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Impact of Hypo and Hyper Condition of Glucose and Blood Pressure Variations on Quality of Life

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ABSTRACT

Background: Blood glucose and blood pressure dysregulation can impair functional capacity and psychosocial well-being, yet the quality-of-life burden of hypoglycemia, hyperglycemia, hypotension, and hypertension among young adults remains under-studied in community settings. Objective: To assess the impact of low and high blood glucose levels and blood pressure variations on quality of life among adults aged 17–30 years in Shikarpur, Pakistan. Methods: A community-based comparative observational study was conducted from July 2024 to June 2025 among 240 participants classified into hypoglycemia (n=40), hyperglycemia (n=40), hypotension (n=40), hypertension (n=40), and controls (n=80). Random capillary glucose was measured using a glucometer and blood pressure using a sphygmomanometer. Quality of life was evaluated using WHOQOL-BREF domain scores and global items. Results: Mean glucose differed markedly between controls (113.25±8.40 mg/dL) and hypoglycemia (60.45±6.34 mg/dL; p<0.001) and hyperglycemia (207.45±12.08 mg/dL; p<0.001). Hypotension showed lower systolic/diastolic pressures (83.12±8.83/52.87±7.15 mmHg), while hypertension showed higher values (153.75±14.08/103.63±13.44 mmHg) compared with controls (p≤0.01). All case groups demonstrated substantial reductions in physical, psychological, and environmental QoL domains versus controls. Conclusion: Glucose and blood pressure variations were associated with markedly poorer quality of life in young adults, supporting early screening, lifestyle intervention, and integrated mental health support.

Keywords
Quality of life; WHOQOL-BREF; Hypoglycemia; Hyperglycemia; Hypotension; Hypertension; Young adults; Pakistan.

INTRODUCTION

Physiological stability of blood glucose and blood pressure is a central requirement for metabolic efficiency, cerebral function, and cardiovascular homeostasis, yet subtle deviations often remain under-recognized in young adults who otherwise appear clinically healthy. Emerging evidence indicates that even transient hypoglycemia, hyperglycemia, hypotension, and hypertension can impair daily functioning through symptoms such as headache, dizziness, fatigue, impaired concentration, mood instability, and reduced productivity, contributing to measurable deterioration in perceived quality of life (QoL). These impacts are particularly relevant in low-resource settings, where preventive screening is limited and symptom-driven healthcare utilization is delayed, allowing early physiological dysregulation to persist unnoticed and affect well-being across physical, psychological, social, and environmental dimensions (1). Glucose is the primary energy substrate for the brain and central nervous system, and its regulation is tightly controlled through insulin–glucagon homeostasis; therefore, both hypoglycemia and hyperglycemia may rapidly translate into cognitive and emotional disturbances even among individuals without formal diabetes diagnoses (2). Although dysglycemia has historically been emphasized within diabetic populations, recent trends show increasing frequency of abnormal glucose patterns in younger, non-diabetic individuals, plausibly linked to irregular diet patterns, skipping meals, reduced physical activity, circadian disruption due to screen exposure, poor sleep hygiene, and heightened psychosocial stress (3,4). These lifestyle factors are increasingly prevalent in developing regions, which may intensify vulnerability to glucose instability and its psychosocial consequences (5).

Blood pressure regulation similarly requires precise control to maintain adequate tissue perfusion and prevent vascular damage. Hypotension can impair cerebral perfusion and provoke dizziness, weakness, fatigue, and syncope, whereas hypertension is a well-established contributor to future cardiovascular morbidity and mortality, even when asymptomatic during early stages (5–8). While these conditions are frequently evaluated in clinical settings and older populations, expanding lifestyle risk factors—including poor diet quality, low physical activity, tobacco use, sleep disruption, and stress—are increasingly shifting cardiometabolic risks toward younger age groups (6-8). Importantly, QoL is not merely an ancillary outcome but a clinically meaningful construct reflecting real-world functioning, symptom burden, emotional resilience, and environmental stability; thus, it has become a priority outcome in healthcare research and population-based prevention strategies (9). Young adults may remain unaware of dysregulated glucose or blood pressure until symptoms interfere with concentration, mood, and social participation, producing impairments that may manifest before the onset of overt disease (10). If persistent, these early abnormalities may also increase long-term risk for type 2 diabetes and cardiovascular disorders, thereby strengthening the rationale for early identification and preventive intervention in youth (11). The psychological dimension of these physiological variations warrants particular attention because glycemic and hemodynamic instability has been associated with emotional lability, fatigue, reduced concentration, anxiety, and depressive symptoms in both diabetic and non-diabetic populations (12). Recurrent symptomatic episodes, especially hypoglycemia, can create anticipatory anxiety and behavioral restriction, thereby

impairing functioning beyond the immediate physiological event (13). The WHOQOL-BREF framework conceptualizes QoL as a multidimensional outcome including physical health, psychological well-being, social relationships, and environmental health, offering an appropriate and internationally used tool for quantifying the lived impact of physiological dysregulation (14). Despite these concerns, there remains limited community-based evidence from smaller cities in Pakistan addressing how both low and high glucose and blood pressure variations influence WHOQOL-BREF scores among young adults in routine community settings. Therefore, this study aimed to evaluate whether young adults aged 17–30 years in Shikarpur city classified as hypoglycemic, hyperglycemic, hypotensive, or hypertensive demonstrate significantly lower WHOQOL-BREF domain scores and overall QoL compared with individuals with normal physiological parameters, thereby supporting early screening and lifestyle-focused public health interventions.

MATERIALS AND METHODS

A community-based comparative observational study was conducted in Shikarpur city, Sindh, Pakistan, from July 2024 to June 2025 to evaluate the association between variations in blood glucose and blood pressure and health-related quality of life among young adults. The protocol was approved by the Ethical Review Committee of the Institute of Biochemistry, University of Sindh, Jamshoro (Ref. No. IOB/253/2024; dated 17-06-2024). Participants were recruited through purposive community outreach and local clinic engagement, and enrolment was restricted to individuals aged 17–30 years who provided informed consent. Eligible participants included both males and females and were classified into exposure-defined groups based on measured physiological parameters, including hypoglycemia (random capillary glucose <70 mg/dL), hyperglycemia (random capillary glucose >125–140 mg/dL as operationally defined in this study), hypotension (systolic blood pressure <90 mmHg and/or diastolic blood pressure <60 mmHg), and hypertension (systolic blood pressure ≥130 mmHg and/or diastolic blood pressure ≥80 mmHg). A control group consisted of individuals within normal physiological ranges for both blood glucose and blood pressure at measurement. Pregnant women were excluded due to gestational variations in glucose and blood pressure, and individuals with major organ dysfunction were excluded to reduce clinical confounding related to chronic disease severity. A total sample of 240 participants was enrolled, comprising 40 participants in each exposure-defined case group and 80 controls, consistent with the planned recruitment strategy and feasibility-based enrolment approach.

Data collection was conducted using a structured questionnaire package consisting of two components. Questionnaire A was a condition-specific tool developed for this study to capture demographics, symptom frequency and severity, lifestyle patterns (dietary habits, sleep patterns, physical activity), perceived emotional and cognitive impact, self-management behaviors, coping mechanisms, and awareness/education regarding blood glucose and blood pressure variations. Questionnaire B was the WHOQOL-BREF instrument developed by the World Health Organization, used to quantify quality of life across four domains: physical health, psychological health, social relationships, and environmental health, along with two global items assessing overall quality of life and satisfaction with health (14). All questionnaires were administered using standardized procedures with uniform instructions, and confidentiality and voluntariness were maintained throughout recruitment and participation. Physiological measurements were performed using a glucometer (Accu-Chek Performa device) for random capillary blood glucose assessment and a sphygmomanometer (Certeza CR-1002) for blood pressure measurement. Blood glucose values were recorded in mg/dL and classified according to the operational cutoffs described above. Blood pressure values were recorded in mmHg and classified based on systolic and diastolic thresholds, with values directionally consistent with the hypotensive or hypertensive classification. The primary outcome was quality of life measured using WHOQOL-BREF domain scores and overall QoL indicators, with secondary outcomes including the presence and distribution of symptom burden and demographic characteristics across physiological groups. Data were entered into SPSS and Microsoft Excel 2010 for statistical analysis. Continuous variables were summarized as mean ± standard deviation, and categorical variables were summarized as frequency and percentage. Group comparisons of physiological parameters and quality-of-life outcomes between each case group and its control comparator were conducted using two-tailed hypothesis tests at a significance level of $p<0.05$, with reporting of mean differences, 95% confidence intervals, and standardized effect sizes (Cohen's d) to enhance clinical interpretability. Data integrity was maintained through standardized collection procedures, anonymized datasets, and consistent coding approaches within statistical software.

Table 1. Demographic and Clinical Characteristics of Participants by Condition (n=240)

Variables	Normoglycemia (n=40)	Hypoglycemia (n=40)	Normoglycemia (n=40)	Hyperglycemia (n=40)	Normotension (n=40)	Hypotension (n=40)	Normotension (n=40)	Hypertension (n=40)
Gender								
Male	20 (50.0)	16 (40.0)	20 (50.0)	16 (40.0)	20 (50.0)	10 (25.0)	20 (50.0)	25 (62.5)
Female	20 (50.0)	24 (60.0)	20 (50.0)	24 (60.0)	20 (50.0)	30 (75.0)	20 (50.0)	15 (37.5)
Age (years)								
17–20	9 (22.5)	19 (47.5)	9 (22.5)	12 (30.0)	10 (25.0)	22 (55.0)	10 (25.0)	7 (17.5)
20–25	16 (40.0)	11 (27.5)	16 (40.0)	12 (30.0)	14 (35.0)	15 (37.5)	14 (35.0)	14 (35.0)
25–30	15 (37.5)	10 (25.0)	15 (37.5)	16 (40.0)	16 (40.0)	3 (7.5)	16 (40.0)	19 (47.5)
Educational status								
Uneducated	4 (10.0)	8 (20.0)	4 (10.0)	10 (25.0)	3 (7.5)	6 (15.0)	3 (7.5)	6 (15.0)
Matriculation	6 (15.0)	10 (25.0)	6 (15.0)	18 (45.0)	16 (40.0)	13 (32.5)	16 (40.0)	19 (47.5)
Higher education	29 (72.5)	20 (50.0)	29 (72.5)	10 (25.0)	19 (47.5)	21 (52.5)	19 (47.5)	14 (35.0)
Postgraduate	1 (2.5)	2 (5.0)	1 (2.5)	2 (5.0)	2 (5.0)	0 (0.0)	2 (5.0)	1 (2.5)
Family history								
Yes	4 (10.0)	16 (40.0)	4 (10.0)	28 (70.0)	18 (45.0)	23 (57.5)	18 (45.0)	38 (95.0)
No	36 (90.0)	24 (60.0)	36 (90.0)	12 (30.0)	22 (55.0)	17 (42.5)	22 (55.0)	2 (5.0)

Table 2. Comparison of Random Capillary Blood Glucose Between Normoglycemia and Dysglycemia Groups (n=40 each)

Variable (Operational threshold)	Normoglycemia (n=40)	Dysglycemia Group (n=40)	Min–Max (Normoglycemia)	Min–Max (Dysglycemia)	p-value
Hypoglycemia (<70 mg/dL)	113.25±8.40	60.45±6.34	99–132	40–70	p < 0.001
Hyperglycemia (≥140 mg/dL)	113.25±8.40	207.45±12.08	99–132	140–510	p < 0.001

Table 3. Comparison of Blood Pressure Between Normotension and Blood Pressure Variation Groups (n=40 each)

Variable (Operational threshold)	Normotension (n=40)	BP Variation Group (n=40)	Min–Max (Normotension)	Min–Max (BP Variation)	p-value
	Mean±SD				
Hypotension SBP (<90 mmHg)	114.74±4.10	83.12±8.83	105–120	60–100	0.01
Hypotension DBP (<60 mmHg)	77.25±3.46	52.87±7.15	70–85	40–70	0.002
Hypertension SBP (≥130 mmHg)	114.74±4.10	153.75±14.08	105–120	140–185	p < 0.001
Hypertension DBP (≥80 mmHg)	77.25±3.46	103.63±13.44	70–85	90–140	p < 0.001

Table 4. WHOQOL-BREF Domain Scores by Condition Compared with Physiologically Normal Group (n=40 per group)

Group (n=40 each)	Q1 Overall QoL	Q2 Satisfaction with Health	Physical Health	Psychological Health	Social Relationships	Environmental Health	Overall QoL
	Mean±SD						
Hypoglycemia	3.07±0.99	2.57±0.90	36.42±9.42	42.75±16.73	53.25±22.20	37.66±13.04	29.28±8.87
Hyperglycemia	2.80±1.06	2.60±1.03	37.45±12.24	38.35±11.98	42.18±21.78	32.39±10.19	25.91±7.84
Hypotension	2.72±1.01	2.50±1.01	33.36±13.03	37.38±13.32	51.93±19.37	27.43±10.45	25.88±7.33
Hypertension	2.77±0.83	2.37±1.07	31.88±12.98	41.92±14.91	58.30±24.28	32.95±11.96	28.36±8.92
Physiologically Normal (Reference)	4.35±0.66	4.47±0.59	81.78±3.01	80.35±2.95	79.28±3.30	81.10±2.86	55.28±1.25

A total of 240 participants aged 17–30 years were included. Females predominated in hypoglycemia (60%), hyperglycemia (60%), and hypotension (75%), whereas males predominated in hypertension (62.5%), while the control group maintained equal sex distribution (50% male, 50% female) across comparisons (Table 1). Age distribution suggested that hypoglycemia and hypotension clustered more frequently in participants aged 17–20 years, with 47.5% of hypoglycemia and 55% of hypotension participants falling in this category, whereas hyperglycemia and hypertension were comparatively more frequent in the 25–30-year group (40% and 47.5%, respectively). Educational disparities were evident, with a higher proportion of uneducated participants among case groups (collectively 19%) compared with controls (9%), and a lower proportion completing higher education (40% vs 60%), indicating potential socioeconomic and literacy-related gradients in risk and self-management capacity. Family history appeared disproportionately common among cases, particularly hyperglycemia (70%) and hypertension (95%), compared with controls, supporting familial predisposition as a dominant contextual factor for early physiological dysregulation in this cohort.

Marked physiological separation between cases and controls was observed across all exposure categories. In the hypoglycemia comparison, mean random capillary glucose was 60.45±6.34 mg/dL (range: 40–70) versus 113.25±8.40 mg/dL (range: 99–132) in controls, yielding a mean difference of −52.80 mg/dL (95% CI: −56.11 to −49.49) with a very large standardized effect (Cohen's d=−7.10) and a statistically significant difference ($p<0.001$) (Table 2). Conversely, hyperglycemia subjects had a mean glucose of 207.45±12.08 mg/dL (range: 140–510), which exceeded controls by +94.20 mg/dL (95% CI: +89.57 to +98.83), again reflecting an extremely large effect (d=+9.05) and strong statistical significance ($p<0.001$). Similarly, blood pressure comparisons demonstrated substantial and directionally consistent differences between hypotension, hypertension, and controls (Table 3). Hypotensive subjects showed a systolic mean of 83.12±8.83 mmHg versus 114.74±4.10 mmHg in controls (MD −31.62; 95% CI: −34.68 to −28.56; d=−4.59; p=0.01), and a diastolic mean of 52.87±7.15 mmHg versus 77.25±3.46 mmHg (MD −24.38; 95% CI: −26.88 to −21.88; d=−4.34; p=0.002). Hypertensive subjects demonstrated systolic and diastolic means of 153.75±14.08 mmHg and 103.63±13.44 mmHg, exceeding controls by +39.01 mmHg (95% CI: +34.40 to +43.62; d=+3.76; $p<0.001$) and +26.38 mmHg (95% CI: +22.01 to +30.74; d=+2.69; $p<0.001$), respectively.

Quality of life outcomes showed profound reductions across all WHOQOL-BREF dimensions among case groups compared with controls (Table 4). Global QoL perception (Q1) was reduced from 4.35±0.66 in controls to 3.07±0.99 in hypoglycemia (MD −1.28), 2.80±1.06 in hyperglycemia (MD −1.55), 2.72±1.01 in hypotension (MD −1.63), and 2.77±0.83 in hypertension (MD −1.58), all reflecting large standardized deficits (d ranging approximately −1.5 to −2.2). Satisfaction with health (Q2) showed the deepest decline in hypertension (2.37±1.07 vs 4.47±0.59; MD −2.10; d=−2.36), closely followed by hypotension (MD −1.97; d=−2.28) and hypoglycemia (MD −1.90; d=−2.33). The physical health domain exhibited the most extreme reductions, with control mean 81.78±3.01 contrasted against 36.42±9.42 in hypoglycemia (MD −45.36; d=−6.12), 37.45±12.24 in hyperglycemia (MD −44.33; d=−4.80), 33.36±13.03 in hypotension (MD −48.42; d=−4.96), and 31.88±12.98 in hypertension (MD −49.90; d=−5.11), indicating a substantial impairment in functional capacity and symptom burden. Psychological health scores were similarly reduced, particularly in hyperglycemia (38.35±11.98 vs 80.35±2.95; MD −42.00; d=−4.52) and hypotension (MD −42.97; d=−4.23), suggesting pronounced mood disturbance and mental strain in groups with physiological dysregulation. Social relationship scores were relatively less impaired than physical and psychological domains but remained meaningfully lower than controls (79.28±3.30), with hypertension demonstrating comparatively higher social scores (58.30±24.28; MD −20.98; d=−1.11) than other case groups, while environmental health was lowest in hypotension (27.43±10.45 vs 81.10±2.86; MD −53.67; d=−6.55), reflecting reduced stability, safety, and access-related QoL dimensions. Overall QoL composite scores were reduced from 55.28±1.25 in controls to 29.28±8.87 in hypoglycemia, 25.91±7.84 in hyperglycemia, 25.88±7.33 in hypotension, and 28.36±8.92 in hypertension, representing very large standardized deficits (d approximately −4.1 to −5.6), collectively supporting a strong association between abnormal physiological parameters and impaired quality of life in young adults.

DISCUSSION

The present study demonstrates a consistent and clinically meaningful association between abnormal blood glucose or blood pressure states and impaired quality of life among young adults in Shikarpur, Pakistan. Across all exposure-defined groups (hypoglycemia, hyperglycemia, hypotension, and hypertension), WHOQOL-BREF domain scores were substantially lower than controls, with particularly pronounced deficits in physical health and environmental domains. These findings align with broader evidence that cardiometabolic risk is increasingly shifting toward younger age groups, largely driven by lifestyle transitions, urbanization-linked dietary changes, physical inactivity, psychosocial stress, and limited preventive health literacy in low-resource settings (15). Importantly, the observed quality-of-life burden suggests that early physiological dysregulation may manifest as functional and emotional impairment long before young individuals are formally diagnosed or engaged in structured medical care, reinforcing the need for community-focused screening and lifestyle counseling strategies.

In the glucose groups, females were disproportionately represented in both hypoglycemia and hyperglycemia, consistent with evidence that sex hormones influence insulin sensitivity and glycemic regulation, and that hormonal variability may contribute to differences in metabolic response and symptom vulnerability (16). The clustering of hypoglycemia and hypotension among participants aged <20 years suggests that early adulthood may represent a sensitive window during which dietary irregularity, missed meals, prolonged screen exposure, delayed sleep onset, and circadian rhythm disruption may destabilize metabolic homeostasis and increase symptomatic episodes (17). These behavioral patterns are increasingly reported in youth populations and have been implicated in insulin resistance pathways and impaired glucose regulation, particularly when combined with sedentary lifestyle and nutritional quality decline (17). Moreover, the higher prevalence of family history among hyperglycemia and hypertension participants supports a familial predisposition framework, suggesting that genetic risk may interact with adverse lifestyle behaviors to produce early dysregulation even before overt disease develops (18).

The blood pressure findings further highlight a concerning expansion of both hypotension and hypertension in youth. Female predominance in hypotension and male predominance in hypertension mirror patterns reported in other populations, though the determinants may differ by context. The high frequency of family history in the hypertensive group reinforces inherited cardiovascular risk, while the symptom burden reported (headaches, reduced concentration, impaired productivity) is consistent with the functional disruption described in young hypertensive cohorts (19). Evidence from Pakistan similarly indicates a growing prevalence of hypertension among young adults, with obesity, sedentary behavior, and daily smoking acting as strong correlates in hospital-based and community screening efforts, supporting the plausibility that early-life risk clustering is already clinically significant (19). In contrast, hypotension may be intensified by behavioral triggers including inadequate hydration, prolonged standing, irregular sleep cycles, and missed meals, all of which are common in younger adults, particularly females, and may contribute to repeated episodes of dizziness, fatigue, and reduced attentional capacity (20). Collectively, these patterns suggest that both ends of the blood pressure spectrum may represent under-recognized contributors to diminished well-being in young adults.

A notable contribution of this study is the magnitude of psychological impairment across groups, especially among hyperglycemic and hypertensive participants, indicating that physiological dysregulation is not only a biomedical risk but also a psychosocial burden. Prior research has demonstrated that poor glycemic control is associated with depressive symptoms, anxiety, emotional lability, and reduced quality of life in both diabetic and non-diabetic populations, likely mediated through neuroendocrine stress responses, fatigue, and symptom-driven restriction of daily activities (21,22). Similarly, young adults with elevated blood pressure have been reported to experience increased stress, sleep disturbance, frustration, and impaired perceived health even in early stages, particularly when diagnosis is delayed and management is not initiated (23). The WHOQOL-BREF findings in this study are consistent with evidence from South Asian populations showing that cardiometabolic and vascular abnormalities are strongly linked to reductions in physical and psychological well-being, with downstream effects on daily functioning and perceived life satisfaction (24). The comparatively less impaired social domain, particularly in hypertension, may reflect cultural and family support structures that preserve social engagement despite physical and psychological strain, though this interpretation requires confirmation through qualitative inquiry.

Despite these strengths, the findings should be interpreted within important limitations. The purposive sampling strategy may limit generalizability and introduce selection bias, and group differences in education and family history may confound associations with quality of life. Additionally, single time-point random glucose and blood pressure measurements may misclassify transient states, and the observational nature of the design precludes causal inference. Future work should incorporate probability-based sampling, repeated physiological measurements, standardized diagnostic thresholds consistent with random glucose and blood pressure guidelines, and multivariable regression models to isolate independent predictors of WHOQOL-BREF outcomes. Nevertheless, the very large observed deficits in physical, psychological, and environmental QoL domains underscore an urgent public health need for early detection, health education, and integrated lifestyle–mental health interventions in youth populations, particularly in settings where routine preventive screening is not yet embedded into primary care.

CONCLUSION

In young adults from Shikarpur, Pakistan, hypoglycemia, hyperglycemia, hypotension, and hypertension were each associated with markedly reduced WHOQOL-BREF scores compared with physiologically normal controls, with the greatest impairments observed in physical health and environmental domains and substantial deficits in psychological well-being, indicating that early-life glucose and blood pressure dysregulation represents a silent yet significant threat to functional capacity, emotional stability, and perceived well-being; these findings support the need for early screening, health literacy interventions, lifestyle modification strategies, and integration of mental health support within youth-focused preventive care pathways to reduce symptom burden and protect long-term cardiometabolic health.

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