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Evaluation of Dietary Intake and Food Insecurity: A Case Study on Selected Households from Lahore,Pakistan

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ABSTRACT

Background: Food insecurity consistently challenges middle-income countries, including Pakistan. The aim of this study was to evaluate the dietary food intake of the households in the selected location through a semi-structured questionnaire. **Methods**: A cross sectional study was carried out among 500 households comprised 2094 participants to investigate dietary intake and status of food insecurity. Furthermore, socio-demographic and weekly dietary food intake was collected through a semi-structured questionnaire in 2019. Those households who assent to participate were included in the study. **Results:** Mean household size was 5.80±2.05 comprised 49.27% male and 50.61% female. Six food types were commonly consumed in the study population. Among these foods (g/capita/day) starch remained at the top 734.43 followed by fruits 256.02 and vegetables 89.77. These data highlighted limited dietary diversity and reduced dietary intake. The energy intake (per capita/day) from the food basket, contribution of the starch was the highest 32.37% versus protein 14.43%, milk 14.08%, vegetables 1.31%, and fruit 7.79% with an overall calories intake 81.08% from all food groups except tea. Finally, of the 500 households, 42.4% people were below the poverty line, 41.8% people at the poverty line, and 15.8% people were above the poverty line. **Conclusion:** The results showed that dietary intake of the participants was below the reference intake, demonstrating food insecurity and unbalanced diet.

Keywords: *Dietary intake; Food insecurity; Poverty; Food diversity*

Introduction

Food is a collection of essential nutrients taken to complete requirement for energy and nutrients except non-nutritional substances (Karim *et al.*, 2018). Adequate food intake is a consistent challenge in middle income countries, such as Pakistan (Sheikh et al., 2020). Although, Pakistan has made notable progress in ensuring the availability of food, such as cereals, milk, vegetables, beef, mutton, poultry, two fundamental threats are still prevailing. First, balance diet concept is still a long way to perceive the importance of and second, intake of inadequate food. This lack of awareness resulted in two classes of consumers; the high income class consumes more beef, mutton, and poultry; whereas the less fortunate class consumes more starch

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based foods (Government of Pakistan, 2017). This is further explained by the fact that around 70% of the expenditure of Pakistan is for cereals, sugars, and fats; while the major source of calorie is derived from wheat; indicating that the quantity of food is more important than the quality (Haider and Zaidi, 2017).

Likewise, around 60% of populations reside in rural and remaining 40% live in urban. The second class i.e. 40% of the population in urban areas experiences below recommended calories or less diversified foods, which can lead to a number of non-communicable diseases. Main objectives of this study include a) the level and composition of food consumed by an average household; b) finding poverty line in the study population; c) calories intake of an average household; d) comparison of per capita food consumption by an average household with previous study to estimate differences in pattern of food insecurity.

Materials and Methods

Estimation of total household food consumption (kg/w): This study was carried out in Johar Town, located in Lahore, Punjab. A sample size of 500 households was chosen and the required data was collected through the random sampling technique. A semi-structured questionnaire was used for food consumption. Those household members who agree to participate in the study were included in the study. In-charge of the household filled the questionnaire in the presence of a trained researcher. Likewise, different markers, that can reflect the quantity of the diet, were shown to the households to accurately estimate food (e.g, serving size). The households were not interviewed during national and religious holidays to remove biases; since a household may consume a typical diet. A semi-structured food frequency questionnaire was used (Cade *et al.*, 2004) that comprised questions related to household size, income of household, and food items they consume.

In order to calculate household food consumption (kg) per week for a particular item the household size was multiplied with total intake of that particular food item in grams then the whole was divided by 1000.

*Food consumption (kg/w/household) = Household size*intake of food item (g/wk)/1000*

Calorie intake requirement of different age groups: Mean age was calculated by dividing total individuals in a specific age group by total household size, which is 500 in this case. Likewise, calorie intake requirement was retrieved from internet for Pakistani population as shown in **Table 2**.

Individual food consumption (g/day/person): Total food consumption for a particular food (g/day) for each individual was estimated by dividing total household food consumption (kg/w) by household size and multiplying by 1000. The obtained value was then divided by 7, giving food consumption per day per person.

*Food consumption (g/day/person) = Food consumption (kg/wk/household) x 1000/household size*7*

Adult equivalent estimation: Weight converted to adult equivalent was calculated by dividing average calories required for a particular age group (**Table 2**) by needed reference calories which was 2000 in this case. Then adult equivalent was estimated by multiplying individual mean household size for a particular age group with weight converted to adult equivalent in a specific age group (**Table 3**). This estimation is important; since total adult equivalent which is 6.84 in this case has to be used for per capita food consumption.

Per capita food consumption: The food consumption per capita was estimated through dividing the value obtained from above equation by adult equivalent (6.84) as shown in following equation.

Food consumption (kg/capita/w) = Food consumption per household per week (kg)/6.84

Calorie consumption (per capita per day): Intake of each food groups, such as starch (potato, rice, pasta, oats, noodles, roti, bread, etc.) were considered for each household. Number of participants that consume a particular food was

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also estimated. The participants of the study were asked, for example, how much potato they consumed on a daily basis. It was noted that on average potato intake was 225 g (almost 1 potato). Then intake was converted to exchange size, for example, one potato is 2 serving size. Then exchange size was converted to kcal using following equation:

Average kcal consumption per capita per week = exchange size x number of person consuming food x number of calories in one exchange of food

Poverty line estimation: Poverty line (PL) was estimated (Karim *et al.*, 2018) using calorie estimated in following equation:

PL= Average Kcal consumption per capita per day/2000

In which, PL describes poverty line; and a person will be poor if his/her food consumption correspond to 2000 or less than 2000. Here, 2000 kcal/day is considered as standard normal calorie intake indicated by the U.S. Food and Drug Administration (FDA) guidelines. Moreover, poverty line would be equal to 1, if a person consumes 2000 kcal/day i.e., to be at the poverty line, PL>1 indicates that the person is consuming more than 2000 kcal/day and above poverty line. On the other hand, PL<1 indicates that the person is below poverty line i.e. consuming less than 2000 kcal/day.

Ethical consideration: The Research Ethics Committee of School of Health Sciences (SHS) in its 10th meeting has approved this Research.

Data analysis: The collected data was analyzed by SPSS version 21. Descriptive statistics, including mean, standard deviation, minimum and maximum and the composition of actual households were estimated.

Results

Table 1 shows the mean household size for various age groups (5.80±2.05). Furthermore, the household consisted of 49.27% male and 50.61% female. Of the total household members (age-wise), children up to age of 5 years were 4.06%, aged 6-10 years were 5.95%, adolescents aged 11-15 years were 8.12%, adults aged 16-60 years were 80.37%, and aged above 60 years were 3.96%.

Energy intake requirement is retrieved from internet for Pakistani population (online) as shown in **Table 2**; indicating that energy requirement of different group is different.

Adult equivalent estimation: The household composition was converted into adult equivalent using their energy requirements by age (**Table 1** and **Table 2**). An adult requires 2000 kcal per day. The children up to age of 5 years require 1304 kcal, which was 0.65 of energy requirements for adults (2000 kcal). In the same way children, aged 5-10 years require 1768 kcal per day, which was 0.88 of energy requirements for adults. The children aged 11- 15 years and adults aged 60 years are considered as equal to adults. On the other hand, the average energy requirement of males (2146 kcal) and females (1632 kcal) aged above 60 years is 1889, and the adult equivalent of above 60 years of age is calculated as 0.94 of adult requirement. Hence, energy requirement for all age groups was converted into adult equivalent as shown in **Table 3**. The above-mentioned data was utilized to calculate the total adult equivalent of the households, which was estimated at 6.84 represented in **Table 3**.

Estimation of main food groups consumption (kg/wk/household): Starch was the main food groups being consumed, showing that average households derived most of their energy requirements from this category.

Estimation of individual food items from each main food groups (*kg/wk/household):* Rice was on the top followed by potato; indicating that diversity in energy intake is limited only to rice and potato. Considering the published data elsewhere in Pakistan, it was found that the intake of rice and potatoes in the study area were much higher with respect to other food commodities, but was lower compared to other Asian countries.

Main sources of protein intake included meat from chicken, beef/mutton and eggs; showing protein intake is low in the study population compared to the dietary reference intake.

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Moreover, from the dairy intake the participants preferred milk versus yogurt and cheese (20.26), indicating that the study participants consumed 30% less than the recommended amount.

Cooked vegetable intake exceed than the raw vegetables and juice made from raw vegetables. The participants consumed 3.65 (or 89.72 g/capita/day); while the recommended quantity is more (Hu, 2003, Yip *et al.*, 2019). Fruit juice intake was comparatively high versus fresh and dried fruit. Overall, fruit intake in this study was low. These reflecting participants were not food secure in terms of their vegetables and fruit intake. Moreover, people like to have tea with sugar rather than without sugar. The values found were 3.15 kg/wk/household tea with sugar compared to 1.07 kg/wk/household tea without sugar.

Average energy consumption: Likewise, average (kcal/capita/wk) energy intake of household was: starch 5085, proteins 2267, milk 2213, vegetables 206.45, fruits 1224.72, fats and oils 1769.73, and tea 1143.4 (**Table 4**). The percent calories per day/person was divided by 7 as can be seen in column 4 of **Table 4**. The results showed that the participant's intake of energy from starch was high 32.37% per day/capita compared to other sources of foods while the recommendation is at least 55% energy has to be taken from carbohydrates/starch group. Furthermore, percentage energy per day per person (column 5) show overall, participant's energy intake is 81.08% from all food groups (except tea) compared to 93.9 of HIES Pakistan 2010-11 estimate (Goverment of of Pakistan, 2010).

All type of food consumption: **Table 5** shows consumption of various food items on weekly basis. Major consumption included rice, roti, potato, milk, dried fruit and fruit juices. The results indicated that the rice intake was low compared with other Asian countries; while potato consumption is high, indicating that the study population is expected to get greater quantity of potassium, B vitamins, and fiber (Gibson and Francis, 2015). **Table 6** describes details of food items (Comparison of the current study with previous studies).

Estimation of PL: PL was calculated using daily calorie intake of an individual from the sample households and taking as a reference 2000 kcal/day. Accordingly, of the 2094 participants, 42.4% people were below poverty line, indicating that the participants consume less than 2000 kcal/day and are food insecure. Moreover, 41.8% people were at poverty line, indicating that they consume 2000 kcal/day; while only 15.8% of people were above poverty line, indicating that their calorie intake was more than 2000 kcal/day.

Table 1. Composition of household and demographics

Household composition	N	Minimum	Maximum	Sum	Mean ± SD
Household members	500	-5	15	2904	5.80 ± 2.05
Male	500	0	8	1431	2.86 ± 1.30
Female	500	-2	7	1470	2.94 ± 1.39
Ages (y) groups					
Up to 5	500	0	4	118	0.23 ± 0.57
6 to10	500	0	3	173	0.34 ± 0.57
11 to 15	500	0	5	236	0.47 ± 0.74
16 to 60	500	0	60	2334	4.66 ± 3.11
Above 60	500	0	9	115	0.23 ± 0.63

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Table 2. Daily calorie requirements by age groups (Goverment of of Pakistan, 2010)

Age (years)	Average (kcal required)
Children up to 5	1304
5-10	1768
11-15	2640
16-60	2399
Above 60	1889
Total (average)	2000

Table 3. Actual household size converted to adult equivalent

Composition	Mean	Weight converted to adult equivalent	Adult equivalent
Age groups (y)			
Children up to 5	0.23	0.65	0.15
5-10	0.34	0.88	0.30
11-15	0.47	1.32	0.62
16-60	4.66	1.18	5.54
Above 60	0.23	0.94	0.21
Household size	5.80		6.84

Table 4. Average Kcal consumption per capita from foods and beverages (Karim *et al.*, 2018)

Foods	Calorie intake/capita /wk	Calorie intake/capita /day	Calorie (%)/capita/day	HIES Pakistan 2010-11 estimate
Starch	5085.10	726.44	32.37	51.7
Protein	2267.10	323.87	14.43	3.5
Milk	2213.10	316.15	14.08	13.4
Vegetables	206.45	29.49	1.314	5.0
Fruits	1224.72	174.96	7.79	5.0
Fat/Oil	1769.73	252.81	11.26	15.3
Tea	1143.48	163.35	7.27*	-
Total	13909.68	1987.07	88.54	93.9

Table 5. Food consumption (kg/wk/household)

Foods	Intake (kg/wk/household)	Foods	Intake (kg/wk/household)
Rice	6.25	Yogurt	3.36
Pasta	0.71	Milkshake	3.05
Oats	0.54	Cheese	1.45
Noodles	3.22	Vegetable cooked	1.65
Roti	3.22	Vegetable raw	0.94
Potato	5.15	Vegetable juices	1.03
Bread	1.02	Fruit raw	2.97
Biscuit	0.26	Fruit dried	3.05
Barley	1.29	Fruit juices	4.34
BUN	0.78	Butter	0.14
Peas	1.81	Margarine	0.18
Corn	1.81	Cooking oil	0.37
Lentils	1.58	Cream	0.17
Beef	1.10	Salad dressing	0.16

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Table 5. Food consumption (kg/wk/household)

Foods	Intake (kg/wk/household)	Foods	Intake (kg/wk/household)
Fish	1.01	Tea with sugar	3.14
Eggs	0.91	Nuts	0.50
Chicken	1.83	Tea without sugar	1.07
Milk	12.36	Beans	1.80

Table 6. Food consumption of current and previous study conducted in Swat (Karim *et al.*, 2018)

Foods	Study from Swat	Present study
Flour/roti	372.51	79.37
Beef	27.53	27.17
Poultry/ Chicken	41.29	45.20
Potato	20.79	126.74
Fruit (Total)	66.39	256.02
Vegetable (Total)	177.12	89.97
Milk	166.37	498.54
Rice	70.29	153.92
Bean	20.70	44.44
Pulses/ Lentils	28.31	39.05
Cooking oil	33.09	38.27
Tea	6.92	104.14

Discussion

Household composition, demographics, and calorie intake: Average household size (**Table 1**) in our study is slightly higher, indicating there is greater need for effective control of growth rate in the near future. However, it is still within range when compared with other countries (United Nations, 2017). Regarding the calorie intake need of individuals, it is different for different age group/gender, however, on average the needed energy would be greater than 2000 (**Table 2**).

Adult equivalent estimation: The household composition was converted into adult equivalent using participants' calorie needs by age (**Tables 1** and **Table 2)**. An adult requires 2000 kcal per day. The children up to age of 5 years require 1304 calories. When divided (1304/2000) gave 0.65 of calorie requirements for adults (2000 kcal). Likewise, children aged 5-10 years require 1768 calories per day that estimated as 0.88 calorie requirements for adults; while children aged 11-15 years and adults aged 60 are considered equal to adults. On the other hand, people aged above 60 years require 1889 kcal which is the average calorie requirements for males (2146 kcal) and females (1632 kcal) aged above 60 years, and the adult equivalent of above 60 years of age is calculated as 0.94 of adult requirement. Hence, calorie requirement for all the age groups were converted into adult equivalent represented in **Table 3**. The above-mentioned data was utilized to calculate the total adult equivalent of all household members, which was estimated at 6.84 (**Table 3**).

Estimation of main food groups consumption (kg/wk/household): Food security and patterns of food consumption relies on a range of factors; such as rural or urban area, facilities, transportation, and access to food, income status, family size, health expenses, and education level (Hayat *et al.*, 2016). A recent study conducted in Punjab-Pakistan showed that one fourth of the households (576 households) were food insecure (Ahmed *et al.*, 2017)). Another survey from Pakistan depicted that 28% people were poor; while 22% people had limited access to food (Rifat-uz-Zaman and Ali, 2013). The results of the current study indicated

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poor dietary or limited diversity in food intake by the participants.

Estimation of individual food items from each main food groups: Dietary fibers intake was low and below the recommendations, indicating that diversity in energy intake is limited to rice and potato. Considering the published data elsewhere in Pakistan (Arifullah *et al.*, 2008) it was found that the intake of rice and potatoes in the study area was high, but it was lower than other Asian countries, such as South Korea where rice consumption was noted to be 179.4 g/day per person (Cha *et al.*, 2012). Some Asian countries consume rice as their staple food, so they might need higher intake requirement. On contrary, Pakistani nation, consume other grains as well, such as wheat, so in this study reduced intake of rice might be due to the consumption of other grains. Consuming more refined staple grain like rice intake is shown to be associated with elevated diabetes risk (Anjana *et al.*, 2015).

The American dietetic association suggests 0.8-1.0 g of protein/kg body weight/day for healthy adults or at least 56.0 g and 46.0 g of protein per kg body should be consumed in a day by men and women, respectively. This implies that protein intake is low in the study population. Previous studies have indicated that adults (19-30 years) consumed more protein (91 g/day) compare to older adults 66 g/day (Fulgoni and Victor, 2008), possibly due to low appetite and energy demand in this age group, in addition to food insecurity due to poverty (Volpi *et al.*, 2013).

The united states department of agriculture (USDA) food system (Myplate) recommends around 3 cups of milk (approximately 708 g) for adult men and women. The present intake of milk and its derivatives is approximately 30% less than the recommended amount. the cost effective dairy products, such as milk based blend products (Perotti *et al.*, 2019, Tahir *et al.*, 2019) are recommended.

The overall vegetable consumption was far less compared to other countries (Varela-Moreiras *et al.*, 2010) and at least 400 g of fruit and vegetables per day (World Health Organization, 2003) or 230 g (Hu, 2003, Yip *et al.*, 2019) is recommended.

Although 20-35% of total calories should be obtained from fat (Joint, 2008), this amount of energy is approximately correspond to a daily intake of 44-77 g of fat per person per 2000 kcal a day. The participants consumed 38.22 g/capita/day, indicating that, fat consumption was 13.12% less than the standard.

Average calorie consumption: **Table 4** shows that the participant's intake of energy from starch was high compared to other sources of foods. The WHO recommends lower minimum limit i.e. at least 55% of energy should be consumed from carbohydrates, 10% from protein, and 15% from fats. According to the results, intake of the carbohydrates is low, indicating that the participants were food insecure in terms of carbohydrates. Overall, the participants' calories intake was 81.08% from all food groups except tea which was less than 93.9 of HIES Pakistan 2010-11 estimate (Goverment of of Pakistan, 2010).

All types of food consumption: It can be seen from **Table 5** that diversity in food intake was limited that may lead to undernutrition (Khamis *et al.*, 2019). The WHO recommends a healthy and more diverse diet over an extended period of time, which can provide macronutrients, such as proteins, fats, carbohydrates, including dietary fibers and micronutrients, for example, vitamins and minerals. Rice intake in the present study was low compared to other Asian countries like Japan (National Health and Nutrition Survey, 2010) (Watanabe *et al.*, 2013) where average daily rice intake is 341.6 g. In the case of potato consumption , it was higher than the average consumption in the UK (90 g/day; provide 7% of total energy), indicating that the study population is expected to get greater quantity of potassium, B vitamins, and fiber (Gibson and Francis, 2015).

Comparison of the current study with previous studies: The first comparison was made with a study conducted in Swat, KPK, and Pakistan in 2018 for 100 households (**Table 6**) (Karim *et al.*, 2018). Food intake of beef/chicken, vegetables,

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fish, eggs, and milk were low versus previous study (Karim *et al.*, 2018). However, a notable increase was seen in case of potato, fruit, milk, rice, beans, lentils, and tea in the present study compared to the study in Swat (Karim *et al.*, 2018). Thus, a diversified food basket for consumption is expected to promote the quality of life (Kumar, 1997).

Estimation of Pl: An average adult person needs 2000 kcal/day according to the FDA guidelines and previous studies. PL was also calculated using daily calorie intake of a person from the sample households and taking as a reference 2000 kcal/day. Accordingly, of the 2094 participants, 42.4% of the subjects were below poverty line, indicating that the participants of the study consumed less than 2000 kcal/day. Moreover, 41.8% of the participants were at PL, indicating that they consumed 2000 kcal/day; while only 15.8% of the subjects were above PL, indicating that their calorie intake was more than 2000 kcal/day (**Table 7**). The overall findings of the study indicated that a big proportion of the study population was food insecure (42.4%).

Conclusion

The analysis on 500 households reflected the massive spectrum of food insecurity indicated in terms of poverty (42.4%) in the study population. Of the six main food groups, share of the three food groups (starch, vegetables, and fruits) were on the top, indicating poor dietary or limited diversity in food intake by the participants. Furthermore, the study population received most of their energy from rice and potatoes, highlighting lack of diversity in energy intake. Overall, dietary intake of various food commodities was below the reference intake.

As a limitation, the sample selected for the current study included only households from Johar Town, Lahore, and Pakistan, so households of all parts of Lahore were not included. Secondly, those households who did not agree to participate or disclosed information of their household composition were not included in this study. Therefore, a significant number of households of the study area were not represented in the study sample and the dietary intake of all major foods evaluated in the present study may be different for a study sample greater than the present study.

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Authors' contribution

Bacha U designed the study and drafted the manuscript. Yousaf S, Zafar M, Raza A, Arbaz Khan M, Bano S, Tauqeer Z conducted the survey and collected the data. Mustafa F helped in calculation portion and serving size. Naveed Afzal M critically reviewed and evaluated the manuscript. All authors read and approved the final manuscript.

Conflict of interest

Authors declare that there is no conflict of interest.

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