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Original Article

Relationship Between Dietary Habits, Immunity, and Drug Effectiveness in Infectious Diseases

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ABSTRACT

Background: Dietary diversity may be associated with host health and recovery during infectious illness, although evidence from Pakistani outpatient populations remains limited. Objective: To examine associations between dietary diversity, recalled infection frequency, patient-reported medication response, and reported recovery duration among adults with common infectious illnesses. Methods: This analytical cross-sectional study included 412 adults attending selected outpatient departments in Lahore, Pakistan. Dietary-diversity scores were categorized as low, moderate, or high. Recalled infection frequency during the preceding six months, perceived symptom response following prescribed medication, and reported recovery duration were assessed using a structured questionnaire. Categorical associations were evaluated using Pearson's chi-square test, and crude odds ratios were calculated for high recalled infection frequency. Results: Low, moderate, and high dietary diversity were reported by 148 (35.9%), 176 (42.7%), and 88 (21.4%) participants, respectively. High recalled infection frequency occurred in 48.6% of the low-diversity group, 23.9% of the moderate-diversity group, and 9.1% of the high-diversity group (χ^2=60.33; df=4; p<0.001; Cramér's V=0.271). Compared with high dietary diversity, the crude odds of high infection frequency were greater for moderate diversity (OR=3.13; 95% CI: 1.40–7.01) and low diversity (OR=9.47; 95% CI: 4.28–20.98). Mean reported recovery duration was 9.1 days in the low-diversity group and 3.7 days in the high-diversity group. Conclusion: Higher dietary diversity was associated with fewer recalled infections and shorter reported recovery duration, but the cross-sectional design did not establish causality. Keywords: Dietary Diversity; Infectious Diseases; Infection Frequency; Patient-Reported Outcomes; Recovery Duration; Nutrition; Outpatients; Pakistan.

INTRODUCTION

Infectious diseases remain an important cause of outpatient healthcare utilization and morbidity, particularly in low- and middle-income countries. Although antimicrobial agents, antipyretics, and other supportive medications constitute the principal components of infection management, clinical recovery is also influenced by host-related factors, including nutritional intake, underlying health status, immune competence, treatment adherence, and disease severity. Adequate intake of energy, protein, vitamins, and minerals supports epithelial barriers and the cellular and humoral components of innate and adaptive immunity, whereas inadequate nutritional intake may impair host defence and prolong recovery from infection (1–3).

Micronutrients such as vitamins A, C, and D, zinc, iron, and selenium contribute to immune-cell development, antioxidant protection, inflammatory regulation, and maintenance of physical barriers

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against pathogens (2,4). Nutrient deficiencies and undernutrition may compromise these functions and increase susceptibility to infection, particularly among socioeconomically vulnerable populations (3,5). Dietary diversity is therefore frequently used in nutritional epidemiology as a practical indicator of the variety of food groups consumed and as an indirect measure of the likelihood of adequate nutrient intake. Nevertheless, dietary diversity does not directly establish biochemical nutrient sufficiency, nutritional status, or immune competence and should be interpreted as a dietary exposure rather than a diagnostic nutritional measure.

Dietary practices in Pakistan are influenced by socioeconomic position, education, food availability, household structure, and urbanization. Community-based evidence has demonstrated considerable variation in the dietary patterns of Pakistani adults according to sociodemographic characteristics (6). Research conducted in Lahore has also identified gaps in nutrition knowledge among adults, suggesting that many individuals may have an incomplete understanding of the relationship between everyday food choices and health outcomes (7). National and regional studies have further reported inadequate dietary diversity and micronutrient-related nutritional problems among women and children, indicating that suboptimal nutritional intake remains relevant within the Pakistani population (8,9).

The possible relationship between nutrition and infection outcomes is supported by local observations involving specific infectious conditions. Vitamin D deficiency has been associated with severe clinical manifestations among hospitalized patients with dengue fever in Lahore, while a separate Pakistani study reported a high frequency of vitamin D deficiency among children with urinary tract infection (10,11). These findings do not demonstrate that nutritional deficiency independently causes infection or determines disease severity; however, they indicate that nutritional factors may coexist with and potentially modify host responses during infectious illness. Evidence focusing on overall dietary diversity and patient-reported recovery experiences across common outpatient infections in Pakistan remains limited.

Food intake and nutritional status may also influence medication use and response through several pathways. Meals can alter gastric emptying, gastrointestinal pH, drug dissolution, absorption, and bioavailability, while particular food components may interact with selected antimicrobial agents (12). Systematic reviews have demonstrated clinically relevant food-related changes in the bioavailability of some β-lactam antibiotics, macrolides, and tetracyclines, although the magnitude and clinical importance of these interactions differ according to the drug, formulation, meal composition, and administration schedule (13,14). Malnutrition may additionally alter drug distribution, protein binding, hepatic metabolism, and renal elimination; however, these pharmacokinetic effects cannot be inferred solely from dietary-diversity scores or patient-reported symptom improvement (15).

Nutritional status has also been associated with treatment outcomes in prolonged infections such as tuberculosis, where undernutrition may coexist with greater disease severity and poorer therapeutic outcomes (16,17). Nevertheless, evidence from tuberculosis and other chronic infections cannot be directly generalized to heterogeneous acute outpatient illnesses. Moreover, perceived improvement after medication is influenced by infection type, baseline severity, natural disease course, treatment selection, treatment adherence, concurrent medication use, and time elapsed since treatment initiation. Patient-reported symptom response should therefore be distinguished from objectively measured pharmacological effectiveness.

Routine infection management commonly emphasizes medication completion, hydration, and monitoring of warning signs, while structured dietary assessment and counselling may receive less attention. Nutritional counselling may represent a useful supportive component of care, but its effectiveness must be evaluated using prospective and intervention-based research rather than inferred from cross-sectional associations. Before such interventions are developed, locally relevant observational evidence is needed to determine whether dietary patterns are associated with patients' reported infection and recovery experiences.

The present analytical cross-sectional study therefore examined the relationship between dietary diversity and selected infection-related outcomes among adults receiving outpatient treatment for common infectious illnesses in Lahore, Pakistan. Specifically, it assessed whether dietary-diversity category was associated with recalled frequency of infection during the preceding six months, patient-reported time to symptom improvement following prescribed medication, and reported duration of recovery from the current illness. It was hypothesized that lower dietary diversity would be associated with more frequent recalled infections, less favourable patient-reported medication response, and longer reported recovery duration.

MATERIALS AND METHODS

An analytical cross-sectional study was conducted among adult patients attending selected outpatient departments of public and private hospitals in Lahore, Pakistan. The study population comprised patients receiving medical care for common infectious illnesses, including respiratory tract infections, urinary tract infections, gastrointestinal infections, and dengue-like febrile illness. Because the investigation assessed dietary exposure and infection-related experiences within a single observational assessment, its purpose was to identify associations rather than establish temporal sequence or causality.

Adults aged 18–60 years who had been clinically diagnosed with an infectious illness and were receiving treatment at the time of data collection were eligible for inclusion. Patients with terminal chronic illness, cancer, severe psychiatric illness, or incomplete clinical information were excluded. Individuals were recruited through non-probability convenience sampling from the participating outpatient departments. A total of 412 eligible participants with sufficiently complete questionnaire data were included in the analysis.

Data were collected using a structured questionnaire developed to obtain sociodemographic, dietary, clinical, and treatment-related information. The questionnaire comprised four principal domains: participant characteristics; usual dietary intake and food-group consumption; infection history; and patient-reported medication response and recovery experience. Sociodemographic information included age, sex, educational level, socioeconomic characteristics, smoking status, and the presence of reported comorbidities, including diabetes mellitus and hypertension. Clinical information included the category of the current infectious illness, the recalled number of infectious episodes during the preceding six months, time to perceived symptom improvement following treatment, reported recovery duration, and history of revisiting a healthcare facility for the same illness.

Dietary habits were assessed using a simplified food-frequency approach adapted from nutritional epidemiological assessments previously used in Pakistani populations (8). Participants reported their consumption of major food groups, including fruits, vegetables, cereals, pulses, eggs, meat or other animal-source foods, and dairy products. Information concerning fried foods, commercially prepared foods, sugar-sweetened beverages, and daily water consumption was also obtained. Dietary diversity was summarized on a 10-point dietary-diversity scale according to the number of food groups reported. Scores of 0–3 were classified as low dietary diversity, scores of 4–6 as moderate dietary diversity, and scores of 7–10 as high dietary diversity. Dietary-diversity category was treated as the principal exposure variable. The score represented food-group variety and was not interpreted as a biochemical measure of nutritional status or micronutrient sufficiency.

Recalled infection frequency during the preceding six months was used as an indirect infection-history indicator rather than a direct measure of immune function. Participants reporting three or more infectious episodes were categorized as having a high frequency of recalled infection, those reporting one or two episodes as having a moderate frequency, and those reporting no infectious episodes as having a low frequency. This outcome was interpreted cautiously because infection frequency may be affected by exposure patterns, comorbidities, healthcare-seeking behaviour, occupation, household conditions, and recall accuracy.

Patient-reported medication response was assessed according to the time between initiation of prescribed treatment and perceived symptom improvement. Improvement within 24–48 hours was categorized as a favourable response, improvement within 48–72 hours as an intermediate response, and absence of perceived improvement within 72 hours as an unfavourable response. This variable represented the participant's perceived symptomatic response and was not considered an objective measure of drug bioavailability, pharmacokinetics, antimicrobial susceptibility, or pharmacological effectiveness. Reported recovery duration was defined as the number of days taken to recover from the current infectious episode, based on the participant's report and available clinical information.

The principal dependent variables were recalled infection-frequency category, patient-reported medication-response category, and reported recovery duration. Other recorded outcomes included healthcare-facility revisit for the same illness. Potential confounding variables considered in the analysis included age, sex, educational level, socioeconomic status, smoking status, and reported comorbidities. The type of infectious illness was also considered clinically relevant because symptom course, treatment requirements, and expected recovery time may differ across infection categories.

Questionnaires were reviewed for completeness before data entry. Data were coded and analysed using IBM SPSS Statistics version 26.0. Categorical variables were summarized as frequencies and percentages. Continuous variables were summarized using means and standard deviations when their distributions were approximately symmetrical. Dietary-diversity categories were cross-tabulated with recalled infection frequency and patient-reported medication response. Pearson's chi-square test was used to evaluate associations between categorical variables, subject to fulfilment of expected-frequency assumptions.

Logistic regression analysis was used to examine the association between dietary diversity and an unfavourable patient-reported medication response. Dietary-diversity category was entered as the principal explanatory variable, with the high-diversity category used as the reference where appropriate. Demographic and clinical covariates were considered in adjusted analyses to reduce confounding. Results were expressed using odds ratios with 95% confidence intervals and exact p-values. Recovery duration was compared across dietary-diversity categories using an appropriate group-comparison procedure according to the observed distribution of the variable. All statistical tests were two-sided, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 412 participants were included in the analysis. Of these, 148 (35.9%) had low dietary diversity, 176 (42.7%) had moderate dietary diversity, and 88 (21.4%) had high dietary diversity. Thus, 324 participants (78.6%) were classified within the low- or moderate-diversity categories, whereas approximately one-fifth had high dietary diversity (Table 1).

Table 1. Distribution of Participants According to Dietary-Diversity Category

Dietary-diversity category	n (%)
Low	148 (35.9)
Moderate	176 (42.7)
High	88 (21.4)
Total	412 (100.0)

Dietary-diversity scores were categorized as low (0–3), moderate (4–6), and high (7–10).

A graded association was observed between dietary diversity and recalled infection frequency during the preceding six months. Among participants with low dietary diversity, 72 (48.6%) reported a high infection frequency, compared with 42 (23.9%) in the moderate-diversity group and 8 (9.1%) in the high-diversity group. Conversely, a low recalled infection frequency was reported by 27 (18.2%) participants with low dietary diversity, 52 (29.5%) with moderate dietary diversity, and 48 (54.5%) with high dietary diversity (Table 2).

The overall association between dietary-diversity category and recalled infection-frequency category was statistically significant (χ^2=60.33, df=4, p<0.001). The corresponding Cramér's V of 0.271 indicated a moderate association between the two variables.

Table 2. Association Between Dietary Diversity and Recalled Infection Frequency During the Preceding Six Months

Dietary-diversity category	Low infection frequency, n (%)	Moderate infection frequency, n (%)	High infection frequency, n (%)	Total, n
Low	27 (18.2)	49 (33.1)	72 (48.6)	148
Moderate	52 (29.5)	82 (46.6)	42 (23.9)	176
High	48 (54.5)	32 (36.4)	8 (9.1)	88
Total	127 (30.8)	163 (39.6)	122 (29.6)	412

Percentages are calculated within dietary-diversity categories. Low infection frequency represented no reported infectious episode during the preceding six months; moderate frequency represented one or two episodes; and high frequency represented three or more episodes. Pearson's χ^2=60.33; df=4; p<0.001; Cramér's V=0.271.

In crude binary comparisons, participants with low dietary diversity had 9.47 times greater odds of reporting a high infection frequency than participants with high dietary diversity (OR=9.47; 95% CI: 4.28–20.98). Participants with moderate dietary diversity also had greater odds of high infection frequency than those with high dietary diversity (OR=3.13; 95% CI: 1.40–7.01) (Table 3). These estimates were unadjusted and therefore did not account for demographic, socioeconomic, clinical, or infection-related confounding.

Table 3. Crude Association Between Dietary Diversity and High Recalled Infection Frequency

Dietary-diversity category	High infection frequency, n/N (%)	Crude OR	95% CI	p-value
High	8/88 (9.1)	1.00	Reference	—
Moderate	42/176 (23.9)	3.13	1.40–7.01	0.005
Low	72/148 (48.6)	9.47	4.28–20.98	<0.001

OR, odds ratio; CI, confidence interval. The outcome was high recalled infection frequency, defined as three or more reported infectious episodes during the preceding six months. Odds ratios were calculated from the reported aggregate counts and were not adjusted for potential confounders.

Reported recovery duration also varied across the available dietary-diversity categories. Participants in the low-diversity group had a mean reported recovery duration of 9.1 days, compared with 3.7 days among those in the high-diversity group. This corresponded to an absolute mean difference of 5.4 days and a 59.3% shorter reported recovery duration in the high-diversity group relative to the low-diversity group. However, the manuscript did not provide the recovery duration for the moderate-diversity group, measures of dispersion, distributional information, or a complete statistical comparison. Consequently, no confidence interval, effect size, or inferential p-value could be validly calculated for this outcome.

Table 4. Reported Recovery Duration According to Available Dietary-Diversity Categories

Dietary-diversity category	Mean reported recovery duration, days	Mean difference versus low diversity, days	Relative difference versus low diversity, %
Low	9.1	Reference	Reference
High	3.7	−5.4	−59.3

Values were limited to those explicitly reported in the manuscript. Measures of dispersion and the corresponding value for the moderate-diversity group were unavailable; therefore, inferential comparisons were not performed.

The manuscript further indicated that participants with greater dietary diversity experienced earlier perceived symptom relief following prescribed medication. However, the frequencies of favourable, intermediate, and unfavourable patient-reported medication responses were not reported. The proposed logistic-regression output, including coefficients, odds ratios, confidence intervals, covariate adjustments, model-fit statistics, and exact p-values, was also unavailable. These outcomes could therefore not be presented quantitatively or included in a valid regression table.

Overall, the available results demonstrated a dietary-diversity gradient in recalled infection frequency. Nearly half of participants with low dietary diversity reported three or more infections during the preceding six months, compared with fewer than one-tenth of those with high dietary diversity. The available recovery-duration means also suggested a shorter reported illness course among participants with high dietary diversity. These findings represent unadjusted cross-sectional associations and do not establish that dietary diversity independently altered immune function, medication effectiveness, or subsequent recovery.

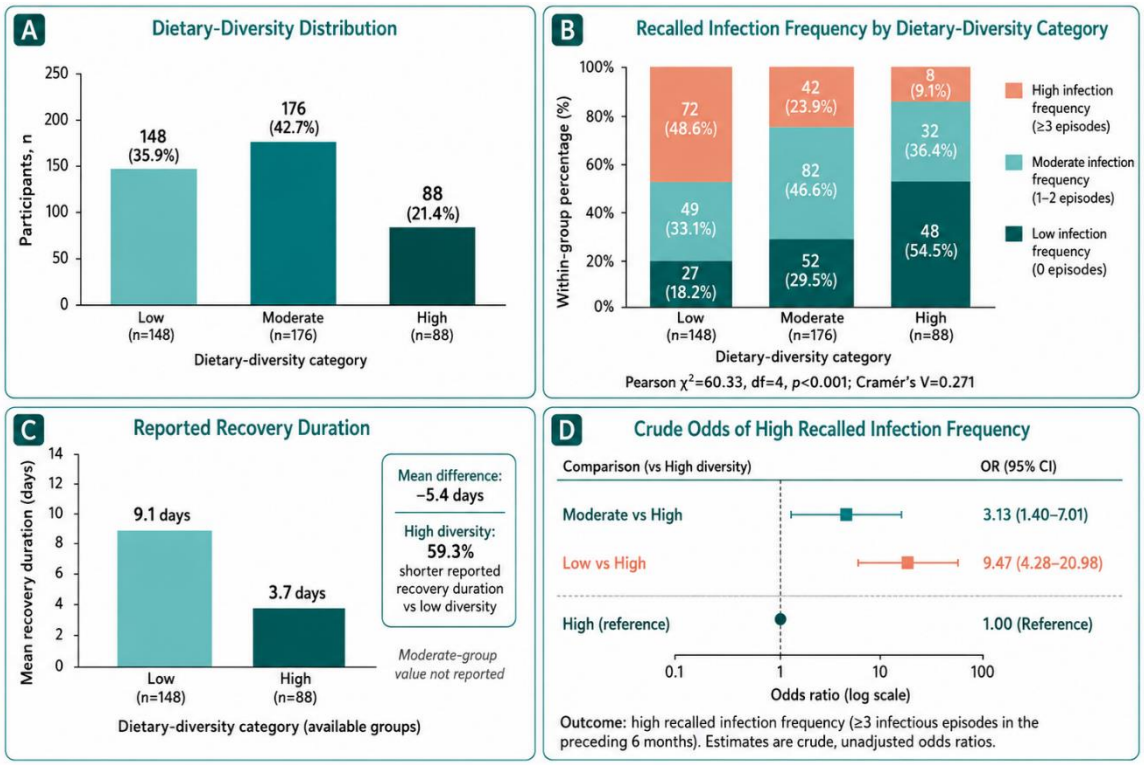

Figure 1. The four-panel figure summarizes the relationship between dietary diversity, recalled infection frequency, and recovery duration among 412 adults with infectious diseases. Panel A shows that 148 participants (35.9%) had low dietary diversity, 176 (42.7%) had moderate diversity, and 88 (21.4%) had high diversity. Panel B demonstrates a clear gradient in recalled infection frequency, with high infection frequency decreasing from 48.6% in the low-diversity group to 23.9% in the moderate-diversity group and 9.1% in the high-diversity group, while low infection frequency increased from 18.2% to 54.5% across the same categories; this association was statistically significant (χ^2=60.33, df=4, p<0.001; Cramér's V=0.271). Panel C indicates that mean reported recovery duration was 9.1 days in the low-diversity group and 3.7 days in the high-diversity group, representing a 5.4-day absolute difference and a 59.3% shorter reported recovery duration among participants with high dietary diversity. Panel D shows that, compared with the high-diversity reference group, the crude odds of reporting three or more infections during the preceding six months were higher in the moderate-diversity group (OR=3.13; 95% CI: 1.40–7.01) and markedly higher in the low-diversity group (OR=9.47; 95% CI: 4.28–20.98).

DISCUSSION

The present analytical cross-sectional study identified a graded association between dietary diversity and recalled infection frequency among adults receiving outpatient treatment for common infectious illnesses in Lahore. Participants with low dietary diversity were more likely to report three or more infectious episodes during the preceding six months than those with high dietary diversity. The association was statistically significant and moderate in magnitude, while the crude odds of high recalled infection frequency were substantially greater in the low- and moderate-diversity groups than in the high-diversity group. The available recovery data also indicated a shorter mean reported recovery duration among participants with high dietary diversity. These findings should, however, be interpreted as unadjusted observational associations rather than evidence that dietary diversity directly improved immune function, medication effectiveness, or recovery.

The distribution of dietary-diversity scores showed that more than three-quarters of participants were classified within the low- or moderate-diversity categories. This pattern is broadly consistent with nutritional research from Pakistan demonstrating that dietary practices vary according to education, socioeconomic position, food availability, and other demographic characteristics (6). Research conducted among adults in Lahore has similarly identified limitations in nutrition knowledge, which may influence the selection and diversity of foods consumed during both health and illness (7). Inadequate dietary diversity has also been documented among nutritionally vulnerable groups in Pakistan, particularly women and children, although findings from those populations cannot be directly generalized to the present adult outpatient sample (8,9). Dietary choices may additionally change during outbreaks or periods of restricted mobility, as observed during the COVID-19 pandemic in Pakistan, when food-choice motives and health behaviours were influenced by changing social and environmental conditions (19).

The observed gradient between dietary diversity and recalled infection frequency is biologically plausible because adequate intake of energy, protein, vitamins, minerals, and essential fatty acids contributes to the maintenance of epithelial barriers and normal innate and adaptive immune responses (1–4,20). Vitamins A, C, and D, zinc, iron, selenium, and other nutrients support immune-cell development, antioxidant defence, inflammatory regulation, antibody production, and tissue repair (2,4,20). Deficiencies affecting several nutrients may therefore coexist with greater susceptibility to infection, particularly in socioeconomically vulnerable populations (3,5). Nutritional disturbances have also been reported among children with severe acute malnutrition and infectious complications in Pakistan, illustrating the close clinical relationship between illness, reduced intake, and metabolic imbalance (18).

Local evidence involving specific infections provides further context. Vitamin D deficiency has been associated with more severe dengue manifestations among hospitalized patients in Lahore, and vitamin D deficiency has also been reported among Pakistani children with urinary tract infection (10,11). International evidence similarly suggests that vitamins and zinc may influence host responses during acute respiratory infections, although supplementation effects differ by baseline status, disease type, and study design (21). Cross-sectional observations involving COVID-19 have also reported associations between zinc and vitamin status and clinical prognosis, but such findings remain vulnerable to confounding and reverse causation (22). The present study did not measure vitamin concentrations, inflammatory biomarkers, leukocyte function, antibody response, or other immunological indicators. Consequently, recalled infection frequency should be interpreted as an indirect infection-history indicator rather than a direct measure of immune competence.

The crude odds estimates demonstrated that participants with low dietary diversity had markedly greater odds of reporting high infection frequency than those with high dietary diversity. Although the magnitude of this relationship was clinically notable, several alternative explanations remain possible. Socioeconomic disadvantage may simultaneously reduce access to diverse foods and increase exposure to overcrowding, environmental contamination, occupational hazards, and delayed healthcare. Comorbidities, smoking, vaccination status, sleep, physical activity, household composition, and previous antimicrobial use may also influence infection frequency. Because adjusted regression results were not available, the independence of dietary diversity from these factors could not be established.

Reverse causation is another important consideration. Recurrent or prolonged illness may reduce appetite, alter food preferences, limit food preparation, decrease household income, or lead patients to avoid particular foods. Under these circumstances, low dietary diversity may partly result from poor health rather than precede it. The cross-sectional design and the use of recalled exposure and outcome information did not permit confirmation of temporal order. Prospective studies are therefore required to determine whether dietary diversity predicts subsequent infection incidence after adjustment for exposure risk, comorbidities, socioeconomic conditions, and baseline nutritional status.

The available recovery-duration data also suggested a potentially important gradient. Mean reported recovery duration was 9.1 days in the low-diversity group and 3.7 days in the high-diversity group, corresponding to an absolute difference of 5.4 days. Adequate nutritional intake may support energy metabolism, tissue repair, hydration, and immune responses during illness (3,5,20). Nevertheless, recovery time is strongly affected by infection diagnosis, disease severity, pathogen characteristics, medication selection, treatment adherence, age, comorbidity, and healthcare access. The manuscript did not provide the moderate-diversity group value, measures of dispersion, diagnosis-specific recovery estimates, or an adjusted statistical comparison. The observed difference should therefore be regarded as descriptive and hypothesis-generating rather than as a confirmed effect attributable to diet.

The manuscript also proposed an association between dietary habits and medication response. Food can influence the absorption and bioavailability of selected medicines by altering gastric emptying, gastrointestinal pH, intestinal transport, or chemical binding (12). Systematic reviews have reported clinically relevant food-related changes in the bioavailability of certain β-lactam antibiotics, macrolides, and tetracyclines, although the direction and magnitude of these interactions depend on the particular drug and meal conditions (13,14). Malnutrition may also affect protein binding, volume of distribution, hepatic metabolism, and renal elimination (15). Pharmacokinetic variability has been demonstrated for first-line antituberculosis drugs, including differences related to age, disease status, and HIV coinfection (23).

These mechanisms cannot, however, be inferred from the present data. Medication names, doses, routes, schedules, food-administration timing, adherence, antimicrobial susceptibility, and serum drug concentrations were not reported. Patient-perceived symptom improvement may reflect the natural course of illness, antipyretic or analgesic use, placebo effects, treatment adherence, initial disease severity, or differences in diagnosis rather than altered pharmacological effectiveness. Drug response may also be compromised by inappropriate prescribing, drug–drug interactions, and antimicrobial resistance, which were not assessed in this study (24,25). The term patient-reported medication response is therefore more appropriate for interpreting the study outcome than objective drug effectiveness.

The findings may nevertheless have practical relevance. Dietary assessment is rarely the principal focus of brief outpatient consultations for acute infection, yet simple screening may identify patients with restricted food intake, dehydration, food insecurity, or potentially problematic food–medication practices. Nutrition counselling should not replace evidence-based antimicrobial or supportive treatment, and the present study did not test a counselling intervention. However, clinicians may reasonably provide diagnosis-appropriate advice regarding hydration, adequate energy and protein intake, and adherence to medication-specific food instructions. Any formal recommendation to integrate structured dietary counselling into infection-management protocols should be evaluated through prospective controlled studies.

The study had several strengths. It included 412 adults from outpatient settings and examined a locally relevant but comparatively understudied relationship between dietary diversity and patient-reported infection experiences. The use of graded dietary-diversity categories allowed examination of a dose-response-like pattern, and the available aggregate data supported calculation of a statistically significant association, an effect-size estimate, and crude odds ratios. The analysis also distinguished dietary diversity from objective nutritional status and patient-reported medication response from pharmacological effectiveness.

Several limitations substantially affect interpretation. The cross-sectional design prevented establishment of temporality or causality. Convenience sampling may have introduced selection bias and limited representativeness. The participating institutions, recruitment period, screening process, and nonparticipation rate were not reported. Dietary intake, infection history, symptom improvement, and recovery duration were based principally on participant report and were therefore susceptible to recall error and social-desirability bias. The dietary-diversity instrument, food-group definitions, recall period,

and category thresholds were not accompanied by complete validation information. Recalled infection frequency was an indirect proxy influenced by exposure and healthcare-seeking behaviour rather than a direct immunological measure.

The study also combined heterogeneous infectious conditions with different causes, severities, treatments, and expected recovery periods. “Dengue-like febrile illness” may have included unconfirmed diagnoses, increasing the possibility of misclassification. Medication type, dose, duration, adherence, treatment timing, concurrent medication use, and antimicrobial resistance were not available. Objective nutritional indicators such as body mass index, serum albumin, micronutrient concentrations, and dietary energy or protein intake were not measured. No immune biomarkers were assessed. The recovery-duration analysis lacked a moderate-diversity estimate and measures of variability, while the reported medication-response data were insufficient for quantitative analysis. Finally, adjusted regression estimates were unavailable, leaving considerable potential for residual confounding.

Future studies should use prospective, diagnosis-specific designs with standardized diagnostic criteria, validated dietary-assessment instruments, objective nutritional and immune biomarkers, and complete medication documentation. Recruitment should include consecutive or probability-based sampling where feasible. Analyses should adjust for age, sex, socioeconomic status, infection type and severity, comorbidities, smoking, vaccination, medication adherence, and previous antimicrobial exposure. Longitudinal follow-up would allow direct measurement of symptom resolution, treatment response, recurrence, and healthcare revisits. Randomized trials would ultimately be required to determine whether structured dietary counselling or nutritional intervention improves clinically important infection outcomes.

CONCLUSION

Higher dietary diversity was associated with fewer recalled infectious episodes and a shorter reported recovery duration among adults receiving outpatient treatment for common infectious illnesses in Lahore. Participants with low dietary diversity had substantially greater crude odds of reporting three or more infections during the preceding six months than those with high dietary diversity. These findings indicate an observational relationship between dietary variety and patient-reported infection experiences but do not establish that dietary diversity directly improves immunity, medication effectiveness, or recovery. Prospective studies using validated dietary measures, objective biomarkers, medication verification, diagnosis-specific follow-up, and adjustment for major confounders are needed to clarify the direction and clinical significance of these associations.

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