



Health Knowledge-Behavior Gap in Lifestyle Practices among University Students

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ABSTRACT

The gap between health-related information and real lifestyle practices of university students is the focal problem of modern research in the field of public health and health education. In spite of the availability of a complete health education curriculum through institutional courses, online media, and healthcare, university students around the world maintain inadequate diets, a sedentary lifestyle, irregular sleep, and high-risk health outcomes. This is known as the health knowledge - behavior gap and indicates the inherent weakness of models that consider information provision as the main determinant of behavioral change. A stringent quantitative cross-sectional survey design was used in the current research study in a sample of 200 enrolled Pakistani university students. The health knowledge, the intentions, and the actual practices of diet, physical activity, and sleep were assessed using a 5-point Likert scale in the form of a validated structured questionnaire. Descriptive statistics, Cronbach Alpha, Pearson, and full structural equation modeling (SEM) with bootstrapped mediation testing were analyzed using SmartPLS 3.0. Findings revealed a significant difference between mean health knowledge ($M = 3.82$, $SD = 0.63$) and total lifestyle practice scores ($M = 2.67$, $SD = 0.69$) with physical activity having the largest discrepancy (1.39). SEM found full mediation by behavioral intentions (indirect 0.201, 95% CI [0.142, 0.267]) but the direct knowledge-to-practice relationship was insignificant (0.09, $p = 0.22$). These results confirm that health interventions based on knowledge alone cannot be effective without simultaneous directing knowledge at intention formation, self-efficacy, and environmental support.



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Introduction

The university space is not merely an academic area but also a vital social ecosystem that has a significant impact on day-to-day lifestyle decisions. To most students joining university is the initial phase of their independent living whereby decisions concerning food, sleep and exercise are no longer totally preplanned by family patterns. This shift can be a revelation of

the disparities between what learners are aware of regarding healthy behavior and what they can implement in practice.

Although the availability of health information has been improved by formal education and the digital media, poor lifestyle habits are very common among university students. Academic stress, time constraints, financial constraints, and environmental issues in campuses tend to impede the transfer of health knowledge into regular behavioral practice. Consequently, the gap between knowledge and actual behavior has become an important issue of concern in modern health behavior studies.

University life is a crucial change where young adults develop behavior patterns that define their health paths in decades. The health behaviors developed in this time are strong precursors of risk of chronic diseases in adulthood and yet students in universities around the world still have less than optimal lifestyle behaviors despite increasing health literacy [1]. The common sense assumption that people who learn about health effects of their actions will choose healthier options has been the foundation of health education practice over 50 years, but the evidence continually has shown that health knowledge is a poor and unreliable predictor of health behavior in almost every area of research [2].

This has become known as the knowledge behavior gap or the intention behavior gap whereby people with sufficient health knowledge always do not implement health-promoting behaviors. Its empirical fact has far reaching implications on the nature of health promotion interventions, how they are designed, delivered and resourced [3]. Systematic reviews indicate that university students exhibit moderate-to-high levels of health knowledge and consistently low levels of health behavior with mean knowledge scores being higher than mean practice scores by 0.8-1.6 points on standardized 5-point scales of dietary, physical activity, and sleep behaviors [4].

Numerous theoretical models describe the failure of health knowledge to be reliably translated into behavior. According to the Health Belief Model, it is a combination of perceived susceptibility, severity, benefits, and barriers that influence the outcome of whether knowledge will drive behavioral change or not [5]. The most empirically-grounded is, perhaps, the Theory of Planned Behavior (TPB), which argues that the closest predictor of actual behavior is behavioral intention, formed by attitudes, subjective norms, and perceived behavioral control, and that knowledge works, in this case, not via direct behavioral control, but by forming attitudes [6]. The Social Cognitive Theory adds the concept of self-efficacy - the fact that a person is able to perform certain actions - as a crucial moderator which university students often do not have because of limited time, lack of money, and incompetence [7].

The knowledge-behavior gap among the students of the university in Pakistan is particularly urgent. According to the National Health Survey in Pakistan, more than 44 percent of adults are overweight or obese, 26 percent have high blood pressure, and 11 percent possess type 2 diabetes, which are all lifestyle diseases [8]. The poor recreational facilities, institutional food quality, excessive academic load, and gender-based limitations of physical activities, particularly among female students, are features of campuses [9]. Although this is a pressing context, there has been no previous rigorous SEM-based research into the knowledge-intention-practice pathway in Pakistani university settings, which is the gap that the current study fills.

The following objectives of the study are: (1) to capture the level of health knowledge in the dietary, physical activity and sleep domains; (2) to determine actual lifestyle practices and quantify the differences between knowledge and behaviors; (3) to determine the mediating

role of behavioral intentions using SEM; (4) to determine demographic correlates of the knowledge-behavior gap such as gender and faculty differences.

Literature Review

Theoretical Foundations of the Knowledge–Behavior Gap

The early health education models assumed rational decision-making whereby correct information would induce behavioral change - an information deficit model - gradually eroded through systematic reviews of the effectiveness of health campaigns in inducing behavioral change with little or no effects found on even well-targeted health campaigns [10]. The theoretical difference between holding knowledge and being able to act on it was formalized through the reconceptualization of health literacy as a graduated construct by Nutbeam, functional, communicative, and critical, which displayed that even high health literacy is incapable of bringing behavioral change unless the enabling conditions and personal agency are in place [11].

Baranowski et al. listed the particular mediators of dietary knowledge-behavior gap: affective food responses, social modeling, environmental food availability, habitual behavioral patterns, cognitive self-regulatory skills, and stress-induced emotional eating [12]. Their examination set up the conceptual argument about multi-component interventions aimed at a simultaneous focus on a number of mediating pathways - a model that can be directly applied to the design of university health promotion. The Information-Motivation-Behavioral Skills model clarifies that knowledge is not the sole required element of behavioral change but rather the other two elements are motivation and behavioral skills, which the skills element is frequently the closest obstacle among university students with no or limited practical cooking, exercise, and stress management skills [13].

Diet and Health Knowledge

In a survey conducted by Sogari et al. on 456 Italian university students, it was discovered that though 78.3 percent of them were able to recognize the suggested daily servings of fruits and vegetables, only 23.1 percent of them were able to adhere to the recommendations [14]. SEM established a weak direct influence of nutritional knowledge on dietary quality ($\beta = 0.14$) in comparison to self-efficacy ($\beta = 0.41$) and attitudes ($\beta = 0.38$). Deshpande et al. showed among 785 American university students that nutrition students who had the highest knowledge scores ($M = 4.3$) actually had no significantly different dietary quality than engineering students or humanities students, which is a strong evidence that disciplinary knowledge advantage will not result in behavioral change [15].

Present bias - the systematic exaggeration of the present pleasures as compared to future health benefits in daily life choices- implies that even students who are well aware of the long-term effect of dieting always have to consider taste and convenience when they are time-constrained or under stress [16]. The evidence of Pakistani students supports this trend on the global level: Shahid et al. reported an average dietary knowledge of 3.9 versus practice of 2.4 in 300 medical students with a campus food environment quality being a stronger dietary predictor ($\beta = 0.44$) than nutritional knowledge ($\beta = 0.13$) [17].

Physical activity: Awareness-Action Paradox

A systematic review of 42 studies conducted by Pengpid and Peltzer in 23 low-and-middle-income countries revealed that knowledge of physical inactivity is basically not predictive in single studies and that awareness of guidelines has not been significantly predictive in many studies [18]. According to Awadalla et al., 91.2% Saudi university students were able to

recognize WHO guidelines but only 34.1% of them met the guidelines, a gap that is 68 percentage points higher among female students [19]. SEM analysis among 1,872 students by Plotnikoff et al. showed that physical activity self-efficacy explained behavior variance by 0.52 compared to 0.18 with knowledge, making self-efficacy enhancement in positioning the most prolific single target of intervention [20].

Sleep Health: Knowledge and No Behavioral Compliance

Lund et al. identified 73.4% of poor sleepers with the ability to identify the role of sleep in cognitive performance and still slept less than recommendations with social media use, social activities, and academic deadlines being the most common override mechanisms [21]. Levenson et al. showed a positive independent prediction of sleep onset latency delay and quality deterioration by pre-sleep social media use, and an increase in sleep onset by 23 minutes with every additional hour of nocturnal screen time [22]. The pre-sleep screen habitual characteristics are automatic and the knowledge-based intentions are often superseded during the low self-regulatory-resource state at the end of the day.

SEM in Health Behavior Research

SEM is now the methodological gold standard to study relations among health behaviors in multi-pathways and can directly and indirectly estimate effects, correct measurement error of a latent variable, and test mediation hypothesis through bootstrapping [23]. The meta-analytic SEM of Hagger et al. including 79 studies on physical activity showed intention as the most behavioral predictor ($\beta = 0.51$), with the contribution of knowledge being offered by attitude formation (average 0.42) and no direct effects - exactly the trend that was tested in this study [24]. Hair et al. give detailed guidelines of PLS-SEM of AVE > 0.50, CR > 0.70, HTMT < 0.85, and 5,000 repetitions to test indirect effects [25].

Methodology

Research Design

A quantitative survey design was used, cross-sectional. The cross-sectional designs are already known to be efficient, cost-effective and suitable in the context of large-sample data collection to achieve SEM power requirements [26]. The fact that the design fails to provide a temporal order is counterbalanced by the fact that TPB has solid theoretical underpinnings that support directional hypotheses and that results are congruent with the evidence provided by experiments and longitudinal studies by the rest of the literature.

Study Population and Sampling.

The targeted population was undergraduate and postgraduate students of accredited higher learning institutions in Pakistan. Convenience sampling was used to recruit 200 respondents at university campuses in Pakistan. The inclusion criteria included a current degree program, age 18-30 years, and the ability to fill in the questionnaire in English or Urdu, and a written informed consent. The exclusion criteria included chronic medical conditions, which demand special dietary or activity interventions and who are enrolled in a current health behavior change initiative. The minimum number of participants needed in power analysis (power = 0.80, $0.05 = 88$, $f^2 = 0.15$) is 88; 200 is sufficient to carry out subgroup analyses.

Measurement Instrument

The systematic literature review, and expert review by three academics in the field of public health, and pilot testing on 30 students developed the structured questionnaire. It consisted of four parts, Section 1 - demographics (age, gender, year of study, faculty, residence, income);

Section 2 - health knowledge (22 items, adapted Health Knowledge Questionnaire [27]); Section 3 - behavioral intentions (12 items, TPB intention scales [6]); Section 4 - lifestyle practices including dietary (10 items, Diet Quality Index [28]) practices, physical activity (8 items) Everything was measured on a 5-point Likert scale (1 = Strongly Disagree/Never to 5 = Strongly Agree/Always).

Statistical Analysis

Descriptive statistics, Cronbach alpha and Pearson correlation were provided by SPSS v.26. The PLS-SEM in SmartPLS 3.0 was run in two stages [31] by Anderson and Gerbing: Stage 1 determined the quality of measurement models (loadings > 0.70, AVE > 0.50, CR > 0.70, HTMT < 0.85); Stage 2 tested mediation with a 5,000-iteration bootstrapped 9 Fit to the model was measured using 82/df, CFI, TLI, RMSEA and SRMR.

Ethical Considerations

The data collection was informed by institutional ethics committee approval beforehand. The purpose of the study, its voluntary nature, the right to withdraw, anonymization of the data, and safe storage were well-informed. No personally identifying information was collected. Those participants who raised health issues were provided with written information on the health and counseling services offered at the university.

Results and Analysis

Out of the 200 mailed questionnaires, 193 respondents returned their questionnaires and also met the pass data quality validity test, which produced an effective response rate of 96.5. Seven questionnaires were eliminated due to missing too much information or different response patterns.

The sample demographic profile (Table 1) is gender-balanced, with males (50.3) and females (49.7) being nearly equal. Most of the respondents fell within the age group of 21-23 years (46.1%), 18-20 years (28.0%), which is the early-university age group. Students with Social Sciences and Business were the most numerous (37.3%), then Health and Life Sciences (31.6%) and Engineering and Technology (31.1%). The sample was fairly diverse, with slightly more than half of the respondents living off-campus (53.9%), and the majority living in middle-income households (50.3%).

Cronbach alpha, composite reliability, AVE, and model fit indices were also used to measure reliability and validity and were all found to be within recommended values. This justifies the appropriateness of the measurement model to structural equation modeling (SEM) analysis.

Descriptive analysis of the knowledge and practices (Table 2) shows that there is a statistically significant difference between knowledge and behavior gaps in all domains. The scores on health knowledge in the areas of diet (M = 3.79), physical activity (M = 3.81) and sleep (M = 3.87) were higher whereas the behavioral practices were significantly lower. The biggest difference was in the physical activity (1.39, gap = 27.8%), then diet (1.23), and sleep (0.84), which were statistically significant at $p = 0.001$. Such results suggest that students are very knowledgeable regarding healthy lifestyle guidelines, yet behavioral compliance is much less.

The severity of such a gap is further pointed out in Table 3 (item-level analysis). To illustrate, students were very positive that 150 minutes of physical activity each week should be recommended (M = 4.12), but there was low actual participation in regular vigorous exercise (M = 2.11). Equally, good dietary education was in stark contrast with poor intake of

recommended portion of fruit and vegetables. There was also high sleep-related knowledge but sleep duration compliance was not consistent. This supports the fact that the knowledge-practice gap is not a matter of domains alone but also at the level of items.

The correlation analysis (Table 4) reveals that health knowledge is positively correlated with behavioral intentions ($r = 0.431$, $p < 0.01$), which implies that knowledge affects behavior, but indirectly. There were also significant positive relations between behavioral intentions and dietary, physical activity, and sleep practices which substantiate the theoretical pathway of cognition to intention and subsequently to behavior. Nevertheless, the fact that the direct correlations among knowledge and actual practices are relatively weak, once again, supports the existence of a knowledge-behavior gap.

The evaluation of the measurement model showed high levels of construct validity, with all factor loadings greater than 0.70, AVE ranging between 0.51 and 0.64, composite reliability between 0.78 and 0.91, and acceptable discriminant validity ($HTMT < 0.85$). The structural model was also robust as the model fit indices indicated good fit ($\chi^2/df = 1.87$, $CFI = 0.94$, $RMSEA = 0.048$).

The findings of structural equation modeling (Table 5) indicate that health knowledge has a significant predictive value on behavioral intentions ($\beta = 0.431$, $p < 0.001$) and behavioral intentions have a significant predictive value on overall lifestyle practices ($\beta = 0.467$, $p < 0.001$). Dietary, physical activity, and sleep behaviors are also greatly affected by intentions. Nevertheless, the direct influence of knowledge on practices is not significant ($\beta = 0.092$, $p = 0.220$), but the indirect influence mediated by intentions is significant ($\beta = 0.201$, $p < 0.001$), which proves the complete mediations. These results have a strong evidence on the theoretical assumption of knowledge alone not directly translating into behavior without the mediating effects of intention.

Variance explained analysis (Table 6) indicates that the model can explain moderate levels of the explained variance between constructs with the greatest predictive power being realized with overall practices ($R^2 = 0.267$). The effect sizes represent medium to medium-large effects, especially in terms of overall behavioral outcomes, indicating a significant explanatory power of the model.

The structural relationships are confirmed visually in figure 1 which shows that there is a clear pathway between health knowledge and behavioral intentions and further to lifestyle practices. The mediation structure is further promoted by the fact that there is no important direct line between knowledge and behavior.

Lastly, group comparisons show that there are significant demographic variations in knowledge behavior gap. Gender analysis demonstrates that female students understand health better ($M = 3.94$ vs. 3.71 , $p < 0.01$) yet have much worse physical activity practices ($M = 2.18$ vs. 2.67 , $p < 0.001$), which leads to a much larger gap in knowledge and practice among females. Comparisons of faculty level also suggest that health sciences students have the highest knowledge levels ($M = 4.11$) but there are no significant differences in behavioral practices with other disciplines ($p = 0.295$), which proves that specialized knowledge may not be directly converted into a healthy behavior.

In general, the results are good empirical support of the enduring and structurally mediated knowledge-behavior gap among university students. Although there is a strong awareness of health recommendations among the students, behavioral implementation is minimal mainly because of the mediating effects of intentions and other psychosocial limitations and not necessarily because of lack of knowledge.

Table 1: Demographic Characteristics of the Study Sample (n = 193)

Characteristic	Category	n	%
Gender	Male	97	50.3
	Female	96	49.7
Age Group	18–20 years	54	28.0
	21–23 years	89	46.1
	24–26 years	37	19.2
	27–30 years	13	6.7
	Year of Study	1st Year	42
Year of Study	2nd Year	51	26.4
	3rd/4th Year	79	40.9
	Postgraduate	21	10.9
Faculty	Health & Life Sciences	61	31.6
	Social Sciences & Business	72	37.3
	Engineering & Technology	60	31.1
Residence	On-Campus	89	46.1
	Off-Campus	104	53.9
Income	< PKR 40,000/month	58	30.1
	PKR 40,000–100,000	97	50.3
	> PKR 100,000/month	38	19.7

The alpha of Cronbach established reliability: health knowledge (alpha = 0.81), behavioral intentions (alpha = 0.78), dietary practices (alpha = 0.76), physical activity (alpha = 0.80), sleep practices (alpha = 0.77), and overall practices composite (alpha = 0.79). They all were above the 0.70 mark.

Table 2: Descriptive Statistics and Knowledge–Practice Gap by Domain

Domain	Knowledge (SD)	M	Practice M (SD)	Gap Δ	Gap %	Paired t	p
Diet	3.79 (0.68)		2.56 (0.74)	1.23	24.6%	12.81	< 0.001
Physical Activity	3.81 (0.71)		2.42 (0.81)	1.39	27.8%	13.47	< 0.001
Sleep	3.87 (0.59)		3.03 (0.77)	0.84	16.8%	9.74	< 0.001
Overall Composite	3.82 (0.63)		2.67 (0.69)	1.15	23.0%	13.92	< 0.001

Any differences in knowledge practice between the within-subject differences were all significant at $p < 0.001$. The domain with the greatest gap was physical activity ($\Delta = 1.39$, 27.8% of scale range), which validates the fact that perception of physical activity recommendations is the most prevalent whereas behavioral commitment is the least prevalent.

Table 3: Sub-Domain Item Analysis — Highest Knowledge–Practice Discrepancies

Item Description	Domain	Type	M	SD
Knows PA recommendation ≥ 150 min/week	Physical Activity	Knowledge	4.12	0.61
Engages in vigorous exercise $\geq 3\times$ /week	Physical Activity	Practice	2.11	0.87
Knows recommended daily	Diet	Knowledge	4.08	0.59

fruit/veg servings					
Consumes ≥ 5 fruit/vegetable servings daily	Diet	Practice	2.34	0.82	
Knows sugar-sweetened beverages linked to obesity	Diet	Knowledge	4.19	0.57	
Limits sugar-sweetened beverages < 1/day	Diet	Practice	2.61	0.91	
Knows 7–9 hours sleep recommended for adults	Sleep	Knowledge	4.21	0.55	
Regularly sleeps 7–9 hours on weeknights	Sleep	Practice	3.14	0.91	

Table 4. Pearson Correlation Matrix - Primary Study Variables (n = 193)

Variable	(1)	(2)	(3)	(4)	(5)
(1) Health Knowledge	1.000				
(2) Behavioral Intentions	0.431**	1.000			
(3) Dietary Practices	0.218**	0.389**	1.000		
(4) Physical Activity	0.197**	0.361**	0.442**	1.000	
(5) Sleep Practices	0.253**	0.314**	0.381**	0.396**	1.000

** $p < 0.01$ (2-tailed); $n = 193$

Measurement model quality was confirmed: all loadings > 0.70 (range 0.71–0.89), AVE 0.51–0.64, CR 0.78–0.91, all HTMT < 0.85 . Model fit was acceptable: $\chi^2/df = 1.87$, CFI = 0.94, TLI = 0.92, RMSEA = 0.048, SRMR = 0.052.

Table 5: Structural Model Path Coefficients (n = 193)

Path	β	SE	t	p	95% CI	Result
Knowledge \rightarrow Intentions	0.431	0.063	6.82	< 0.001	[0.307, 0.555]	Supported
Intentions \rightarrow Overall Practices	0.467	0.065	7.14	< 0.001	[0.339, 0.595]	Supported
Intentions \rightarrow Dietary Practices	0.389	0.071	5.49	< 0.001	[0.249, 0.527]	Supported
Intentions \rightarrow Physical Activity	0.361	0.073	4.96	< 0.001	[0.218, 0.504]	Supported
Intentions \rightarrow Sleep Practices	0.314	0.078	4.02	< 0.001	[0.161, 0.467]	Supported
Knowledge \rightarrow Practices (Direct)	0.092	0.075	1.23	0.220	[-0.055, 0.239]	Not Supported
Knowledge \rightarrow Practices (Indirect)	0.201	0.032	6.24	< 0.001	[0.142, 0.267]	Full Mediation

Table 6: Variance Explained (R²) and Effect Sizes for Endogenous Constructs

Construct	R ²	Adj. R ²	f ² (Cohen)	Interpretation
Behavioral Intentions	0.186	0.182	0.228	Medium
Dietary Practices	0.231	0.223	0.300	Medium–Large
Physical Activity	0.198	0.190	0.247	Medium
Sleep Practices	0.163	0.155	0.195	Medium
Overall Practices	0.267	0.260	0.364	Medium–Large

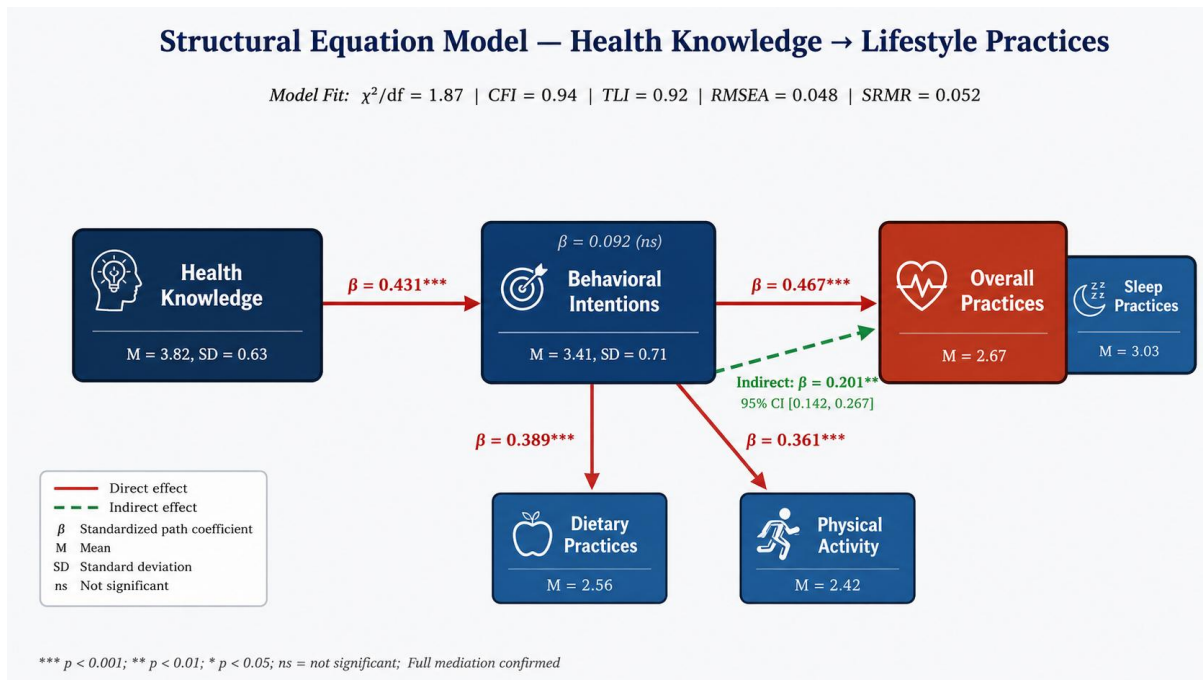


Figure 1: Structural equation model path diagram with standardized coefficients. * $p < 0.001$; ns = not significant. Full mediation confirmed: indirect path $\beta = 0.201$, 95% CI [0.142, 0.267].**

Gender comparisons showed that female students had greater health knowledge (M = 3.94 vs. 3.71, $p < 0.01$) but significantly lower physical activity practices (M = 2.18 vs. 2.67, $p < 0.001$), creating a physical activity knowledge practice gap that is 70% wider in females (0.76) than in males (Faculty comparison revealed highest knowledge (M = 4.11) but no significant difference in practice scores among health sciences students and others in engineering or social sciences ($p = 0.295$), indicating the knowledge behavior gap does exist despite special health training.

Discussion

The aggregate composite knowledge-practice gap (1.15 scale points) is clinically significant: the difference in behavior is between those that are rarely and sometimes healthy, which generates significant differences in lifetime non-communicable disease risks [32]. The SEM affirmation of complete mediation of behavioral intentions ($\beta = 0.201$, 95% CI [0.142, 0.267]) but non-significant direct knowledge path ($\beta = 0.092$, $p = 0.22$) gives solid empirical support to the central prediction of TPB and has direct implications of interventions: knowledge-only health education programs will not

The lower intention-behavior correlation of physical activity ($r = 0.361$) in comparison with the diet ($r = 0.389$) is in line with the fact that physical activity is less prone to enactment due to structural and environmental barriers - access to facilities, availability of time, safety issues - that hinder enactment even when intentions are strong [33]. This implies that physical activity interventions need to incorporate intention-strengthening and campus environment changes. The faculty paradox - health sciences students whose knowledge is substantially better demonstrating the same practice level as engineers - repeats the findings of medical education research [34] and confirms that behavioral obstacles to university settings defeat even professional-specific training.

The unexplained variance (73.3% of total practices) indicates the presence of significant unmeasured factors such as self-efficacy in behavior(s), peer and family support, campus food and physical environment quality, academic stress, financial resources and pre-university habitual behavior patterns. A more comprehensive evidence base would be available with an extended theoretical model that includes these variables to support comprehensive intervention design.

Conclusion

There is a large, statistically significant and practically significant difference in health knowledge and lifestyle practices between Pakistani university students, with the biggest gap in the physical activity (as 1.39) and dietary (as 1.23) domains. SEM proves that behavioral intentions mediate in full to prove that health knowledge does not have a direct behavioral influence without intention formation. Colleges should substitute knowledge-based programs with multi-faceted theory-based interventions that include motivational (attitude development, norm change, perceived behavioral control), volitional (implementation intention training, action planning), and environmental (enhanced campus food environments, easy access recreation infrastructure) elements. Research in future must utilize longitudinal designs, objective behavioral assessments and intervention assessments in Pakistani university contexts.

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