 at the
time of data collection). About 30.3% and 22.4% families
had income between 13,000–15,000 and 16,000–20,000
respectively. Per capita income was calculated and it was
found that 25% adolescent girls’ family members were
living on less than 55 rupees/day/person which makes it
around half cent/day. Whereas 28% families were living
on Rs 100/day/person. The findings of the study were
not in consistent with previous studies which showed no
significant association ($p > 0.05$) between per capita in-
come and nutritional status of the participants [2]. Aver-
age household income was also found to be one of the
significant determinant of poor nutritional status in final
regression model with AOR = 2.901.
Household bills which on probe was found to be
mostly of electricity took the major chunk of poor
household incomes as 65% reported it to be the next
major expenditure after food, with rent resuming the
second place at 21.4%. Studies in the past have shown
that the type of housing one lives in for example
rented, mortgaged, housing instability, struggle with
mortgage or rent payments/behind on rent, moved to a
different dwelling for cost or other such arrangements
also have negative implications on health status of an
individual [25, 28].
About 58% of the adolescents’ fathers were working as
laborers indicating towards lack of skills and education
in poor households and consequently low incomes. The
studies have also shown that occupation of the family is
strongly related with the risk of under nutrition in ado-
lescent girls as mal nutrition was found to be more
prevalent in families whose occupation was labor as
compared to the girls who belonged to families whose
main occupation was business [2].
An increasing trend towards nuclear families was
witnessed as more than 72% adolescents were living in
nuclear families. This trend is in clash with traditions of
South Asian culture where a great value is placed on
joint family systems and elders such as grandparents and
paternal uncles are given a lot of importance. A later
regression analysis also supported joint family system
which showed that girls who lived in joint families had
lesser odds of being malnourished than those who lived
in nuclear families. It shows that joint families have a
protective effect towards malnourishment. It might be
due to the reason that grandparents being comparatively
free of other stresses of work spend more time with their
grand children and are better able to take care that their
grand children have eaten enough. Another plausible
explanation is that in joint families, more food choices
might be available as there are more persons to contrib-
ute towards family income thereby increasing purchas-
ing power. Further research on this aspect is needed to
confirm these hypotheses.

| Variable | Level | Frequency | Percentage | Fisher Exact value | P-value |
|----------|-------|-----------|------------|--------------------|---------|
| Food bought not lasting | Yes | 81 | 72.3 | 1.136 | .209 |
| Frequency of food shortage | No | 31 | 27.7 | | |
| | Every month | 38 | 33.9 | .050 | .690 |
| | Some months | 42 | 37.5 | | |
| | Never | 32 | 28.6 | | |
| Who is served meals first in the family | Father | 83 | 74.1 | | |
| | Mother | 16 | 14.3 | | |
| | Brother | 10 | 8.9 | | |
| | Sister | 1 | .9 | | |
| | You | 2 | 1.8 | | |
| Are you served the same food as your brothers | Yes | 106 | 94.6 | .000 | .694 |
| | No | 6 | 5.4 | | |
| Is food saved for you if you skip meals | Yes | 89 | 79.5 | .415 | .465 |
| | No | 21 | 18.8 | | |
| | Doesn’t go out | 1 | .9 | | |
| | sometimes but not always | 1 | .9 | | |
Personal and educational characteristics of the participants

The adolescent girls were divided into two groups according to age, the early adolescents (13 years to 15 years) and late adolescents (16 years to 19 years). It was found that there existed no significant association between age and BMI (>0.05). The findings of this study were not in consistent with previous study findings which showed a significant association between nutritional status and age [2]. However, the present study showed significant association between education of the participant and their nutritional status (< 0.05). This finding is in line with previous studies which show an

Table 5 Binary logistic regression analysis for the association of different variables with below normal BMI among adolescent girls

| Variable                      | OR    | 95% CI for EXP(B) Lower | 95% CI for EXP(B) Upper | AOR    | 95% CI for EXP(B) Lower | 95% CI for EXP(B) Upper | Sig.  |
|-------------------------------|-------|-------------------------|-------------------------|--------|-------------------------|-------------------------|------|
| Work status                   | 2.48  | 1.147                   | 5.380                   | 2.062  | .284                    | 14.990                  | .475 |
| Student or not                | 2.000 | .931                    | 4.297                   | .125   | .016                    | .962                    | .046 |
| Menstruation period regularity| 0.896 | 0.227                   | 3.532                   | .787   | .098                    | 6.309                   | .822 |
| Frequency of illness          | 3.194 | 1.418                   | 7.198                   | 8.028  | 1.959                   | 32.900                  | .004 |
| Age category                  | 1.661 | .775                    | 3.564                   | 1.495  | .529                    | 4.224                   | .448 |
| Number of rooms               | 2.025 | .945                    | 4.339                   | .249   | .071                    | 1.712                   | .194 |
| Number of washrooms           | 2.267 | .968                    | 5.306                   | 1.465  | .301                    | 7.127                   | .636 |
| House ownership               | 3.002 | 1.367                   | 6.596                   | 6.103  | 1.610                   | 23.132                  | .008 |
| Fathers' occupation           | 2.221 | 1.029                   | 4.795                   | 2.796  | .814                    | 9.604                   | .103 |
| Earning members of family     | .586  | .250                    | 1.373                   | 1.024  | .974                    | 5.326                   | .978 |
| Average household income      | 2.379 | .919                    | 6.156                   | 4.791  | .791                    | 29.031                  | .088 |
| Expenses other than food      | .801  | .362                    | 1.771                   | .846   | .218                    | 3.280                   | .809 |
| Transport expenditure         | .376  | .126                    | 1.122                   | .287   | .039                    | 2.137                   | .223 |
| Food insecurity               | 1.720 | .747                    | 3.965                   | .859   | .450                    | 7.672                   | .392 |
| Frequency of food shortage    | .842  | .382                    | 1.856                   | .166   | .036                    | .765                    | .021 |
| Served same food              | .710  | .137                    | 3.682                   | 1.772  | .118                    | 26.524                  | .679 |
| Food saved for the participant| 1.569 | .579                    | 4.252                   | .968   | .202                    | 4.637                   | .968 |
| Fathers' education            | 3.456 | 1.544                   | 7.737                   | 2.282  | .664                    | 7.846                   | .191 |
| Mothers' education            | 2.935 | 1.314                   | 6.554                   | .802   | .206                    | 3.122                   | .750 |
| Health status at birth        | 1.379 | .549                    | 3.460                   | 1.109  | .235                    | 5.243                   | .896 |
| Six months health history     | 1.408 | .658                    | 3.011                   | .325   | .076                    | 1.382                   | .128 |
| Type of family structure      | .688  | .292                    | 1.619                   | .120   | .023                    | .616                    | .011 |
| Sanitary napkin               | .496  | .160                    | 1.540                   | 1.099  | .191                    | 6.330                   | .916 |
| Reuse of sanitary napkin      | .342  | .155                    | .756                    | .532   | .082                    | 3.442                   | .508 |
| Bath frequency                | 2.298 | 1.043                   | 5.061                   | 2.071  | .569                    | 7.534                   | .269 |
| Per capita income             | .784  | .354                    | 1.736                   | .162   | .030                    | .879                    | .035 |
| Food expenditure out of total budget | .469 | .179                   | 1.227                   | .550   | .101                    | 2.981                   | .488 |

Table 6 Final model of bivariate regression showing association of most significant variables with below normal BMI among adolescent girls

| Variable                      | OR    | 95% CI for EXP(B) Lower | 95% CI for EXP(B) Upper | AOR    | 95% CI for EXP(B) Lower | 95% CI for EXP(B) Upper | Sig.  |
|-------------------------------|-------|-------------------------|-------------------------|--------|-------------------------|-------------------------|------|
| Frequency of illness          | 3.194 | 1.418                   | 7.198                   | 2.996  | 1.198                   | 7.491                   | .019 |
| House ownership               | 3.002 | 1.367                   | 6.596                   | 3.513  | 1.366                   | 9.031                   | .009 |
| Average household income      | 2.379 | .919                    | 6.156                   | 2.901  | .975                    | 8.630                   | .055 |
| Frequency of food shortage    | .842  | .382                    | 1.856                   | .431   | .164                    | 1.133                   | .088 |
| Fathers' education            | 3.456 | 1.544                   | 7.737                   | 2.941  | 1.187                   | 7.287                   | .020 |
| Type of Family structure      | .688  | .292                    | 1.619                   | .411   | .145                    | 1.168                   | .095 |
| Constant                      |       |                         |                         | 470.844|                       |                         | .003 |
improved nutritional status with increase in education level [2, 29]. Similarly the study showed significant association between education of fathers and nutritional status of the participants which is in consistent with findings of previous study which showed a decline in malnutrition with increase in fathers’ education [2]. This difference might be due to the fact that with increase in education one is more likely to get a better paid job which automatically increases the amount one tend to spend on food budget. The results of this study were also consistent with other studies which showed significant association between nutritional status of the participants and their mothers, education level [30, 31].

A recent study in India has also showed a strong correlation between the nutritive food intake by adolescent girl and education of the fathers [32]. A study carried out in India with same socio economic setting has also found literacy status of father to be significantly associated with the nutritional status of the adolescent girls [2].

**Health status and hygiene practices of the participants**

58% of the participants were found to underweight with BMI < 18.5 m², whereas 33.9% were falling in the normal category with BMI 18.5–24.9 m². Only a small percentage of 8% fell in overweight BMI > 25 m². This finding is in consistent with previous findings that malnourished girls had low BMI [2, 33].

The previous studies also showed similar findings as the nutritional status of female garment factory workers in Bangladesh was found to be poorer [20]. Whereas past studies have established a link between adult obesity and high birth weight [34] however no association between health status at birth and low BMI was found as nearly 78% participants reported that they were born healthy and of normal weight. Morbidity has long been associated with ill health. A past study has also shown the vicious cycle of poor health and frequently recurring infections [35]. General health was found to be poorer and it points towards vicious cycle of ill health and disease as 58% reported of falling ill within the past 6 months. Around 34% and 32% of the participants reported of falling ill weekly and monthly, thereby identifying frequency of illness as one of the most significant determinant of nutritional status (p < 0.05).

It was found that a majority of adolescent girls were taking bath only once a week, which might also be due to the fact that 73% of adolescent families had only one washroom for the family as the economist agree that Socio economic status also determines to a large extent the availability and access to proper sanitation which include not only safe drinking water but also opportunity to bath and toilet facility. In the past a study has also suggested that poor personal hygiene may contribute to the phenomenon of under-nutrition [2].

**Food security and gender equality**

An overwhelming majority of around 72% said that their families become food insecure, of which around 34% experience it every month while 38% said food insecurity is experienced sometimes. Final regression model also found food insecurity to be one of the most significant determinant of nutritional status as it was found that girls whose families are food insecure have lesser chances of having poor BMI than those whose families are food secure, this finding is very different and might be due to fact that the girls who are food insecure tend to eat with more care than others for fear of not having enough to eat. However further research in this aspect is needed before a concluding statement can be given.

Gender bias was not found in the present study as nearly 95% girls reported that they are served the same food as their brothers and 80% reported that food is saved for them if they are not at home. This finding is not in line with the finding of a previous study in Bangladesh which reported otherwise [36, 37].

The present study tries to identify the most significant socio demographic characteristics which are associated with poor nutritional status in adolescent girls belonging to economically deprived households. Although a few studies have been conducted in the past on adolescent girls but none of the study was community based according to the knowledge of this author. The study is especially important from the perspective that socio demographic determinants were studied. However, as the study was carried out on small scale due to financial, cultural and time constraints on the part of researcher, the results cannot be generalized to all the working adolescents. Nevertheless, this descriptive analytical study provides a new dimension for future studies in the same socio economic and geographical settings on a larger scale.

**Conclusion**

It can be concluded from this study that certain socio demographic determinants such as house ownership, frequency of illness and fathers’ education are significantly associated with the poor nutritional status of adolescent girls belonging to low income households. The study also shows some interesting findings when it is found that living in joint families and being food insecure is negatively associated with poor nutritional status among adolescent girls. The findings of the present study can be used as a pilot study and future study on a larger sample throughout the country is recommended. This will help in drawing attention of
the world towards an important role, socio demographic determinants play in health and nutrition of the population especially the adolescent girls who are future mothers. It can help in planning effective nutritional interventions for adolescent girls by targeting the most significantly associated socio demographic determinants of nutritional status in this age and socio economic group.

Abbreviations
BMI: Body Mass Index; SES: Socio Economic Status.

Acknowledgements
The study is a part of M. Phil research on adolescent girls. The researcher wants to thank all the participants of the study and the facilitators Mr. and Mrs. Afzal of academy for girls, Shah di Khooee and Ms. Samina Kaiser of Mochipura without whom assistance the author would not be able to access adolescent girls.

Funding
The research was not funded by any individual or institute. All the expenses incurred on the research were bore by the first author.

Availability of data and materials
The datasets generated during and/or analyzed during the current study are not publicly available due to confidentiality ensured to the participants but are available from the corresponding author on reasonable request.

Authors' contributions
FH was responsible for conception and design; data collection, analysis and interpretation of data; drafting and revising the manuscript. MA helped in statistical analysis and interpretation of the data. SS helped in critical revision of the study article. AH made substantial contribution to conception and design of the study and critical revision of the study article. All authors read and approved the final manuscript.

Ethics approval and consent to participate
The research was carried out according to the declaration of Helsinki and informed verbal consent was taken from the adolescent girls and their guardians. The confidentiality was ensured and the participants were informed of their right to withdraw anytime if they decide not to participate in the study. The permission to conduct study on adolescent girls was taken by the authorities concerned and study was approved by the concerned authority.

Consent for publication
All the authors have given their consent for publication.

Competing interests
The authors declare that there is no conflict of interest

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Author details
1Department of Higher Education, Punjab, Pakistan. 2Statistical officer NHRC/PHRC Research Center, Shaikh Zayed Medical Complex, Lahore, Pakistan. 3Government College of Home Economics, Gulberg, Lahore, Pakistan. 4Department of Public Health and Community Medicine & Deputy Director at Department of Undergraduate Medical Education, Shaikh Khalifa Bin Zayed Al-Nahyan Medical College and Shaikh Zayed Post Graduate Medical Institute, Shaikh Zayed Medical Complex, Lahore, Pakistan.
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