Master of Science in Public Health

Assessment of Dietary Diversity and Food Insecurity in Rural Households of Tehsil Kallar Syedan Rawalpindi: A Cross-Sectional Survey

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__Declaration__

In submitting this dissertation, I certify that I have read and understood the rules and regulations of DPH and QAU regarding assessment procedures and offences and formally declare that all work contained within this document is my own apart from properly referenced quotations.

I understand that plagiarism is the use or presentation of any work by others, whether published or not, and can include the work of other candidates. I also understand that any quotation from the published or unpublished works of other persons, including other candidates, must be clearly identified as such by being placed inside quotation marks and a full reference to their source must be provided in proper form.

This dissertation is the result of an independent investigation. Where my work is indebted to others, I have made acknowledgments.

I declare that this work has not been accepted in substance for any other degree, nor is it currently being submitted in candidature for any other degree

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ABSTRACT

Background: Food insecurity and poor dietary diversity are major concerns associated with malnutrition and non-communicable diseases. Pakistan has faced numerous challenges, including COVID-19, floods, and inflation, which have significantly impacted the food security and dietary diversity of its population.

Objectives: This cross-sectional study aimed to assess the dietary diversity and food insecurity status in rural households of the sub-district of Rawalpindi and examine the socio-demographic factors associated with these outcomes.

Methodology: A validated sample of 259 households was selected using a systematic sampling method. The Household Dietary Diversity (HDDS) and Household Food Insecurity Access Scale (HFIAS) were used to collect data on dietary diversity and food insecurity. Data were analyzed using descriptive and inferential statistics.

Results:

The study found no significant association between household dietary diversity and food insecurity (p=0.848). Most households had high dietary diversity (72.2%), and significantly associated with marital status (p value=0.025), employment status (p value=0.01) and body mass index (p value=0.049). Regarding food security, 94.6% of households were food secure, while 5.4% were food insecure. Employment status (p=0.001) and education level (p=0.009) were significantly associated with food insecurity.

Conclusion: The study found no significant association between dietary diversity and food insecurity, but employment status and education level were significantly associated

with food insecurity. Most households had high dietary diversity and were food secure. These results highlight the need for targeted interventions and policymaker action to address food insecurity and promote dietary diversity in vulnerable populations.

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TABLE OF CONTENTS

Chapter   Page

Contents

LIST OF TABLES

LIST OF FIGURES

Abbreviations

ANC	Antenatal Care
CMBs	Crop protection products of multinational brands
DBM	Double burden of malnutrition
DD	Dietary Diversity
DDS	Dietary Diversity Score
DDIs	Dietary diversity indicators
FI	Food insecurity
FAO	Food and Agricultural Organization
HDDS	Household dietary diversity score
HFIAS	Household food insecurity access score
LMICs	Lower middle income countries
SDGs	Sustainable developmental goals
WFP	World Food Programme
USDA	United States Department of Agriculture

CHAPTER I: Introduction

No poverty and zero hunger exists two most essential Sustainable Developmental Goals (SDGs) and emphasized to attain better quality of life ensure by the year 2030 (Mallick 2015). Pandemic Covid-19 has considerably increase food insecurity that adversely influence socio-economic characteristics and livelihood of household (Bukari et al. 2022). Floods and raising inflation has a negative collision on household food security in Pakistan(Fang and Sanogo 2014). In developing countries foremost cause of malnutrition is food insecurity and interlinked with population growth, health services, education, political institution, food cost, food manufacturing, food trade, payments and per capita GDP (Awad et al. 2023). In Pakistan frequency of food insecurity, stunting and wasting in under five years age children more than 50% and malnutrition among young children is more prevailing cause of morbidity and mortality (Hirani 2013.; Ishaq et al. 2018.). Dietary diversity has association with nutritional status and diet quality furthermore it reflects by dietary diversity (Arimond et al. 2004). However, there is indirect association between dietary diversity patterns and food insecurity whereas dietary patterns directly correlated with under-nutrition and over-nutrition (Adeomi et al. 2022). Food insecurity (FI) associated with undesirable mental health issues; stress, anxiety, sleep disorders, depression and suicidal thoughts whereas, FI more to the point negatively associated with body weight, type-2 diabetes, cardiovascular diseases and mental health (Thomas et al. 2021).

Pakistan has ranked as sixth most populated country in the world and estimated population is 235.8 million in year 2022 (World Population Data Sheet. 2022). Studies have shown that dietary behavior and food environment incoherently linked with socioeconomic differences (Mackenbach et al. 2019). Hameed et al. survey data shown 12% food insecurity in the

households across various provinces of Pakistan and extremely vulnerable in term of nutrients and micronutrients adequacy, calorie intake and balance diet (Hameed et al. 2021). Factors like older age household living in urban area and higher education of household head associated with high diet quality (Ebrahimi et al. 2020). It has been studies that double burden of malnutrition (DBM) is higher in lower-middle income country's (LMICs) richest households as well as in poorest high-income LMICs households and household- level DBM is relative (Seferidi et al. 2022). Food secure households children has 26% higher dietary diversity score than children of food insecure households and by increasing in maternal education, childhood under-nutrition and stunting improved significantly (Ali et al. 2019). The studies has revealed socio-demographic factors of age, education level and marital status are not associated with dietary diversity however, severe household food insecurity is converse in association towards the household dietary diversity(Hashmi et al. 2021). Whereas, to build certain development of healthy generation, stunting growth is a considerable challenge hence, Pakistan's struggles remain unsatisfactory to achieve global goals (SDGs) of good health and well being too (Ullah et al. 2022). Food insecurity has similar effects in Africa, Latin America, Asia and Caribbean region though differences in food insecurity are not due to health services, food production and population growth (Kundu et al. 2021). Studies of Ethiopia revealed beside the occurrence of rural food insecurity urban household food insecurity happens extensively high due to irregular food prices, market food provisions and urban poverty, however the main reasons reported for inadequate food was household headed by government employed, daily wager and uneducated individuals(Goulding et al. 2020).

 Analysis has shown food security mechanism is set of legal and socioeconomic standards and Uzbekistan has long been concerned with food security(Umarjonovna et al. 2022).   In

Bangladesh, dietary diversity, food with higher nutrients access are higher in households that are more engage with market and food prices increase directly linked with worsening of micronutrient deficiency and child malnutrition due to lowered dietary diversity patterns (Thorne et al. 2010). Status of household food security and child malnutrition affected by the food price, poverty, household head education , age, income and household size among Sub-Saharan African population (Drammeh et al. 2019). Food environments and dietary behavior are not associated with socioeconomic differences (Mackenbach et al. 2019). Nutritional deficiency is at higher rate among adolescents and knowledge and practice about dietary diversity between high school girls exists not adequate and FAO's third version is good indicator for measuring dietary diversity (Islam et al. 2020) (Vakili et al. 2013). Dietary diversity indicators(DDIs) ability limited to nutrients adequacy and DDIs has conflicting association with health outcomes(Verger et al. 2021). Dietary diversity is also a good indicator for assessing nutritional status among pregnant women as dietary perception during pregnancy shown affected on dietary quality and under-nutrition has significantly association with dietary diversity, poor nutrition knowledge, poor dietary practice, poor perceived self-efficacy and ANC attendance (Ali et al. 2014; Diddana 2019). Although, food security situation can be secured by affordability of healthy food (McIntyre et al. 2003). Crop protection products of multinational brands (CMBs) enhance food security rather than sub-standard crop protection (Bilal et al. 2022). Oral nutrition supplements offers essential dense drinks or food, malnutrition and food inadequacy shown more of assistance to improves nutritional status, residence intake and long-term compliance (Wu et al. 2022).

1.1 Rationale

Malnutrition associated with various factors as inadequate dietary diversity and quality lead to under-nutrition including stunting, underweight, and wasting that all are major leading cause of morbidity and mortality among young children, family and communities , furthermore according to the 2017 national nutrition survey, 40.2% children are stunted, 17.7% wasted, 28.9% under-weight children and 9.5% over-weight (NNS-2017; Hirani 2012.; Saaka et al. 2015). Previously, Pakistan has faced food insecurity during COVID-19 that also impairs people to acquire balance diet (Shahzad et al. 2021). Lack of dietary diversity is a challenge for rural communities in developing countries and their diets are mainly reliant on starchy staples, vegetables, fruits and animal products(Ruel et al. 2003). In addition, rainfall-related flood in May 2022 has turn into cause of severe agricultural calamity in Pakistan(Sohail et al.2022). Therefore, all those factors leads poverty and food insecurity related concern higher in various districts of province Baluchistan, Sindh and Punjab (Ullah and Chishti 2023). Dietary diversity and food insecurity are emerging topics, due to above mentioned consequences in Pakistan agricultural sector adversely affected and raising inflation cause crisis on behalf of availability, accessibility and affordability of quality, diversity, adequacy and quality of food. Several literatures are available resting on association of dietary diversity and food insecurity with diverse variables worldwide and in Pakistan too, but there is lack of literatures emphasized investigation specifically in sub-district level of Rawalpindi. Therefore, this study intended to carry out a descriptive cross-sectional survey to assess dietary diversity and food insecurity of the rural households of sub-district (tehsil) Kallar Syedan Rawalpindi. The findings assured be helpful for professional and policy makers to enlighten potential policy actions to improve elevation of accessibility, affordability and availability of healthy foods within specific area and in throughout country.

1.2 Objectives o f the study

1. To determine the extent of dietary diversity within rural households of Tehsil Kallar Syedan.

2. To assess the prevalence of food insecurity among rural households in Kallar Syedan.

3. To explore the potential association between dietary diversity and food insecurity in rural households of Tehsil Kallar Syedan.

Chapter II: Literature Review

Dietary diversity and food insecurity are important factors that can affect household quality of life. Food insecurity is a condition that affects millions of people around the world, and it is associated with a range of adverse health outcomes, including malnutrition, chronic diseases, and mental health problems. Dietary diversity, on the other hand, is a measure of the variety and quality of foods consumed by individuals and has been shown to be associated with better health outcomes. There have been numerous studies conducted on dietary diversity and food insecurity, with many focusing on the health outcomes associated with these factors, as well as interventions to address them.

2.1. Nutrition-related Challenges in Pakistan

Pakistan has been undergo environmental insecurity issues due to variations in environment that adversely enhanced issues of socio-economic loss in a state (Chaudhry et al. 2022). Overall nutrient consumption, food security and food diversity situation remain worst during pandemic. Covid-19 had severe impact on income of the households and compelled bulk of households to modify their dietary patterns, 40% vegetables and 30% fruits related energy consumption declined at household level. Food insecurity has been seen 51.1% among children and most of the children has inadequate intake of vegetable, fruits, milk, meat/poultry and legume groups (Geng et al. 2022). According to World Food Programme (WFP) floods in Pakistan effected 33 million people of 94 districts and poor food security level dropped people to rely on different depressing strategies such as, skipping meal, depart children from schools and sale of construct income assets (WFP 2022). All-age risk factors of morbidity and mortality were child and maternal malnutrition, dietary risks, high systolic pressure, tobacco utilization, air pollution and other non-communicable diseases. Studies also established that for both men and women dietary

iron efficiency was foremost cause surrounded by disabled population in 1990 and 2019 (Hafeez et al. 2023). Among other studies of household level, nutritional status of children under 5-14 years age has vulnerable condition and child labor has been seen in a form of working in restaurant, domestic work, agricultural and industries work. Studies has been found that children working at different positions are 30% wasted, 15.5% stunted across Sindh, Pakistan (Iqbal et al. 2020). In rural region, food intake by women compose of insufficient dietary diversity, micronutrient and zinc inadequacy (Brazier et al. 2020). Poorer agricultural productivity, nutrition knowledge, over population, war, corruption are core cause of hidden hunger and mean global hunger index indicated percentages with 11.6% in worldwide , 13.1% Asia and 19.5% Africa (Uchendu et al. 2022).

2.2. Food Insecurity

The United States Department of Agriculture (USDA) defines food insecurity as a household-level situation in which access to adequate food is limited or uncertain due to economic and social factors. This definition highlights that food insecurity is not solely determined by the availability of food, but also by the ability of individuals to obtain and afford food that is necessary for a healthy diet (Coleman-Jensen 2019). Food insecurity is a major cause of malnutrition that affects productivity in adulthood, and is associated with total income, food prices, poverty level, age of household head, female-headed households, educational status, and household size. Inadequate diet and poor nutrition are responsible for half of all deaths in Sub-Saharan Africa. Household food insecurity in the region is linked to poverty, low income, education level, household size, employment status, age, gender of the household head, and food prices. Education plays an important role in improving food production, access, utilization, and employment opportunities. (Drammeh et al. 2019). Child being severe food insecurity

households encompasses higher prevalence of severely underweight, stunted and wasted. Studies although not provide evidence of nutritional outcome of children and compassionate scope for food insecurity effected by child's dietary diversity (Chandrasekhar et al. 2017). Food insecurity has undesirable links with health related outcomes such as, mental health, body weight, type 2 diabetes and cardiovascular diseases. Studies have revealed that food insecurity consequences and health outcome can be reduce by screening in healthcare settings (Thomas et al. 2021).

2.2.1. Food Security

In 1966, food security is defined by FAO, during World Food Summit as; food security at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and preferences for an active and healthy life. Poverty is foremost cause of food insecurity and factors like environmental degradation, corruption, conflict and terrorism contributes food insecurity, hence poverty eradication remains unsteady. (Shaw et al. 1998).

2.2.2. Dimensions of Food Security

Food security contains four kind of dimensions; (a) **availability** is a measure of food that is at all the time physically available in the relevant vicinity of a population), (b) **access** is a measure of the population's ability to obtain, produce and or purchase available food during a given period) ,(c) **utilization**/consumption is a people have adequate knowledge , and prime sanitary conditions to select, prepare, distribute and ability to derive better nutrition in a given period) and (d) **stability** includes both access and availability extents and must be food secure within a population, household or individual must have access to adequate food at all times) (FAO, 2006).

2.3. Dietary diversity

Dietary diversity refers to the variety of food among food groups that are proficient ensuring to promote health by providing sufficient quantity and essential nutrients. Dietary diversity is positively linked with are availability, accessibility and utilization of food security. It has been found that diversify dietary patterns that contain all food groups considerably reduced probability for under-nutrition and conventional dietary patterns involved legumes, starchy food and cereals considerably increase the chances of thinness or overweight or obesity among school age children and adolescents (Adeomi et al. 2022).

Dietary diversity has positive association with market access and on-farm diversity is not always associated with dietary diversity (Sibhatu, Krishna, and Qaim 2015). Generally guidelines suggested eating huge variety of food among foremost food groups that are associated with improved outcome of hemoglobin concentration, nutrients adequacy and anthropometric indicator (Taruvinga et al. 2013). In studies of northern Ghana, analysis discovered low dietary diversity between mothers and age, marital status, literacy, ethnicity, household membership structure, household income, food purchase, access and control to income as significant socioeconomic determinants of dietary diversity (Zakaria and Laribick 2014). Studies conducted in Nepal showed that socioeconomic characteristics were associated with both food security and dietary diversity. The study assessed micronutrient adequacy and food consumption behaviors of women of reproductive age in Ouagadougou, Burkina Faso and results highlight low micronutrient intakes among urban women. Higher intakes of certain foods were associated with lower risk of micronutrient inadequacy, but ready-to-eat foods bought outside the home were not associated with adequacy (Becquey et al. 2010). The study in rural India revealed that seasonal agricultural income is not sufficient for achieving year-round dietary diversity or food security.

Monsoon crop sale is positively associated with higher food security in winter, indicating the need for similar market transaction opportunities for winter/summer crops. While multiple cropping is associated with higher food security during monsoon, as it cannot be used as a cure-all strategy for achieving year-round dietary diversity or food security Pulses, a major winter crop, are among the higher-priced food items in India(Mondal et al. 2021). The status and factors associated with food insecurity and dietary diversity among lactating mothers specified the importance of adequate food and nutrition for the overall well-being of lactating mothers and expectations and findings has observed negligible about breastfed infants was relating to both food security and dietary diversity (Singh et al. 2020). Previous findings are similar to the present results of dietary diversity has significant associated with nutritional status and nutrient adequacy among children (Caswell et al. 2018).

2.4. Household food insecurity association with dietary diversity

It has been revealed that in Bangladesh during pregnancy and postpartum household dietary diversity especially fruits, vegetables, animal source foods decline with deterioration of food insecurity. (Na et al. 2016). Olaimat et al. discovered that food –based coping strategies likely eating smaller meal, eating cheaper food, or any adult of household intake less food for additional to their children are factors, considerably associated with food insecurity. Furthermore, due to pandemic COVID-19 quality and quantity of nutrition consumption decreases by the loss of food accessibility and cause household food insecurity (Olaimat et al. 2022). Several studies has been established positive association between dietary diversity and household food insecurity, individual or women's dietary diversity by measuring conventional food groups or individual food items over a fixed period of time. Our review of developing-country studies confirms the positive associations found in developed countries between dietary

diversity and nutrient adequacy (i.e., diets that meet requirements of energy and all essential nutrients). In developing countries dietary diversity constantly associated with better child growth and in the few studies socioeconomic factors has large magnitude of association with dietary diversity. Different approaches used to compare dietary diversity indicators with different existing studies to confirm validation of these findings in a variety of circumstances and population group (Ruel et al. 2003). Food-based strategy involve availability and feasible access of nutrient- rich food crops significantly works to overcome nutrient deficiency within a risk population (Frison et al. 2005). Singh et al. examined that food insecurity status and low dietary diversity were found to be associated with each other. However, monthly income of the family was positively associated with food insecurity and participants' or spouses' unemployment was associated with higher odds of food insecurity and dietary monotony (Singh et al. 2020). Several studies have investigated the relationship between food availability, dietary diversity, and household food insecurity. The study of Northwest Ethiopia revealed that prevalence and associated factors of dietary diversity among adolescent girls. The research reveals that there is a low prevalence of adequate dietary diversity among adolescent girls, with only 14.5% exhibiting sufficient diversity. Additionally, food insecurity is identified as one of the leading factors contributing to the low dietary diversity. Therefore, it is recommended to improve the household's food security status to enhance dietary diversification in adolescent girls (Tariku et al. 2019). In a study conducted in selected districts of Uttar Pradesh, India, it was found that while there is a wide range of locally available foods such as grains, vegetables, fruits, milk, fish, eggs, and meat, a significant proportion of households still have a low dietary diversity score. Only 13% of the households achieved the minimum HDDS of 4, which may be due to insufficient knowledge and poor dietary practices among rural populations (Kumar et al. 2019).

2.7 Conceptual Framework
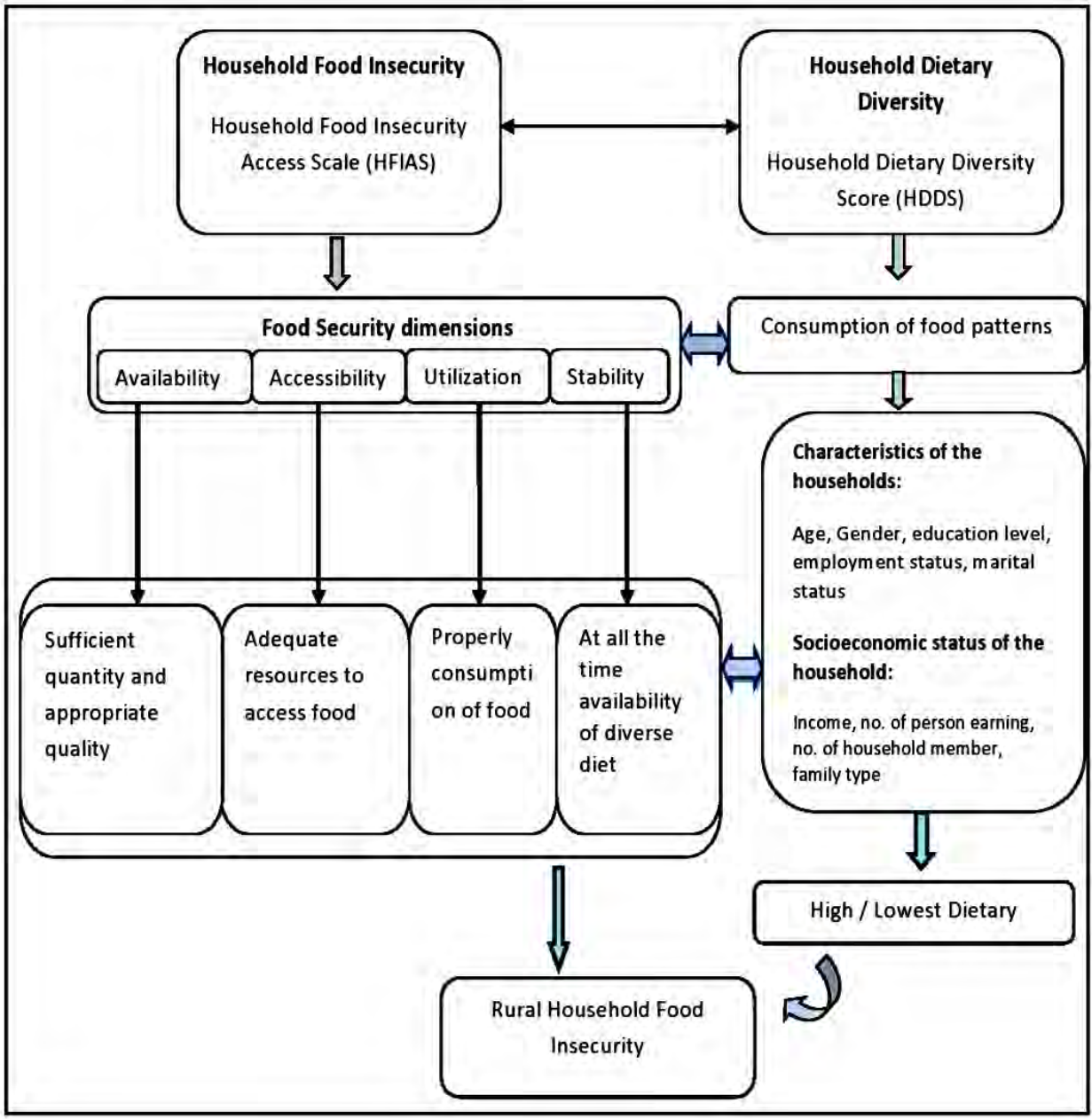
Figure 1: Conceptual Framework, Dietary Diversity and Food Insecurity in Rural Households

(Birhane et al. 2014; Drammeh et al. 2019)

2.8. Operational definitions

2.8.1. Food Security

In 1966, food security is defined by FAO, during World Food Summit as; food security at the individual, household, national, regional and global levels [is achieved] when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and preferences for an active and healthy life. (Shaw and Clay 1998).

2.8.2. Food Insecurity

Food insecurity defined by USDA as household that be lack of expected access to adequate, safe and nutritious food for normal growth and development and for healthy life (USDA 2006). In current study adaptation of the approach used household food insecurity access scale (HFIAS) to estimate the prevalence of food insecurity (Coates, Swindale, and Bilinsky 2007). To assess household food insecurity components HFIAS is valid and straightforward tool (Gebreyesus et al. 2015).

2.8.3. Dietary diversity

Dietary diversity refers to the variety of food among food groups that are proficient ensuring to promote health by providing sufficient quantity and essential nutrients. (Adeomi et al. 2022). In this study household dietary diversity components were measured through household dietary diversity score(HDDS) , increased dietary diversity is associated with household food security and socio-economic status (Kennedy, Ballard, and Dop 2011). To assess dietary diversity at household level HDDS is valid and simple tool(Hussein et al. 2018).

2.8.4. Lowest dietary diversity

A diet that consists primarily of only a few food groups or a small number of specific foods would be considered to have lower dietary diversity. Lowest DD includes consumption of food from only one or two food groups in the previous 24 hours.

2.8.5. Medium dietary diversity

This refers to a diet that includes a range of foods and food groups, but may still be limited in some way. It contains consumption of food from 3 to 5 food groups in the previous 24 hours.

2.8.6. High dietary diversity

This refers to a diet that includes a wide variety of foods and food groups, with an emphasis on consuming many different types of each food group or consumption of food from 6 or more food groups (Kennedy et al. 2011).

2.8.7. Household

According to the U.S. Census Bureau "all the people who occupy a single dwelling unit, regardless of their relationship with one another is called household". Economic and social well-being of individual and families are positively linked with household size and composition. A family household comprises of one householder, married couple with one, more or without children, and siblings or maybe additional non-family people who are not related to householder (Pop-Bulletin-Census 2019).

2.8.8. Cross-sectional survey

As cross-sectional survey is a study design that carries out over a short period of time and purpose of study usually a descriptive survey but aim to find out outcome of interest in a population or within sub-group of population (Levin 2006).

Chapter III: Methodology

3.1. Study settings

Study setting was rural tehsil Kallar Syedan Rawalpindi. It is tehsil/sub-district of Rawalpindi district, Punjab, Pakistan.

3.2. Research design

In current study a quantitative research approach was adopted and a cross-sectional survey method was used. It was carried out over a short period of time and purpose of study usually to find out outcome of interest in a population or within sub-group of population (Levin 2006).

3.3. Research duration

The study time period was six month.

3.4 Study participants

Participant of this study was person who residing in rural household of sub-district Rawalpindi and following were selected on the basis of inclusion and exclusion criteria.

3.4.1 Inclusion Criteria

1. Permanent residence of household.

2. Person who responsible for planning and cooking/preparing meal.

3. Adult ≥ 18 years old

3.4.2 Exclusion criteria

1- Non-permanent residence of household

2- individual < 18 years old were excluded

3.5 Sample size calculation

To calculate sample size, prevalence was derived from existing literature related to association between dietary diversity and food insecurity in urban household of various ethnic group of Karachi(Hashmi et al. 2021) . Calculation was done by using proportion formula for sample size in Open-Epi menu software following previous prevalence taken as 20% and sample size become n=**246** with 95% CI and 5% margin of error. After adding 5% non-response rate final sample size came out to be **259** households.

3.6 Sampling strategy

In current study, systematic sampling strategy was adopted.

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                                    ┌─────────────────────────────┐
                                    │      District Rawalpindi     │
                                    └─────────────────────────────┘
┌──────────────────────────┐        ┌─────────────────────────────┐
│ Simple Random sampling   │ ═════▶ │   Sub-district Kallar Syedan │
└──────────────────────────┘        └─────────────────────────────┘
                                    ┌─────────────────────────────┐
                                    │     Rural union>>village     │
                                    └─────────────────────────────┘

┌──────────────────────────┐        ┌─────────────────────────────┐
│  Systematic sampling     │ ═════▶ │ 259 households selected on   │
└──────────────────────────┘        │ every k^th=6 interval on the│
                                    │ basis of inclusion and       │
                                    └─────────────────────────────┘
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Inclusion Criteria

- Permanent residence of household.
- Person who responsible for planning and cooking meal.
- Adult $\geq$ 18 years old

Exclusion criteria

- non-permanent residence of household

- individual < 18 years old were excluded

Rural household data collected until desired sample size attained i.e. **n=259**

Figure 2: Systematic Sampling Strategy

3.7. Data Collection Tool

3.7.1. Questionnaire Design

An interview-based questionnaire was developed to collect data about socio-demographic characters and main indicators of the study participants. Household base questionnaire of food insecurity involved; status of income, food prices, poverty level, age of the head of household,

female-headed household, educational status, household size (Drammeh et al. 2019). Household dietary diversity associated indicators and dimensions of food security are; availability, accessibility and utilization (Adeomi et al 2022). Household Dietary Diversity Score (HDDS) and Household Food Insecurity Access Scale (HFIAS) were two validated tool used to assess component of this study. Moreover, both are valid and straightforward tools(Hussein et al. 2018).

3.7.2. Questionnaire Content

Questionnaire comprises of three sections as following;

1. **Section A** included socio-demographic characters related to household. Socio-demographic characters were related to the participant of the study mainly about the person who convened inclusion criteria.

2. **Section B** comprises the survey questionnaire to build the HDDS indicators based on to estimate the intensity of dietary diversity at household level by using HDDS guidelines and questions introduced by Food and Nutrition Technical Assistance Project (FANTA). HDDS questionnaire has total 16 food items but classified into 12 groups and information collecting with previous 24-hour recall.(Swindale et al. 2006).

3. **Section C** contains Household Food Insecurity Access Scale (HFIAS) questionnaire based on indicators of household food insecurity and has nine questions in this scale. The respondent is first asked happening of occurrence question(yes/no) in past four weeks, if event "yes" then further frequency of question asked about whether situation happened rarely, sometime or often(Coates et al. 2007).

3.7.3. Variables of the Study

3.7.3.1. Independent Variable

A structured Performa was constructed through information from literature review for independent variables. It includes 10 socio-demographic characters. It includes socio-demographic characters of participants ;gender, age, marital status, respondent status towards head, number of family members, family type, employment status, no. of earning person , education and one anthropometric character body mass index (BMI).

3.7.3.2. Outcome Variable

The major construct of this study tool was designed to assess <u>dietary diversity</u> and food <u>insecurity</u> at household level. Food insecurity was the primary outcome variable and dietary diversity was second outcome variable. Both were measured by validated tools of Household Food Insecurity Scale (HFIAS) and Household Dietary Diversity (HDDS).

3.7.3.3. HDDS

The respondents were asked to recall the food they, their spouse or any household member ate the day before. This data was used to construct a validated tool of household dietary diversity score (HDDS) to obtain data about dietary diversity at household level. It presents comprehensive view of nutritional and food security status over wide-ranging area and indicators of household food access. Food prepared at home and person responsible for preparing /planning food are included while food purchased from outside excluded. Dietary diversity was anticipated by arranging information 24-hour recall on household food consumption from a set of 16 food items. Food items classified into 12 groups and mainly included to calculate household dietary diversity scores: cereals; white tubers and roots; legumes, nuts, and seeds; vegetables; fruits;

meat; eggs; fish and fish products; milk and milk products; sweets and sugars; oils and fats; and spices, condiments, and beverages (Kennedy et al. 2011, Swindale et al. 2006).

Table 1: HDDS creation by combined food groups from the questionnaire

Group number	Food group
1	Cereals
2	White tubers and roots
3	Vegetables
4	Fruits
5	Meat
6	Eggs
7	Fish and other sea food
8	Legumes, nuts and seeds
9	Milk and milk products
10	Oils and fats
11	Sweats
12	Spices, condiments and beverages

The household score will range from 0-12 and is equal to the total number of food groups consumed by the household. If each food group not consumed allotted a score 0 if consumed allotted a 1(Kennedy et al. 2011).

3.7.3.3.1. HFIAS

The HFIAS is validated questionnaire scale determined as described by Coates, Swindale and Bilinsky (2006), used for assessment of household food insecurity access. It consists of nine specific questions related to anxious, availability and accessibility of food during the past four weeks. The questionnaire was translated into simple Urdu language. The respondent is first asked happening of occurrence question(yes/no) in past four weeks, if event "yes" then further

frequency of question asked about whether situation happened rarely, sometime or often. Regulate scoring procedure was used, if the event relating by the question happened never then it was ascribed as zero and move to the next question rather than responding occurrence, if event happened (yes) and it occurred 1or 2 time it attributed point 1 , if event happened 3-10 times in past month it ascribed as 2 points, if it occurred 10 times or more it attributes 3 and sum of nine questions range from minimum 0(food security) to maximum 27(severe food insecurity) (Coates et al. 2007). (Annexure 1)

3.8. Data Collection Process

3.8.1. Pilot Testing

Pilot testing was conducted in tehsil Kallar Syedan Rawalpindi in December 2022. The selection of participant was according to the inclusion criteria. Before starting the actual data collection pilot testing was performed on 10% of the actual sample size of n=259. Performa was tested for any deficiency in questionnaire or to evaluate possible changes need for actual data collection in existing questionnaire. Only a single question had been added in socio-demographic section that was adding BMI question (it contains four options; underweight, normal, over-weight and obesity) further, among other indicators essential for assessment of dietary diversity.

3.8.2. Data collection

Households of villages from selected rural union were approached to collect data. A written informed consent (Annexure1) was obtained from respondents who met inclusion criteria and

were voluntarily agreed to participate in this study. After obtaining consent, interviews were administered and their responses were recorded on questionnaire (Annexure 1) by researcher.

3.9. Data Analysis Procedure

In Statistical Package for Social Sciences (SPSS) version 17.0 code book was developed and data was entered carefully. Before proceeding further analysis data was checked and clean for any error and then carried out transformation of data. Mainly data analysis had been done in to descriptive analysis and inferential analysis stages.
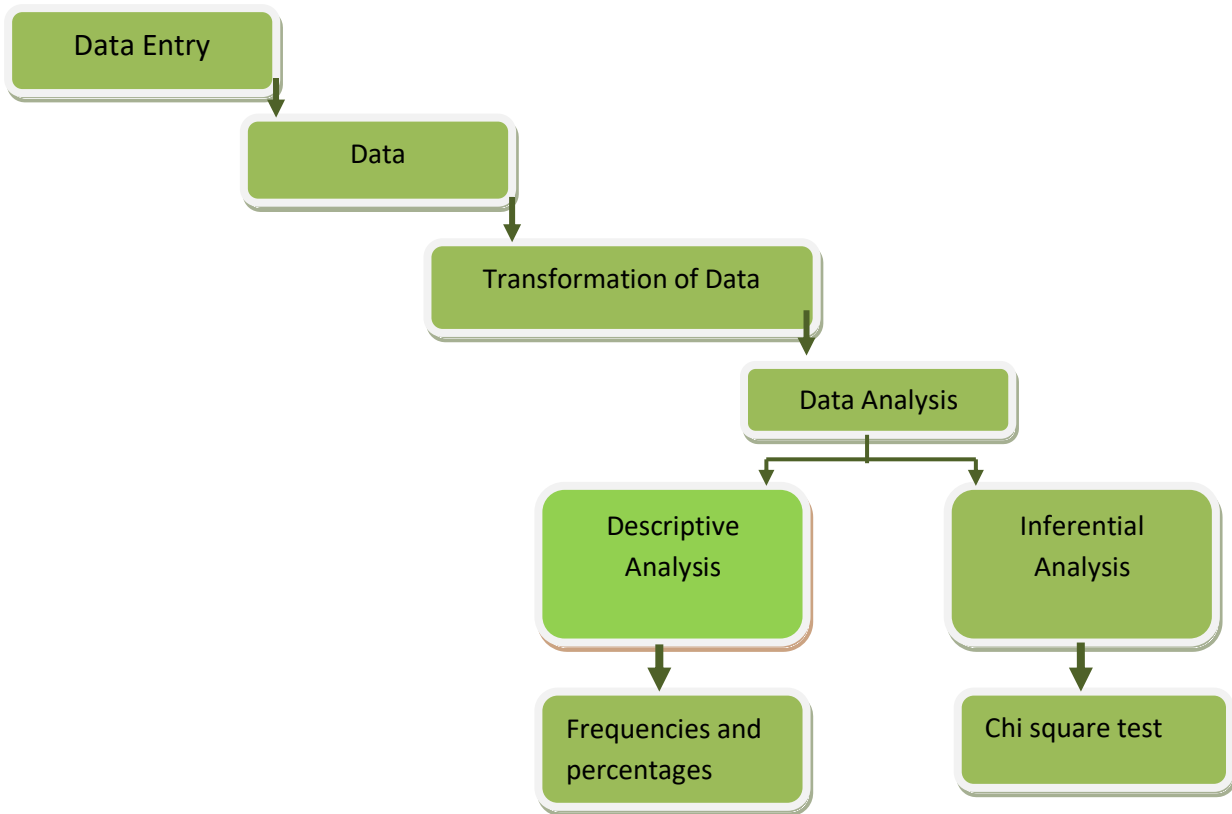
Figure 6: Data Analysis procedure

3.9.1. Transformation of Data

Data of dietary diversity and food insecurity were transformed into different categories. Dietary diversity transformed into three categories, minimum, moderate and maximum dietary diversity. Food insecurity was also transformed into two categories, food secure food insecure.

3.9.2. Descriptive Analysis

Descriptive statistics were done for socio-demographic attributes and outcome variables; dietary diversity and food insecurity. Data was summarizing into frequencies and percentages. Finally results presented in tables, and bar charts.

3.9.3. Inferential Analysis

Association of dietary diversity and food insecurity variables were established with socio-demographic variables using Pearson's Chi-square test. Moreover Chi square test of independence was also calculated to find out association between dietary diversity and food insecurity. A p-value < 0.05 was considered as significance.

3.10. Ethical Consideration

Ethical considerations were in this research study were to obtain ethics approval, take informed consent involved each respondent was participate voluntarily and to ensure confidentiality and anonymity of information.

3.10.1. Ethical Approval

The approval of the Institutional Review Board (IRB) Al-Shifa School of Public Health Rawalpindi, Pakistan was obtained before conducting a study. Research synopsis was submitted to Al-Shifa School of Public Health Rawalpindi and IRB approval was obtain on September

2022 (Annexure 3). After the permission from District of Rawalpindi officer, research was conducting in rural households as according to the sampling strategy.

3.10.2. Informed Consent

Before starting actual data collection participants were explained the purpose of research, duration, risk, benefit and written informed consent were obtained (Annexure2). The participants were informed about participation in this research voluntary and can withdraw anytime and data will remain anonymous.

Chapter IV: Results

The present study aimed to assess the dietary diversity and food insecurity in rural households of tehsil Kallar Syedan Rawalpindi. Data analysis was carried out using SPSS-17.0. Initially, the demographic characteristics were identified through frequencies and percentages. Descriptive statistics and alpha reliability coefficients were computed. Chi-square test of independence was computed to assess the dietary diversity and food insecurity. Finally association between dietary diversity and food insecurity were also find out by chi-square test of independence. A summary of descriptive and inferential statistics is given below.

4.1. Demographic Characteristics:

A total of 259 households were examined in this study to determine sociodemographic characteristics.. Majority of the participants were female (n=151, 96.9) and were 35-40 years of age group (n=100, 38.6). On average respondents had 93.4% primary to higher education (n=242) and 6.6% (n=17) had no schooling. Mostly household head were employed (n=158, 61%) while only 1 earning member (n=173, 66.8%) with an average household size of 4-8 (n=184, 71%) family members. Mostly household had nuclear (n=140, 54.1%) family type. Approximately 5.4% (n=14) households had food insecurity. Few of household classified into medium dietary diversity (n=67, 25.9%) while mostly households had high dietary diversity (n=187, 72.2%). Demographic characteristics of the respondents are shown in table 2.

Table 2: Descriptive summary of sociodemographic variables

S.No.	Variable	Frequency (n)	Percentage (%)
1	**Gender**		
	Male	8	3.1
	Female	251	96.9
2	**Age**		
	18 – 24	73	28.2
	25 – 34	28	10.8
	35 – 44	100	38.6
	45 – 54	49	18.9
	55 – 64	9	3.5
3	**Marital Status**		
	Single	89	34.4
	Married	164	63.7
	Widowed	5	1.9
4	**Respondent status**		
	Household head	42	16.2
	Spouse of household head	123	47.5
	Other adult female	94	36.3
5	**No. of family members**		
	Less than 4	18	6.9
	4-8	184	71.0
	More than 8	57	22.0
6	**Type of family**		
	Extended	112	43.2
	Nuclear	140	54.1
	Other	7	2.7
7	**Employment status**		
	Unemployed	51	19.7
	Employed	158	61.0
	Self-employed	50	19.3
8	**Earning members in family**		
	1 member	173	66.8
	2 members	51	19.7
	3 members	19	7.3
	4 members	6	2.3
	5 members	3	1.2
	More than 5	7	2.7
9	**Education level**		
	Primary	47	18.1
	Secondary	70	27.0
	Intermediate	79	30.5

	Graduation	42	16.2
	Masters	4	1.5
	No schooling	17	6.6
10	**Body mass index**		
	Underweight	55	21.2
	Normal	185	71.4
	Over-weight	14	5.4
	Obese	5	1.9

4.2. Descriptive results of Household Dietary Diversity

In current study, household dietary diversity score was classified into 12 food groups. Total score was computed for each type and was further categorized into lowest, medium and high dietary diversity. Result shows that cereal consumed by all household 100% (N=259) within past 24 hours. Spices (95.8%, 248), vegetable (93.8%, 243), fats (92.3%, 239) and sugar (91.5%, 237) were major food groups. However, small proportion (16.2%, 42) of rural households had consumed fish. 54.4% (n=141) had consumed eggs and potatoes, 53.7 %(n=139) households had consumed meats. Milk (87.6%,227) , pulses and legumes (82.2%, 213) and fruits (79.9%, 207) of households consumed these food groups in 24 hour recall period. Household dietary diversity was assessed by using scale HDDS and descriptive statistics of computed HDDS is shown in table 5.

Table 3: Frequency and Percentages for Household Dietary Diversity

S.No.	Variables	Frequency (n)	Percentages (%)
1	Any kind of Rice, grains like wheat, barley(bread/roti, cereals, noodles ,other)		
	Yes	259	100
2	Any food made up of roots like potatoes etc.		
	No	118	45.6
	Yes	141	54.4
3	Any kind of vegetables		
	No	16	6.2
	Yes	243	93.8
4	Any fruits		
	No	52	20.1
	Yes	207	79.9
5	Meat from sheep, beef, sheep		
	No	120	46.3
	Yes	139	53.7
6	Eggs		
	No	118	45.6
	Yes	141	54.4
7	Fish, dry fish and other seafood		
	No	217	83.8
	Yes	42	16.2
8	Food from the bean, legume, nuts bean and alike		
	No		
	Yes	46	17.8
		213	82.2
9	Milk, cheese, yogurt or other milk products		
	No		
	Yes	32	12.4
		227	87.6
10	Oil, fats or butter added to food or used for cooking		
	No		
	Yes	20	7.7
		239	92.3
11	Sugar, honey, chocolates, candies, cookies and cakes		
	No		
	Yes	22	8.5
		237	91.5
12	Spices, condiments(soy sauce), coffee, tea, green tea		
	No		
	Yes	11	4.2
		248	95.8

In current study, household dietary diversity was divided into three different categories depend upon occurrence of food groups consumed within a previous day. Total score was computed for each type and was further categorized into lowest, medium and high dietary diversity. Frequency and percentages of computed variable is shown in figure 3.
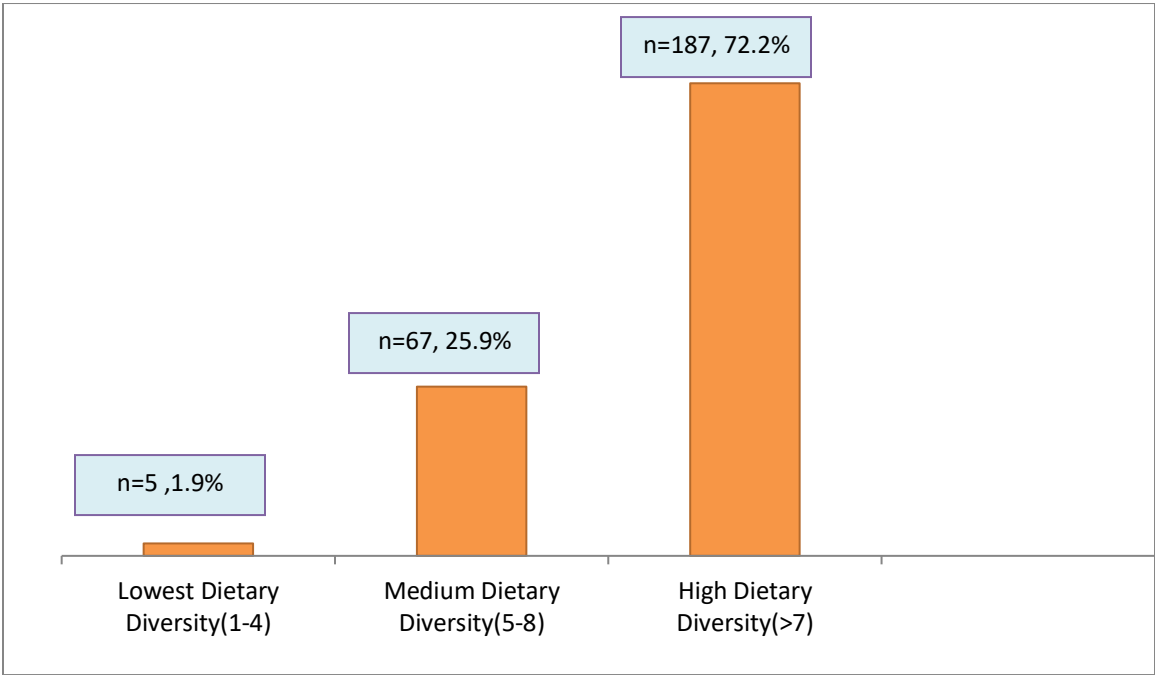
Figure 2: percentages and Frequencies of Household Dietary Diversity

Results show the frequency and percentages of household dietary diversity in the study population. The data suggest that a majority of households (72.2%) had high dietary diversity, while a smaller percentage had medium dietary diversity (25.9%) and a very small percentage had the lowest dietary diversity (1.9%).

4.3. Descriptive summary of household food insecurity

Household food insecurity was assessed by Household food insecurity scale (HFIAS). Results of the study showed that majority of household presented food secure 94.6% (n=245). However

food insecurity is lower about 5.4% (n=14) among rural households. Descriptive summary of household food insecurity is as below in table 5.

Table 4: Descriptive summary of household food insecurity variables

S. No.	Variable	Frequency (n)	Percentage (%)
1	In the past four weeks, did you worry that your household would not have enough food?		
	No	127	49.0
	Yes	132	51.0
1a	How Often?		
	Rarely	72	27.8
	Sometimes	46	17.8
	Often	14	5.4
2	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?		
	No	116	44.8
	Yes	143	55.2
2a	How Often?		
	Rarely	75	29.0
	Sometimes	49	18.9
	Often	19	7.3
3	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	154	59.5
	No	105	20.8
	yes		
3a	How Often?		
	Rarely	54	20.8
	Sometimes	40	15.4
	Often	11	4.2
4	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	164	63.3
	No	95	36.7
	Yes		
4a	How Often?		
	Rarely	52	20.1
	Sometimes	34	13.1
	Often	9	3.5
5	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?		
	No	180	69.5

	Yes	79	30.5
5a	How Often?		
	Rarely	44	17.0
	Sometimes	29	11.2
	Often	6	2.3
6	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?		
	No	191	73.7
	Yes	68	26.3
6a	How Often?		
	Rarely	42	16.2
	Sometimes	19	7.3
	Often	7	2.7
7	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?		
	No	194	74.9
	Yes	65	25.1
7a	How Often?		
	Rarely	38	14.7
	Sometimes	17	6.6
	Often	9	3.5
8	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?		
	No	224	86.5
	Yes	35	13.5
8a	How Often?		
	Rarely	20	7.7
	Sometimes	12	4.6
	Often	3	1.2
9	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?		
	No	231	89.2
	Yes	28	10.8
9a	How Often?		
	Rarely	15	5.8
	Sometimes	12	4.6
	Often	1	0.4

In this study, household food insecurity was divided into two categories depends on incidence of food availability situation during last four weeks. Total score was computed for each category and was further categorized into food secure and food insecure. Results shown that majority of

the current study households were food secure (n=245, 94.6%). Frequency and percentages are shown in figure 3.

14(5.4%)

245(94.6%)

■ Food secure
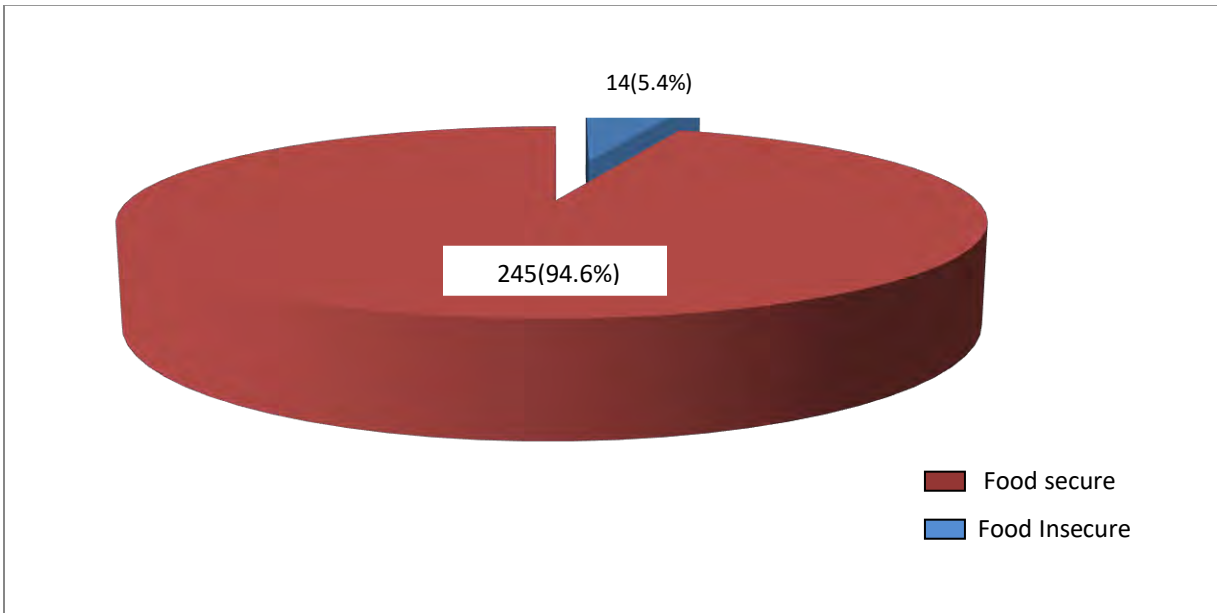■ Food Insecure

Figure 3: Percentage and frequency of Household Food Insecurity

The results provided indicate that out of the total sample size of 259 participants, 245 (94.6%) were classified as food secure, while only 14 (5.4%) were classified as food insecure (figure 5). This is a positive finding in terms of food security, as the vast majority of participants were classified as food secure.

4.4. Inferential Analysis

4.4.1. Pearson Chi-square Results

Association of dietary diversity demographic variable with demographic variables was determined using Pearson Chi-square test of independence. The chi-square test of independence was used to investigate the association of demographic variables with the three levels of dietary diversity (lowest, medium, and high). Before conducting the tests, the assumptions of the tests were confirmed to ensure that the data met the necessary conditions for the test.

The statistical significance of the results was determined using a threshold of p-values less than 0.5. The results of the analysis were summarized in a table, which provides an overview of the associations between sociodemographic characteristics and household dietary diversity. The table allows us to see the strength and direction of the relationships between the variables, providing important insights into the factors that influence dietary diversity.

Overall, the statistical analysis described in the statement is a powerful tool for investigating the relationship between dietary diversity and demographic variables. By confirming the assumptions of the tests and using a threshold of p-values less than 0.5, we can have confidence in the results obtained and use them to inform strategies for improving nutrition in households.

Table 5: Association of Household dietary diversity and socio-demographic characteristics

Variable	Lowest dietary diversity n(%)	Medium dietary diversity n(%)	High dietary diversity n(%)	Chi-square (df)	P-value
Gender					
Male	0 (0)	0 (0)	8 (100)	2	0.204
Female	5 (2.0)	67 (26.7)	179 (71.3)		
Marital Status					
Single	0 (0)	21 (23.6)	68 (76.4)	4	**0.025**
Married	4 (2.4)	45 (27.3)	116 (70.3)		
Widowed	1 (20.0)	1 (20.0)	3 (60.0)		
Respondent status					
Household head	1 (2.4)	9 (21.4)	32 (76.2)		
Spouse of household head	4 (3.3)	36 (29.3)	83 (67.5)	4	0.310
Other adult female	0 (0)	22 (23.4)	72 (76.6)		
No. of family members					
Less than 4	0 (0)	3 (16.7)	15 (83.3)		
4-8	3 (1.6)	46 (25.0)	135 (73.4)	4	0.510
More than 8	2 (3.5)	18 (31.6)	37 (64.9)		
Type of family					
Extended	2 (1.8)	30 (26.8)	80 (71.4)		
Nuclear	3 (2.1)	36 (25.7)	101 (72.1)	4	0.943
Other	0 (0)	1 (14.3)	6 (85.7)		
Employment status					
Unemployed	4 (7.8)	14 (27.5)	33 (64.7)		
Employed	1 (0.6)	42 (26.6)	115 (72.8)	4	**0.013**
Self-employed	0 (0)	11 (22.0)	39 (78.0)		
Education level					
Primary	1 (2.1)	6 (12.8)	40 (85.1)		
Secondary	2 (2.9)	20 (28.6)	48 (68.6)		
Intermediate	0 (0)	23 (29.1)	56 (70.9)	10	0.476
Graduation	1 (2.4)	12 (28.6)	29 (69.0)		
Masters	0 (0)	2 (50.0)	2 (50.0)		
No schooling	1 (5.9)	4 (23.5)	12 (70.6)		
Body mass index					
Underweight	3 (5.5)	7 (12.7)	45 (81.8)		
Normal	2 (1.1)	53 (28.6)	131 (70.3)	6	**0.049**
Over-weight	0 (0)	4 (28.6)	10 (71.4)		
Obese	0 (0)	3 (60.0)	2 (40.0)		

Results of Chi square test analysis demonstrated that household dietary diversity is significantly associated with marital status (p value=0.025), employment status (p value=0.01) and body mass index (p value=0.049). This means that marital status has a statistically significant impact on the variety of foods consumed within households. Results indicated that marital status, employment status and body mass index has a statistically significant impact on the variety of foods consumed within households.

Table 6: Association of HFIAS with sociodemographic characters

Variable	Food Secure n(%)	Food Insecure n(%)	Chi-square (df)	P-value
Gender				
Male	8(100.0)	0 (0.0)	1	0.492
Female	237(94.4)	14(5.6)		
Age				
18 – 24	68(93.2)	5(6.8)		
25 – 34	28(100.0)	0 (0.0)	4	0.639
35 – 44	94 (94.0)	6 (6.0)		
45 – 54	46(93.9)	3 (6.1)		
55 – 64	9 (100.0)	0 (0.0)		
Marital Status				
Single	84 (94.4)	5 (5.6)		
Married	156 (94.5)	9 (5.5)	2	0.863
Widowed	5 (100.0)	0 (0)		
Respondent status				
Household head	40 (95.2)	2 (4.8)		
Spouse of household head	116 (94.3)	7 (5.7)	2	0.973
Other adult female	89 (94.7)	5 (5.3)		
No. of family members				
Less than 4	17 (94.4)	1 (5.6)		
4-8	172 (93.5)	12 (6.5)	2	0.380
More than 8	56 (98.2)	1 (1.8)		
Type of family				
Extended	109 (97.3)	3 (2.7)		
Nuclear	129 (92.1)	11 (7.9)	2	0.159
Other	7 (100.0)	0 (0.0)		
Employment status				
Unemployed	43 (84.3)	8 (15.7)		
Employed	154 (97.5)	4 (2.5)	2	**0.001**
Self-employed	48 (96.0)	2 (4.0)		
Education level				
Primary				
Secondary	46 (97.9)	1 (2.1)		
Intermediate	67 (95.7)	3 (4.3)		
Graduation	73 (92.4)	6 (6.7)	5	**0.009**
Masters	42 (100.0)	0 (0.0)		
No schooling	4 (100.0)	0 (0.0)		
	13 (76.5)	4 (23.5)		

Household food insecurity was also analyzed to check its association with sociodemographic variables. Results show that employment status (p value= 0.001) and education level (p=0.009) are also significantly associated with food insecurity. It was seen that gender, age, respondent status, number of family members, family type, number of earning members related with food insecurity but have no significant association with household food insecurity (p value>0.05).

4.4.2. Association of Household Dietary Diversity with Household Food Insecurity

Chi-square test of independence was carried out to find out association between dietary diversity and food insecurity in rural households of tehsil Kallar Syedan Rawalpindi.

Table 7: Association between Household Dietary Diversity and Food Insecurity

Household Dietary Diversity	Household Food Insecurity Access		Chi square (df)	P value
	Food secure n(%)	Food insecure n(%)		
Lowest dietary diversity	5(100.0)	0(0.0)		
Medium dietary diversity	63(94.0)	4(6.0)	2	0.848
High dietary diversity	177(94.7)	10(5.3)		

Results show a p-value of 0.848 with 2 degrees of freedom, which indicates that there is no significant association between household dietary diversity and food insecurity access. The table also shows the distribution of food secure and food insecure households based on their dietary diversity level. The results indicate that households with high dietary diversity have the highest proportion of food secure households (94.7%) followed by medium dietary diversity households

(94.0%). On the other hand, households with the lowest dietary diversity had a 100% food secure

rate.

Chapter V: Discussion

This study aimed to assess dietary diversity and food insecurity in rural households of tehsil Kallar Syedan Rawalpindi. Household dietary diversity was divided into three categories which included lowest dietary diversity, medium dietary diversity, and high dietary diversity. However, household food insecurity was categorized into two categories, food secure and food insecure. All variables were independently measured with sociodemographic variables to find out their association with each category of household dietary diversity and food insecurity.

The results provide an overview of the demographic characteristics and food security status of the 259 households included in the study. The most of participants were female, which may reflect gender-based differences in household responsibilities. The age distribution was skewed towards the 35-40 age group. The findings of the current study were slightly different from previous studies. A study conducted in Nigeria found almost half of the respondents (47.3%) experienced household food insecurity(Adeomi et al. 2022). Similarly a study of Ethiopia established that food insecurity is a significant problem in the study population, with 75% of households being food insecure and 23% in a state of hunger. Moreover, the study found that households with higher food insecurity scores tended to have lower dietary diversity, indicating that food insecurity is a significant risk factor for poor dietary quality. The results also suggest that households coping with high food prices tend to reduce meal sizes and shift towards poor quality/less expensive food types(Birhane et al. 2014).

The majority of the household presented high dietary diversity (72.2%), low level of medium dietary diversity (25.9%) and low level of lowest dietary diversity (1.9%). The majority of households were food secure (94.6), and a small number of households presented food insecurity

(5.4%). The results of this study indicated that the education level of the respondents was relatively high, with an average of 93.4% having a primary to higher education. However, a small percentage (6.6%) had no schooling, which could potentially impact their ability to access and understand information related to food security. Most households had a single earning member, which highlights the importance of employment status as a potential predictor of food security. The average household size of 4-8 members is consistent with previous research on household size in low- and middle-income countries. Households where no one is employed are more likely to experience food insecurity compared to households where at least one person is employed. The lack of significant association between food insecurity and other sociodemographic variables, such as gender, age, respondent status, number of family members, family type, and number of earning members, suggests that these factors may not be independent predictors of household food insecurity. Hashmi et al. showed that age, marital status, and education level were not statistically significant predictors of food diversity and factors other than age, marital status, and education level may be more important in determining household dietary diversity. Furthermore, severe food insecurity is significantly associated with lower household dietary diversity. (Hashmi et al. 2021).

A current study revealed that all households (100%) consumed cereal, while spices (95.8%), vegetables (93.8%), fats (92.3%), and sugar (91.5%) were major food groups. However, small proportion of rural households (16.2%) consumed fish, while more than half of the households consumed eggs and potatoes (54.4%) and meats (53.7%). Kumar et al. found that the main food groups contributing to the mean of Dietary Diversity Score (DDS) in the households were oil, spices, cereals, and tubers. These food groups were used in 100%, 100%, 98%, and 91% of the households, respectively, within a day. These are staple food items that provide energy and

nutrients, but they may not be sufficient to meet all the nutritional needs of the household. Furthermore, the results show that egg, fish, and meat were not used in any household within the recall period. This indicates that households may be lacking in animal source foods, which are important sources of protein and other essential nutrients (Kumar et al. 2019). An additional study found that there was a strong positive association between household wealth status and dietary diversity score (DDS). Children from food secure households had a significantly higher DDS compared to children from food insecure households. Moreover, the study also found that increasing maternal education and household wealth were protective against childhood stunting and under-nutrition (Ali et al. 2019). The study of South Africa presented a positive correlation between education, access to home gardens, income, and high dietary diversity, while there was a negative correlation between these factors and low dietary diversity. Educated and high-income groups households were more likely to attain a high dietary diversity due to greater awareness and understanding of nutritional health benefits and they can afford expensive sources of energy such as vegetables and fruits, which are prioritized by low-income households(Taruvinga et al. 2013). Iranian households study investigated that higher diet quality was associated with older age and higher education of household heads, as well as households living in urban areas. Findings indicating that a balanced diet is essential for maintaining good health and reducing the risk of chronic diseases such as obesity, type 2 diabetes, and cardiovascular disease. In particular, the associations between higher intake of calcium, fiber, and vitamin C and better diet quality are supported by existing evidence linking these nutrients to improved health outcomes (Ebrahimi et al. 2020). The study of Sindh, Pakistan found that children working in the agricultural sector had a higher prevalence of food insecurity and chronic malnutrition. Agricultural work often involves long hours, low wages, and difficult working conditions, which can result in inadequate food

intake and poor nutritional status (Iqbal et al. 2020). Shahzad et al. suggested that the COVID-19 pandemic had a significant impact on food insecurity, with households experiencing higher levels of food insecurity during the pandemic and demographics and socioeconomic status were associated with increased food insecurity (Shahzad et al. 2021). A study of Bangladesh revealed that lower household income was a potential determinant of lower household food security and dietary diversity scores. Furthermore, significant proportion of households did not received the same quantity and type of food as they did before the COVID-19 pandemic, and that causes job losses and income reductions that were negatively associated with household food security and dietary diversity. Moreover, it can be inferred that household food access, including access to diverse types of food, may have been negatively impacted by the COVID-19 pandemic in Bangladesh (Kundu et al. 2021).

The result of this study indicated a significant association between household dietary diversity and marital status, employment status, and body mass index (BMI).The p-value for marital status is 0.025, which indicates a significant association between marital status and household dietary diversity. Similarly, the p-value for employment status is 0.01, which suggests a significant association between employment status and household dietary diversity. Tieguhong et al. established that despite high diversity of forest foods consumed, 87% of households in the region experienced high levels of food insecurity. Age >46 years and business ownership were associated with food security (Tieguhong et al. 2020).

The study conducted in rural India found, at least 43% of the sample population experiences moderate to severe food insecurity in all seasons. Cereals, mainly rice, remain the most important food item regardless of the season, with negligible consumption of other nutrient-rich foods such as tubers, fish, eggs, and meats. The study shows that multiple cropping is associated

with higher food security only during monsoon, while selling monsoon crops is associated with winter food security (Mondal et al. 2021). Other study investigated that food security in eight Asian food-insecure countries using a panel data analysis approach. The long-run analysis revealed that food availability, economic growth, food stability, rainfall, and temperature significantly determine food security in these countries. An increase in dietary energy supply adequacy, gross domestic product per capita, and agricultural productivity will lead to a reduction in undernourishment. However, food supply variations and rising temperatures may increase undernourishment (Zahid et al. 2022).

This study results showed that approximately 5.4% of households reported severe food insecurity, which is a concerning finding and the majority of households had high dietary diversity, which suggests that they had access to a variety of foods. However, a significant percentage had only medium dietary diversity, which may indicate that they are still at risk of nutrient deficiencies. The study of Ethiopia investigated the relationship between food security, household wealth status, and consumption of food items in both rural and urban households. The results showed a dose-response trend between food insecurity level and the likelihood of the previous day's consumption of certain food items, such as eggs, milk, fish, cereals, and beans. Food-secure households were more likely to consume these items than severely food-insecure households (Gebreyesus et al. 2015).

The result of this study proposed that household food insecurity is significantly associated with employment status (p value= 0.001) and education level (p=0.009). This means that households where the head of the household is unemployed or has a low education level are more likely to experience food insecurity compared to those with employed heads of households or higher education levels. On the other hand, the study did not find any significant association between

household food insecurity and number of family members, family type, or number of earning members, although these factors may still contribute to the risk of food insecurity in households. However the study of Nepal shows that there is a significant association between participants' or their spouses' unemployment and higher odds of food insecurity. Those who were unemployed had a higher risk of being food insecure compared to those who were employed. The odds were four times higher for participants who were unemployed themselves and three times higher for those with unemployed spouses (Singh et al. 2020). The study examined the leading causes of food insecurity in 107 developing countries across three continents between 2000 and 2019. The findings of the study revealed that political institutions, per capita income, and education were vital factors that explained the observed disparities in malnutrition between the regions studied and weak governments, poor income growth, and inadequate educational access are additional barriers to inclusively addressing global food security (Awad 2023).

In current study, there was no significant association between household dietary diversity and food insecurity access. The p-value of 0.848 with 2 degrees of freedom indicates that the relationship between the two variables is not statistically significant. However, the results did show that households with higher dietary diversity tended to have a higher proportion of food-secure households. Specifically, households with high dietary diversity had the highest proportion of food-secure households (94.7%) followed by medium dietary diversity households (94.0%). Even households with the lowest dietary diversity had a 100% food secure rate. Dietary diversity may not be directly linked to food insecurity access , it may still be an important factor to consider in promoting food security. However, other studies have found no significant association between dietary diversity and food security. (Ruel et al. 2018). A study conducted in Ethiopia found that dietary diversity did not predict food insecurity. The given result suggests

that there is a low prevalence of adequate dietary diversity and food insecurity is one of the contributing factors. The lack of access to a variety of foods due to food insecurity can lead to a monotonous and nutrient-poor diet, which can result in poor health outcomes (Tariku et al. 2019).

5.1. Strengths

Some potential strengths of this study include:

1. Focus on an important and relevant issue: The study addresses the important issue of food insecurity and poor dietary diversity, which are major public health concerns and particularly relevant in the context of Pakistan.

2. Representative sample: The study used a systematic sampling method to select a representative sample of households in the sub-district of Rawalpindi, which enhances the generalizability of the findings to the broader population.

3. Validated measures: The study used validated measures, including the Household Dietary Diversity (HDDS) and Household Food Insecurity Access Scale (HFIAS), which have been widely used and are considered reliable tools for assessing dietary diversity and food insecurity.

4. Use of both descriptive and inferential statistics: The study used both descriptive and inferential statistics to analyze the data, which allowed for a comprehensive understanding of the prevalence of dietary diversity and food insecurity, as well as the socio-demographic factors associated with these outcomes.

5. Policy implications: The study has clear policy implications, as the findings can inform policymakers and stakeholders to develop targeted interventions to improve dietary

diversity and address the underlying socio-economic factors contributing to food insecurity in rural areas of Rawalpindi, Pakistan.

5.2. Limitations

- Cross-sectional design: The study used a cross-sectional design, which limits the ability to establish causality or temporal relationships between the variables of interest.

- Self-reported data: The study relied on self-reported data, which may be subject to social desirability bias, recall bias, or misreporting of information. Objective measures of dietary intake and food security would be more accurate.

- Limited generalizability: Although the study used a representative sample of households in the sub-district of Rawalpindi, the findings may not be generalizable to other regions or populations within Pakistan.

- Limited scope of measures: The study used the Household Dietary Diversity (HDDS) and Household Food Insecurity Access Scale (HFIAS) to assess dietary diversity and food insecurity, respectively. While these measures are widely used and validated, they may not capture the full complexity of these constructs or the cultural nuances of food practices and preferences.

- Limited information on other potential factors: The study focused on socio-demographic factors associated with dietary diversity and food insecurity, but did not include information on other potential factors such as cultural beliefs, food availability, or access to healthcare that may also impact these outcomes.

Chapter VI- Conclusion

The study aimed to assess dietary diversity and food insecurity in rural households of Rawalpindi and identify associated socio-demographic factors. The study found that high dietary diversity was prevalent (72.2%), and most households were food secure (94.6%). Employment status and education level were significantly associated with food insecurity, while dietary diversity was associated with marital status, employment status, and body mass index. The findings suggest a need for targeted interventions and policymaker action to address food insecurity and promote dietary diversity in vulnerable populations in Pakistan.

Overall, the findings suggest that while there is a relatively low prevalence of food insecurity and low dietary diversity in the studied population, certain socio-demographic factors are associated with these outcomes. Therefore, it is crucial to identify and address the underlying factors that contribute to food insecurity and poor dietary diversity, such as unemployment and low education levels. Policymakers should prioritize targeted interventions that address these factors to promote food security and improve dietary diversity in vulnerable populations. Future research could also explore the impact of external factors, such as natural disasters or economic shocks, on food security and dietary diversity in the studied population.

Chapter VII- Recommendations

Based on the results of the study, the following recommendations can be made:

1. Targeted interventions should be implemented to address food insecurity in households with low employment status and education level.

2. Policymakers should focus on improving employment opportunities and education access to reduce the risk of food insecurity.

3. Nutrition education programs should be designed to increase awareness of the importance of dietary diversity and encourage the consumption of a variety of foods.

4. Efforts should be made to improve access to affordable and diverse food sources in rural areas to promote dietary diversity.

5. Long-term monitoring and evaluation of food security and dietary diversity should be conducted to assess the effectiveness of interventions and inform future policies.

6. Policymakers and relevant authorities should consider investing in programs that can help increase employment opportunities and improve access to education, which may help address food insecurity in the long run.

7. Since marital status and body mass index were also found to be significantly associated with dietary diversity, more research can be conducted in the future to explore these relationships further and develop targeted interventions accordingly.

8. Finally, it may be useful to conduct similar studies in other parts of the country to gain a better understanding of the food security and dietary diversity status of the population, and develop tailored interventions accordingly.

References

1. Mallick, Seeme. 2015. "SCIENTIFIC PERSPECTIVE ON SUSTAINABLE DEVELOPMENT GOALS FOR PAKISTAN." 21(1).

2. Bukari, Chei, Millicent Abigail Aning-Agyei, Christian Kyeremeh, Gloria Essilfie, Kofi Fosu Amuquandoh, Anthony Akwesi Owusu, Isaac Christopher Otoo, and Kpanja Ibrahim Bukari. 2022. "Effect of COVID-19 on Household Food Insecurity and Poverty: Evidence from Ghana." *Social Indicators Research* 159(3):991–1015. doi: 10.1007/s11205-021-02766-9.

3. Fang, Cheng, and Issa Sanogo. 2014. *Food Price Volatility and Natural Hazards in Pakistan: Measuring the Impacts on Hunger and Food Assistance*. Rome: Food and Agriculture Organization of the United Nations.

4. Awad, Atif. 2023. "The Determinants of Food Insecurity among Developing Countries: Are There Any Differences?" *Scientific African* 19:e01512. doi: 10.1016/j.sciaf.2022.e01512.

5. Hirani, S. A. A. (2012). Malnutrition in young Pakistani children. *Journal of Ayub Medical College*, *24*(2), 150.

6. Arimond, Mary, and Marie T. Ruel. 2004. "Dietary Diversity Is Associated with Child Nutritional Status: Evidence from 11 Demographic and Health Surveys." *The Journal of Nutrition* 134(10):2579–85. doi: 10.1093/jn/134.10.2579.

7. Adeomi, Adeleye Abiodun, Adesegun Fatusi, and Kerstin Klipstein-Grobusch. 2022. "Food Security, Dietary Diversity, Dietary Patterns and the Double Burden of Malnutrition among School-Aged Children and Adolescents in Two Nigerian States." *Nutrients* 14(4):789. doi: 10.3390/nu14040789.

8. Thomas, Melissa K., Lori J. Lammert, and Elizabeth A. Beverly. 2021. "Food Insecurity and Its Impact on Body Weight, Type 2 Diabetes, Cardiovascular Disease, and Mental Health." *Current Cardiovascular Risk Reports* 15(9):15. doi: 10.1007/s12170-021-00679-3.

9. *Https://www.Prb.Org/wp-content/uploads/2022/09/2022-World-Population-Data-Sheet-Booklet.Pdf*.

10. Mackenbach, Joreintje D., Kyra G. M. Nelissen, S. Coosje Dijkstra, Maartje P. Poelman, Joost G. Daams, Julianna B. Leijssen, and Mary Nicolaou. 2019. "A Systematic Review on Socioeconomic Differences in the Association between the Food Environment and Dietary Behaviors." *Nutrients* 11(9):2215. doi: 10.3390/nu11092215.

11. Hameed, Abdul, Ihtsham Ul Haq Padda, and Abdul Salam. 2021. "Analysis of Food and Nutrition Security in Pakistan: A Contribution to Zero Hunger Policies." *Sarhad Journal of Agriculture* 37(3). doi: 10.17582/journal.sja/2021/37.3.1025.1042.

12. Ebrahimi, Sara, Sarah A. McNaughton, Rebecca M. Leech, Morteza Abdollahi, Anahita Houshiarrad, and Katherine M. Livingstone. 2020. "A Comparison of Diet Quality Indices in a Nationally Representative Cross-Sectional Study of Iranian Households." *Nutrition Journal* 19(1):132. doi: 10.1186/s12937-020-00646-5.

13. Seferidi, Paraskevi, Thomas Hone, Ana Clara Duran, Antonio Bernabe-Ortiz, and Christopher Millett. 2022. "Global Inequalities in the Double Burden of Malnutrition and Associations with Globalisation: A Multilevel Analysis of Demographic and Health Surveys from 55 Low-Income and Middle-Income Countries, 1992–2018." *The Lancet Global Health* 10(4):e482–90. doi: 10.1016/S2214-109X(21)00594-5.

14. Diddana, Tona Zema. 2019. "Factors Associated with Dietary Practice and Nutritional Status of Pregnant Women in Dessie Town, Northeastern Ethiopia: A Community-Based Cross-Sectional Study." *BMC Pregnancy and Childbirth* 19(1):517. doi: 10.1186/s12884-019-2649-0.

15. Ishaq, A., Khalid, M., & Ahmad, E. (2018). Food insecurity in Pakistan: A region-wise analysis of trends. *Pakistan Insfitute of Development Economics (PIDE) Working Papers*, *157*, 1-26.

16. Ali, Nazia Binte, Tazeen Tahsina, Dewan Md. Emdadul Hoque, Mohammad Mehedi Hasan, Afrin Iqbal, Tanvir M. Huda, and Shams El Arifeen. 2019. "Association of Food Security and Other Socio-Economic Factors with Dietary Diversity and Nutritional Statuses of Children Aged 6-59 Months in Rural Bangladesh" edited by M. A. Cardoso. *PLOS ONE* 14(8):e0221929. doi: 10.1371/journal.pone.0221929.

17. Hashmi, Shahkamal, Nilofer Fatimi Safdar, Sidra Zaheer, and Kashif Shafique. 2021. "Association between Dietary Diversity and Food Insecurity in Urban Households: A Cross-Sectional Survey of Various Ethnic Populations of Karachi, Pakistan." *Risk Management and Healthcare Policy* Volume 14:3025–35. doi: 10.2147/RMHP.S284513.

18. Ullah, Rahat, Muhammad Akhtar Saleem, and Nizar Ahmad. n.d. "Factors Affecting Stunting Growth of Children in Pakistan: Evidence from Pakistan Demographic Health Survey 2017-18."

19. Kundu, Satyajit, Md. Hasan Al Banna, Abu Sayeed, Mst. Sadia Sultana, Keith Brazendale, Jody Harris, Moumita Mandal, Ishrat Jahan, Mohammad Tazrian Abid, and Md Shafiqul Islam Khan. 2021. "Determinants of Household Food Security and Dietary Diversity during the COVID-19 Pandemic in Bangladesh." *Public Health Nutrition* 24(5):1079–87. doi: 10.1017/S1368980020005042.

20. Goulding, Tara, Rebecca Lindberg, and Catherine Georgina Russell. 2020. "The Affordability of a Healthy and Sustainable Diet: An Australian Case Study." *Nutrition Journal* 19(1):109. doi: 10.1186/s12937-020-00606-z.

21. Umarjonovna, Djurayeva Dildora, and Yoqubjanova Yoqutxon Gulomjonovna. 2022. "CHALLENGES OF FOOD SECURITY."

22. Thorne-Lyman, Andrew L., Natalie Valpiani, Kai Sun, Richard D. Semba, Christine L. Klotz, Klaus Kraemer, Nasima Akhter, Saskia de Pee, Regina Moench-Pfanner, Mayang Sari, and Martin W. Bloem. 2010. "Household Dietary Diversity and Food Expenditures Are Closely Linked in Rural

Bangladesh, Increasing the Risk of Malnutrition Due to the Financial Crisis." *The Journal of Nutrition* 140(1):182S-188S. doi: 10.3945/jn.109.110809.

23. Drammeh, Wuyeh, Noor Aman Hamid, and A. J. Rohana. 2019. "Determinants of Household Food Insecurity and Its Association with Child Malnutrition in Sub-Saharan Africa: A Review of the Literature." *Current Research in Nutrition and Food Science Journal* 7(3):610–23. doi: 10.12944/CRNFSJ.7.3.02.

24. Islam, Mohammad Redwanul, Syed Moshfiqur Rahman, Chandan Tarafder, Md. Monjur Rahman, Anisur Rahman, and Eva-Charlotte Ekström. 2020. "Exploring Rural Adolescents' Dietary Diversity and Its Socioeconomic Correlates: A Cross-Sectional Study from Matlab, Bangladesh." *Nutrients* 12(8):2230. doi: 10.3390/nu12082230.

25. Vakili, Mahdis, Parvin Abedi, Mehrdad Sharifi, and Mostafa Hosseini. 2013. "Dietary Diversity and Its Related Factors among Adolescents: A Survey in Ahvaz-Iran." *Global Journal of Health Science* 5(2).

26. Verger, Eric O., Agnes Le Port, Augustin Borderon, Gabriel Bourbon, Mourad Moursi, Mathilde Savy, François Mariotti, and Yves Martin-Prevel. 2021. "Dietary Diversity Indicators and Their Associations with Dietary Adequacy and Health Outcomes: A Systematic Scoping Review." *Advances in Nutrition* 12(5):1659–72. doi: 10.1093/advances/nmab009.

27. Ali, Fatima, Inayat Thaver, and Shahzad Ali Khan. 2019. "ASSESSMENT OF DIETARY DIVERSITY AND NUTRITIONAL STATUS OF PREGNANT WOMEN IN ISLAMABAD, PAKISTAN." *J Ayub Med Coll Abbottabad* 5.

28. McIntyre, L. (2003). Food security: more than a determinant of health. *POLICY OPTIONS-MONTREAL-*, *24*(3), 46-51.

29. Bilal, Muhammad, Bernhard Brümmer, and Jan Barkmann. 2022. "A Discussion on the Outcomes of Adopted Agricultural Technological Products and Specific Sustainable Development Goals: Evidence from Pakistan." *Cogent Economics & Finance* 10(1):2132644. doi: 10.1080/23322039.2022.2132644.

30. Wu, Xiaojing Sharon, Lina Yousif, Anna Miles, and Andrea Braakhuis. 2022. "A Comparison of Dietary Intake and Nutritional Status between Aged Care Residents Consuming Texture-Modified Diets with and without Oral Nutritional Supplements." *Nutrients* 14(3):669. doi: 10.3390/nu14030669.

31. Survey , N. N., 2017 (2017). *Https://www.Ungm.Org/Public/Notice/54176*.

32. Saaka, Mahama, Anthony Wemakor, Abdul-Razak Abizari, and Paul Aryee. 2015. "How Well Do WHO Complementary Feeding Indicators Relate to Nutritional Status of Children Aged 6–23 Months in Rural Northern Ghana?" *BMC Public Health* 15(1):1157. doi: 10.1186/s12889-015-2494-7.

33. Shahzad, Muhammad Aamir, Ping Qing, Muhammad Rizwan, Amar Razzaq, and Muhammad Faisal. 2021. "COVID-19 Pandemic, Determinants of Food Insecurity, and Household Mitigation

Measures: A Case Study of Punjab, Pakistan." *Healthcare* 9(6):621. doi: 10.3390/healthcare9060621.

34. Ruel, Marie T. 2003. "Is Dietary Diversity an Indicator of Food Security or Dietary Quality? A Review of Measurement Issues and Research Needs." *Food and Nutrition Bulletin* 24(2):231–32. doi: 10.1177/156482650302400217.

35. SohaiL, Nida, Yousra Sarfaraz, and Ammara RafiQue. 2022. "Pakistan Floods: An Insight into Agriculture and Food Supply." *Trakya University Journal of Natural Sciences*. doi: 10.23902/trkjnat.1211393.

36. Ullah, Kifayat, and Muhammad Zubair Chishti. 2023. "Spatial Distribution of Poverty in Pakistan: An Asset-Based Approach." *Future Business Journal* 9(1):2. doi: 10.1186/s43093-022-00162-4.

37. Chaudhry, K. T., Javed, A., & Nazir, M. A. (2022). Humanitarian Crisis and Intervention: Securitizing Environmental Challenges in Pakistan. *Annals of Human and Social Sciences*, *3*(3), 10-20.

38. Geng, Jianli, Shamsheer Ul Haq, Jaffar Abbas, Hongwei Ye, Pomi Shahbaz, Azhar Abbas, and Yuyang Cai. 2022. "Survival in Pandemic Times: Managing Energy Efficiency, Food Diversity, and Sustainable Practices of Nutrient Intake Amid COVID-19 Crisis." *Frontiers in Environmental Science* 10:945774. doi: 10.3389/fenvs.2022.945774.

39. WFP., 2022 (n.d.). *Https://www.Wfp.Org/countries/pakistan*. World Food Program. https://www.wfp.org/countries/pakistan

40. Hafeez, A., Dangel, W. J., Ostroff, S. M., Kiani, A. G., Glenn, S. D., Abbas, J., ... & Mokdad, A. H. (2023). The state of health in Pakistan and its provinces and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. *The Lancet Global Health*, *11*(2), e229-e243.

41. Iqbal, Meesha, Zafar Fatmi, Kausar Khan, Yusra Jumani, Neelma Amjad, and Asaad Nafees. 2020. "Malnutrition and Food Insecurity in Child Labourers in Sindh, Pakistan: A Cross-Sectional Study." *Eastern Mediterranean Health Journal* 26(9):1087–96. doi: 10.26719/emhj.20.040.

42. Brazier, Anna K. M., Nicola M. Lowe, Mukhtiar Zaman, Babar Shahzad, Heather Ohly, Harry J. McArdle, Ubaid Ullah, Martin R. Broadley, Elizabeth H. Bailey, Scott D. Young, Svetlana Tishkovskaya, and Muhammad Jaffar Khan. 2020. "Micronutrient Status and Dietary Diversity of Women of Reproductive Age in Rural Pakistan." *Nutrients* 12(11):3407. doi: 10.3390/nu12113407.

43. Uchendu, Florence N. n.d. "CONCEPTUAL FRAMEWORK OF UNDERLYING FACTORS LIMITING ERADICATION OF HIDDEN HUNGER IN DEVELOPING COUNTRIES."

44. Coleman-Jensen, Alisha. 2019. "Household Food Security in the United States in 2019."

45. Chandrasekhar, S., Víctor M. Aguayo, Vandana Krishna, and Rajlakshmi Nair. 2017. "Household Food Insecurity and Children's Dietary Diversity and Nutrition in India. Evidence from the Comprehensive Nutrition Survey in Maharashtra." *Maternal & Child Nutrition* 13:e12447. doi: 10.1111/mcn.12447.

46. Shaw, D. John, and Edward J. Clay. 1998. "Global Hunger and Food Security after the World Food Summit." *Canadian Journal of Development Studies/Revue Canadienne d'études Du Développement* 19(4):55–76. doi: 10.1080/02255189.1998.9669778.

47. Food Security, 2006 *Https://www.Fao.Org/fileadmin/templates/faoitaly/documents/pdf/pdf_Food_Security_Cocept_Note.Pdf*. Food Security. https://www.fao.org/fileadmin/templates/faoitaly/documents/pdf/pdf_Food_Security_Cocept_Note.pdf

48. Sibhatu, Kibrom T., Vijesh V. Krishna, and Matin Qaim. 2015. "Production Diversity and Dietary Diversity in Smallholder Farm Households." *Proceedings of the National Academy of Sciences* 112(34):10657–62. doi: 10.1073/pnas.1510982112.

49. Taruvinga, A., V. Muchenje, and A. Mushunje. 2013b. "Determinants of Rural Household Dietary Diversity: The Case of Amatole and Nyandeni Districts, South Africa."

50. Zakaria, Hudu, and Dujin Barma Laribick. 2014. "Socio-Economic Determinants of Dietary Diversity among Women of Child Bearing Ages in Northern Ghana."

51. Becquey, Elodie, and Yves Martin-Prevel. 2010. "Micronutrient Adequacy of Women's Diet in Urban Burkina Faso Is Low." *The Journal of Nutrition* 140(11):2079S-2085S. doi: 10.3945/jn.110.123356.

52. Mondal, Pinki, Ruth DeFries, Jessica Clark, Nicole Flowerhill, Md. Arif, Aurelie Harou, Shauna Downs, and Jessica Fanzo. 2021. "Multiple Cropping Alone Does Not Improve Year-Round Food Security among Smallholders in Rural India." *Environmental Research Letters* 16(6):065017. doi: 10.1088/1748-9326/ac05ee.

53. Singh, Devendra Raj, Saruna Ghimire, Satya Raj Upadhayay, Sunita Singh, and Umesh Ghimire. 2020b. "Food Insecurity and Dietary Diversity among Lactating Mothers in the Urban Municipality in the Mountains of Nepal" edited by C. Wilunda. *PLOS ONE* 15(1):e0227873. doi: 10.1371/journal.pone.0227873.

54. Caswell, Bess L., Sameera A. Talegawkar, Ward Siamusantu, Keith P. West, and Amanda C. Palmer. 2018. "A 10-Food Group Dietary Diversity Score Outperforms a 7-Food Group Score in Characterizing Seasonal Variability and Micronutrient Adequacy in Rural Zambian Children." *The Journal of Nutrition* 148(1):131–39. doi: 10.1093/jn/nxx011.

55. Na, Muzi, Sucheta Mehra, Parul Christian, Hasmot Ali, Saijuddin Shaikh, Abu Ahmed Shamim, Alain B. Labrique, Rolf DW Klemm, Lee SF Wu, and Keith P. West. 2016. "Maternal Dietary Diversity Decreases with Household Food Insecurity in Rural Bangladesh: A Longitudinal Analysis." *The Journal of Nutrition* 146(10):2109–16. doi: 10.3945/jn.116.234229.

56. Olaimat, Amin N., Islam K. Alshami, Huda Al Hourani, Wafaa Sarhan, Murad Al-Holy, Mahmoud Abughoush, Narmeen Jamal Al-Awwad, Maha Hoteit, and Ayoub Al-Jawaldeh. 2022. "Food Insecurity, Dietary Diversity, and Coping Strategies in Jordan during the COVID-19 Pandemic: A Cross-Sectional Study." *Nutrients* 14(11):2252. doi: 10.3390/nu14112252.

57. Frison, E., I. F. Smith, J. Cherfas, P. Eyzaguirre, and T. Johns. 2005. "Using Biodiversity for Food, Dietary Diversity, Better Nutrition and Health." *South African Journal of Clinical Nutrition* 18(2):112–14. doi: 10.1080/16070658.2005.11734050.

58. Tariku, Amare, Kedir Abdela Gonete, Gashaw Andargie Bikes, Kassahun Alemu, Aysheshim Kassahun Belew, Molla Mesele Wassie, Tadesse Awoke Ayele, Ejigu Gebeye, Zegeye Abebe, Azeb Atnafu Gete, Melkie Edris Yesuf, Yigzaw Kebede, Abebaw Addis Gelagay, and Kindie Fentahun Muchie. 2019. "Household Food Insecurity Predisposes to Undiversified Diet in Northwest Ethiopia: Finding from the Baseline Survey of Nutrition Project, 2016." *BMC Research Notes* 12(1):54. doi: 10.1186/s13104-019-4083-9.

59. Kumar, Indresh, Madhulika Gautam, Rishi Kumar, and Deepa Srivastava. 2019. "Assess the Diet Diversity Score along with Availability of Food Variety for Rural Household in Banda and Kannauj Districts of Uttar Pradesh." *Natural Sciences*.

60. Birhane, Tesfay, Solomon Shiferaw, Seifu Hagos, and Katia Sarla Mohindra. 2014. "Urban Food Insecurity in the Context of High Food Prices: A Community Based Cross Sectional Study in Addis Ababa, Ethiopia." *BMC Public Health* 14(1):680. doi: 10.1186/1471-2458-14-680.

61. Food Security, 2006 (n.d.). *Https://www.Ers.Usda.Gov/publications/pub-details/?Pubid=45902*. Food Security. https://www.ers.usda.gov/publications/pub-details/?pubid=45902

62. Coates, Jennifer, Anne Swindale, and Paula Bilinsky. 2007. "Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide: Version 3: (576842013-001)."

63. Gebreyesus, Seifu Hagos, Torleif Lunde, Damen H. Mariam, Tasew Woldehanna, and Bernt Lindtjørn. 2015. "Is the Adapted Household Food Insecurity Access Scale (HFIAS) Developed Internationally to Measure Food Insecurity Valid in Urban and Rural Households of Ethiopia?" *BMC Nutrition* 1(1):2. doi: 10.1186/2055-0928-1-2.

64. Hussein, Foziya Mohammed, Aragaw Yimer Ahmed, and Oumer Sada Muhammed. 2018. "Household Food Insecurity Access Scale and Dietary Diversity Score as a Proxy Indicator of Nutritional Status among People Living with HIV/AIDS, Bahir Dar, Ethiopia, 2017" edited by D. A. Lightfoot. *PLOS ONE* 13(6):e0199511. doi: 10.1371/journal.pone.0199511.

65. POP- Bulletin- Census, 2019 (n.d.). *Https://www.Prb.Org/wp-content/uploads/2020/10/2019-74-1-Pop-Bulletin-Census.Pdf*. POP,Bulletin,Census. https://www.prb.org/wp-content/uploads/2020/10/2019-74-1-Pop-Bulletin-Census.pdf

66. Levin, Kate Ann. 2006. "Study Design III: Cross-Sectional Studies." *Evidence-Based Dentistry* 7(1):24–25. doi: 10.1038/sj.ebd.6400375.

67. Kennedy, Gina, Terri Ballard, and M. C. Dop. 2011. *Guidelines for Measuring Household and Individual Dietary Diversity*. Rome: Food and Agriculture Organization of the United Nations.

68. Taruvinga, A., V. Muchenje, and A. Mushunje. 2013a. "Determinants of Rural Household Dietary Diversity: The Case of Amatole and Nyandeni Districts, South Africa." 15.

69. Tieguhong, J. C., D. M. Iponga, M. Tchatat, J. M. Kahindo, J. H. Muyonga, C. Mikolo-Yobo, P. Donn, O. Tchingsabe, A. N. Kaaya, J. L. Ngondi, S. Tutu, R. Emeleme, S. Odjo, J. Loo, and L. Snook. n.d. "Can Wild Forest Foods Contribute to Food Security and Dietary Diversity of Rural Populations Adjoining Forest Concessions? Insights from Gabon, DR Congo and Cameroon."

70. Zahid, Fahmida, Uzma Hanif, and Faiza Javed. 2022. "Climate Change and Food Security: Are Asian Economies Tracking Sustainable Development Goals?" *IRASD Journal of Economics* 4(4):561–82. doi: 10.52131/joe.2022.0404.0099.

71. Ruel, Marie T., Agnes R. Quisumbing, and Mysbah Balagamwala. 2018. "Nutrition-Sensitive Agriculture: What Have We Learned so Far?" *Global Food Security* 17:128–53. doi: 10.1016/j.gfs.2018.01.002.

Annexure 1

Data Collection Tool

Assessment of Dietary Diversity and Food Insecurity in Rural Households of Tehsil Kallar Syedan Rawalpindi: A Cross-Sectional Survey

(Household Questionnaire)

SECTION A: Socio-demographic information

ID/study number
Village
Date
Interviewer

1. Gender	a. Male	1
	b. Female	2
	c. Other	3

2. Age		
	a. 18 – 24	1
	b. 25 – 34	2
	c. 35 – 44	3
	d. 45 – 54	4
	e. 55 - 64	5
	f. 65 +	6

3. Marital status	a. Single	1
	b. Married	2
	c. Separated	3
	d. Divorced	4
	e. Widowed	5

4. Respondent Status	a. Household head	1
	b. Spouse	2
	c. Other adult male	3
	d. Other adult female	4
5. No. of family members	a. Less than 4	1
	b. 4-8	2
	c. More than 8	3
6. Type of Family	a. Extended family	1
	b. Nuclear	2
	c. other	3

7. Employment status	a. Unemployed	1
	b. Employed	2
	c. Self-employed	3
	d. Student	4

8. No. of earning members in the family	a. 1 member	1
	b. 2 member	2
	c. 3 member	3
	d. 4 member	4
	e. 5 member	5
	f. More than 5	6

9. Education Level	a. Primary school	1
	b. Secondary	2
	c. Intermediate	3

d.	Graduation	4
e.	Master	5
f.	Diploma	6
g.	No Schooling	7

10. Body Mass Index	a.	Underweight	1
	b.	Normal	2
	c.	Overweight	3
	d.	Obese	4

SECTION B: Dietary Diversity

[Household level: consider foods eaten by any member of the household, and exclude foods purchased and eaten outside of the home]

Question number	Food Group	Example	Yes=1 No=0
1	CEREALS	Any corn/maize, rice, wheat, sorghum, millet or any other grains or foods made from these (e.g. bread, noodles, porridge or other grain products)	
2	VITAMIN A RICH VEGETABLES AND TUBERS	Any pumpkin, carrots or sweet potatoes , apricot, watermelon, mango, papaya, guava , peach orange , spinach, round guard, turnip, parsley, tomato, peas.	
3	WHITE TUBERS AND ROOTS	white potatoes, taro rots, white cassava	

4	DARK GREEN LEAFY VEGETABLES	dark green/leafy vegetables, including wild ones + *locally available vitamin-A rich leaves such as amaranth, cassava leaves, kale, spinach etc.*	
5	OTHER VEGETABLES	other vegetables (e.g. tomato, onion, eggplant) , including wild vegetables	
6	VITAMIN A RICH FRUITS	ripe mangoes, cantaloupe, apricots (fresh or dried), ripe papaya, dried peaches, watermelon, guava	
7	OTHER FRUITS	other fruits, mulberries	
8	ORGAN MEAT (IRONRICH)	liver, kidney, heart or other organ meats or blood-based foods	
9	FLESH MEATS	beef, lamb, goat, chicken, or other birds	
10	EGGS	chicken, duck, hen or any other egg	
11	FISH	fresh or dried fish	
12	LEGUMES, NUTS AND SEEDS	beans, peas, lentils, nuts, seeds or foods made from these	
13	MILK AND MILK PRODUCTS	milk, cheese, yogurt or other milk products	
14	OILS AND FATS	oil, fats or butter added to food or used for cooking	
15	RED PALM PRODUCTS	Red palm oil, palm nut or palm nut pulp sauce	
16	SWEETS	sugar, honey, sweetened soda or sugary foods such as chocolates, candies, cookies and cakes	
17	SPICES,	spices(black pepper, salt), condiments (soy	

	CONDIMENTS, BEVERAGES	sauce, hot sauce), coffee, tea, green tea.	
			Yes=1 **No=0**
Household level only	Did you or anyone in your household eat anything (meal or snack) OUTSIDE of the home yesterday?		

SECTION C: Food Insecurity

Question number	Question	Response Option	Code
1.	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Yes	
1.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3= Often (more than ten times in the past four weeks)	
2.	In the past four weeks, were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources?	0= No (skip to Q3) 1=Yes	
2.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks)	

		3 = Often (more than ten times in the past four weeks)	
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1 = Yes	
3.a	0 = No (skip to Q4) 1 = Yes	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
4.	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food?	0= No (skip to Q5) 1 = Yes	
4.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0= No (skip to Q6) 1 = Yes	
5.a	How often did this happen?	1 = Rarely (once or twice in the	

		past four weeks)	
		2 = Sometimes (three to ten times in the past four weeks)	
		3 = Often (more than ten times in the past four weeks)	
6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0 = No (skip to Q7) 1 = Yes	
6.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
7.	In the past four weeks, was there ever no food to eat of any kind in your household because of lack of resources to get food?	0 = No (skip to Q8) 1 = Yes	
7.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
8.	In the past four weeks, did you or any household member go to sleep at night hungry because there was not enough food?	0= No (skip to Q9) 1 = Yes	
8.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks)	

		2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	
9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0= No (questionnaire is finished) 1 = Yes	
9.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	

Annexure 2
Informed Consent

Title of study

Assessment of Dietary Diversity and Food Insecurity in Rural Households of Kalar Syedan Rawalpindi: A Cross-sectional Survey

Researcher:

I am Kanwal Nisar, currently enrolled in MSPH in Al-Shifa School of Public Health Rawalpindi.

Purpose:

The purpose of this research is to assess dietary diversity and food insecurity in rural and urban households of Rawalpindi District. In addition to determine the associated risk factors it will help to develop comprehensive guidelines and strategies to overcome nutrition related issues. The identified patterns could be used to more effectively target policies directed at nutrition education or efforts to improve health by diversifying and improving the nutritional quality of household diets, for example, through supplemental feeding programs, home garden promotion, or targeted food assistance programs.

Procedure:

Structured interviews will be conducted for this study. All responses will be collected on questionnaire sheet.

Time required:

It is estimated that it will take approximately 20-30 minutes of your time to complete the interview.

Voluntary participation:

Participation in this study is voluntary. You have the right to not open or complete the anonymous survey.

Confidentiality:

Data from the surveys will be completely anonymous and reported in combined form. Your name will not be collected at any time. After data collection, the interview and demographic responses will be protected. Once submitted the researchers will not be able to withdraw responses due to anonymity and de-identified data.

Risks:

This study will pose not harmful risk to the participants.

Benefits:

There are no direct benefits associated with participation in this study. The potential benefit from this research is to assess dietary diversity and food insecurity in rural and urban households of Rawalpindi. The results of the survey will be considered a foundational cognitive resource to develop evidence-based policies and make informed decisions that address the root causes of malnutrition and consequences of in-accessibility to food. It will also help all stakeholders, including public and private, in planning nutrition-specific interventions.

You will receive no payment for participating in the study.

Right to withdraw from the study:

You have the right to withdraw from the study at any time without penalty.

If you have questions about the study, contact the following individual:

Consent

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Name of Participant_____ Signature of Participant _____ Date _____ (DD/MM/YY)

Annexure 3

IRB Approval Letter

TO WHOM IT MAY CONCERN

This is to certify that **Kanwal Nisar** D/O **Nisar Ahmed** is a student of Master of Science in Public Health (MSPH) final semester at Al-Shifa School of Public Health, PIO, Al-Shifa Trust Rawalpindi. He/she has to conduct a research project as part of curriculum & compulsory requirement for the award of degree by the Quaid-i-Azam University, Islamabad. His/her research topic, which has already been approved by the Institutional Review Board (IRB), is **"Assessment of dietary diversity and food Insecurity in rural households of kallar Sayaddan Rawalpindi".**

Please provide his/her necessary help and support in completion of the research project. Thank you.

Sincerely,

Dr. Ayesha Babar Kawish
Head
Al-Shifa School of Public Health, PIO
Al-Shifa Trust, Rawalpindi

Annexure 4

Scale Reliability

Reliability Statistics HFIAS

Cronbach's Alpha	N of Items
.922	18

Figure 5: Reliability of Household Food Insecurity Access Scale(HFIAS)

Annexure 5

Gant Chart

Activities	September 2022	October 2022	November 2022	December 2022	January 2023	February 2023
Literature search						
Synopsis writing and IRB approval						
Pilot testing						
Data collection						
Data analysis						
Write-up						
Thesis submission						

Annexure 6

Budget

Item	Transport	Stationery and internet	Printing	Publishing
Pilot testing	6000 Rs/-	7000Rs/-	25,000Rs/-	-
Data collection	30,000Rs/-	7,000Rs/-	2000RS/-	-
Thesis report writing	2,000Rs/-	7,000Rs/-	8,000Rs/-	30,000Rs/-
Total expenditure	38,000Rs/-	21,000Rs/-	35,000Rs/-	30,000Rs/-
Grand total	124,000 Rs/-			