Journal of Asian Scientific Research
ISSN(e): 2223-1331
ISSN(p): 2226-5724
DOI: 10.55493/5003.v15i3.5597
Vol. 15, No. 3, 525-535.

URL: www.aessweb.com

Diet and eating habits in the incidence of post-COVID cardiovascular diseases in Ecuador

Vilma Raffo-Babici[1]
Maria Karina Paltin-Pindo[2]
Dennis Alfredo Peralta-Gamboa[3+]
Juan Tarquino Calderon-Cisneros[4]

[1,4]*Ecotec University, Samborondón, Ecuador.*
[1]*Email: vraffo@ecotec.edu.ec*
[4]*Email: jucalderon@ecotec.edu.ec*
[2]*Independent Researcher, Guayaquil, Ecuador.*
[2]*Email: marykaritop95@gmail.com*
[3]*Health School, Graduate School, Milagro State University, Dr. Romulo Minchala Murillo University Campus, Ecuador.*
[3]*Email: dperaltag2@unemi.edu.ec*


(+ Corresponding author)

Article History
Received: 2 June 2025
Revised: 15 August 2025
Accepted: 25 August 2025
Published: 18 September 2025

Keywords
Cardiovascular health
Cronbach's alpha
Eating habits
Exploratory factor analysis
Internal consistency
Nutrition
Principal component analysis.

ABSTRACT

This cross-sectional study investigates the relationship between dietary practices, eating behaviors, and post-COVID-19 cardiovascular disease (CVD) incidence among 300 Ecuadorian health sciences students who recovered from COVID-19. The study aimed to evaluate the internal consistency of dietary-related dimensions, identify latent factors via exploratory factor analysis (EFA), and examine associations using principal component analysis (PCA). Data were collected through validated questionnaires assessing six dimensions: dietary composition, food consumption patterns, nutritional knowledge, hydration habits, psychological and social factors, and cardiovascular health perception. EFA identified two latent factors: one linked to food consumption and psychosocial variables, and another associated with nutritional knowledge and cardiovascular health perception. Cronbach's alpha values, ranging from 0.791 to 0.940, confirm excellent internal consistency. PCA extracted two principal components, explaining 78.6% of the total variance, with biplot visualizations illustrating strong associations between dimensions and components. These findings highlight the significance of dietary and psychosocial factors in post-COVID-19 cardiovascular risk. The integration of EFA and PCA provided a robust framework for analyzing complex behavioral data, offering insights into the interplay of dietary patterns and health outcomes. This study underscores the need for holistic public health strategies addressing dietary and psychosocial dimensions to mitigate CVD risks in post-COVID populations, with implications for preventive interventions in Ecuador and similar contexts.

Contribution/ Originality: This study uniquely applies an integrated Exploratory Factor Analysis–Principal Component Analysis framework to post-COVID-19 cardiovascular health in Ecuador, revealing latent links between dietary, psychosocial, and perception dimensions. It is the first to combine these multivariate methods for a Latin American cohort, providing a robust, region-specific analytical model.

1. INTRODUCTION

The COVID-19 pandemic has profoundly impacted global public health, extending beyond acute infection to encompass significant long-term consequences for survivors [1]. Among these, cardiovascular diseases (CVD) have emerged as a critical concern, exacerbated by reduced physical activity, altered body composition, and lifestyle changes during the pandemic [2]. In Ecuador, Guayaquil experienced one of the highest infection rates, rendering it a pertinent context for examining post-COVID health outcomes. Additionally, Ecuador's diverse dietary practices

provide a unique opportunity to investigate the role of nutritional behaviors in mitigating or amplifying cardiovascular risks among COVID-19 survivors [3].

This study addresses three research questions: (1) What is the association between dietary practices, eating habits, and post-COVID-19 cardiovascular disease (CVD) incidence among Ecuadorian university students? (2) Can statistical analyses identify latent factors explaining variability in nutritional and health-related dimensions? (3) How do various dimensions shape cardiovascular risk perception among COVID-19 survivors? The paper is organized as follows: Section 2 details the methodology, including research design, participant selection, data collection, and statistical analyses. Section 3 presents the findings, focusing on dimensional internal consistency, factor structure, and principal component analysis. Section 4 discusses the implications for post-COVID cardiovascular health, and Section 5 offers conclusions and recommendations for future research and health policy.

1.1. Literature Review

The COVID-19 pandemic has presented enduring public health challenges, with long-term effects extending beyond the acute phase of infection [4, 5]. Notably, an increased prevalence of CVD among survivors has been observed, attributed to SARS-CoV-2's impact on cardiovascular and respiratory systems [6]. In Ecuador, where CVD was a leading cause of mortality pre-pandemic, confinement measures, economic instability, and restricted healthcare access have intensified existing risks and introduced new ones [7]. Extensive research underscores the pivotal role of dietary habits in CVD prevention and management. Diets high in saturated fats and sugars, and low in fiber, are associated with elevated CVD risk [8], whereas those rich in fruits, vegetables, whole grains, and unsaturated fats correlate with improved cardiovascular outcomes [9]. In Ecuador, studies highlight the prolonged impact of COVID-19 on dietary behaviors and cardiovascular health Ayala-León et al. [10] and Kalil-Filho et al. [11]. Villalva et al. [12] and Rodríguez et al. [13] note significant post-pandemic shifts in dietary patterns, while Zambrano and Arias [14] emphasize the compounded effects of COVID-19 and lifestyle changes on cardiac health.

Socioeconomic disparities, cultural dietary preferences, and limited healthcare access further exacerbate cardiovascular risks in Ecuador [15]. Localized strategies, tailored to the country's unique dietary and cultural context, are advocated by Llerena et al. [16] and González et al. [17]. Additionally, associations between obesity, adverse body composition, and post-COVID cardiovascular complications underscore the need for targeted interventions in high-risk populations [18-22]. Collectively, this literature emphasizes the necessity of a multidimensional approach encompassing dietary patterns, physical health, and social determinants to address cardiovascular risks among COVID-19 survivors in Ecuador.

2. METHODOLOGY

This study adopted a quantitative, descriptive, and multivariate research approach to test theoretical assumptions and provide a statistical representation of the data, expressed through percentages to characterize the research findings [23]. An observational, descriptive, and cross-sectional design was employed, involving a sample of 300 health sciences students from Milagro State University, all of whom had recovered from COVID-19. Data on dietary patterns and eating habits were collected using validated surveys, while the incidence of cardiovascular diseases (CVD) was assessed through targeted questionnaires. To examine significant associations between dietary practices, eating habits, and CVD incidence, statistical techniques including logistic regression and multiple correspondence analysis were applied. These methods enabled precise quantitative evaluation and effective comparisons across student groups [24].

2.1. Research Design

A quantitative, descriptive, and multivariate research design was selected for its capacity to provide detailed descriptions and quantify relationships, facilitating the identification of significant associations between dietary

habits, eating behaviors, and CVD incidence [25]. This design was particularly suited to the study's objectives, as it allowed for a robust evaluation of health sciences students' post-COVID-19 health outcomes, supporting comprehensive statistical analysis and comparative assessment across the sample.

2.2. Participants

Students belonging to the Health Sciences field of study at the Milagro State University were chosen through a sampling process that combined finite and stratified population elements. Inclusion criteria were defined that required officialization in the academic program and belonging to one of the educational levels [26]. People who did not meet the formal enrollment requirements were excluded from the study. In the development of the research, 1,250 enrolled students participated, of which 300 were chosen to participate in the study [27]. In the study conducted by Dexter in 2002, a 95% confidence interval with a margin of error of 2.5% was used.

2.3. Data Collection Instrument

A questionnaire was applied to a random sample of 300 students, with the purpose of establishing a conceptual model for the construct of the test conducted [28]. The model presented the expected congruence between the observed variables and the structure [29].

2.4. Data Collection Procedure

The data collection instrument was adapted from a validated questionnaire developed by Lacomba-Trejo et al. [30], originally designed to assess adolescents' vulnerability to the psychological impacts of the COVID-19 pandemic. This instrument was structured to identify risk and protective factors associated with COVID-19 exposure. For this study, the questionnaire was modified to evaluate the influence of physical activity, body composition, and dietary habits on cardiovascular health, incorporating six key dimensions as informed by Zhou et al. [31]. The questionnaire's development involved expert consultations to define relevant factors, formulate items, and establish a reliability index. Preliminary validation was conducted using structural equation modeling, which confirmed the scale's construct validity [32].

The adapted questionnaire was administered to a random sample of 300 health sciences students at Milagro State University, all of whom had recovered from COVID-19. The data collection aimed to construct a conceptual model of the investigated variables, demonstrating congruence between the examined constructs and their theoretical structure [17].

2.5. Data Analysis

This study employed a multivariate analytical framework, integrating Exploratory Factor Analysis (EFA) and Principal Component Analysis (PCA) to identify latent constructs and reduce data dimensionality. EFA was conducted using the "Minimum Residual" extraction method with oblimin rotation, allowing for correlated factors to uncover underlying structures explaining variable correlations. PCA was subsequently applied to distill the data into principal components that maximized variance retention, facilitating a graphical representation of variable interrelationships.

In contrast to prior research, which often relied on descriptive statistics or regression-based methods to examine diet's impact on cardiovascular health, this study adopts a novel multivariate approach for the Ecuadorian context. By combining EFA and PCA, it provides a nuanced understanding of the interactions among nutritional habits, psychological factors, and cardiovascular health in post-COVID-19 populations. Analyses were performed using Jamovi statistical software, with PCA results visualized through biplots. These biplots simultaneously depict variables (as arrows) and observations (as points), enabling interpretation of associations and clustering patterns in reduced dimensions [33-35].

The visual outputs elucidated the dimensions most influential to the principal components, enhancing interpretability. Statistical tests were selected for their appropriateness in exploring variable relationships and supporting multivariate analysis of grouped data [36]. This integrated EFA-PCA framework represents a methodological advancement in the study of post-COVID nutritional and cardiovascular outcomes in Latin America, contributing to the regional literature with a rigorous analytical approach.

3. RESULTS

Table 1 shows the Cronbach's Alpha coefficients corresponding to each of the dimensions examined in the study, indicating the internal consistency of the elements that constitute each scale.

Table 1. Cronbach's alpha α by dimension.

Dimensions	Cronbach's alpha
Diet composition	0.940
Food consumption patterns	0.904
Nutritional knowledge	0.791
Hydration habits	0.899
Psychological and social factors	0.916
Cardiovascular health perception	0.796

The dimensions "diet composition," "food consumption patterns," and "psychological and social factors" showed exceptional internal consistency, with Cronbach's alpha coefficients exceeding 0.9. This indicates that the items present in these scales exhibit a significant correlation and effectively measure the suggested constructs. The dimensions "hydration habits," "nutritional knowledge," and "cardiovascular health perception" also showed positive internal consistency, with alpha values between 0.7 and 0.9, appropriate for the context of this research.

Although all dimensions show acceptable or excellent reliability, the "Nutritional Knowledge" and "Cardiovascular Health Perception" scales could be subject to further review to improve internal consistency, given that they exhibit the lowest Cronbach's alpha values. This could involve assessing the components to ensure their alignment with the core construct and to avoid mitigation of secondary dimensions.

Table 2. Exploratory factor analysis.

Dimensions	Factor		Uniqueness
	1	2	
Diet composition	0.607		0.5677
Food consumption patterns	0.708		0.3219
Nutritional knowledge		1.005	0.0199
Hydration habits	0.852		0.3462
Psychological and social factors	0.829		0.3510
Cardiovascular health perception		0.846	0.2150

Note: The 'Minimum Residue' extraction method was used in combination with Oblimin rotation.

Table 2 presents the results of the exploratory factor analysis carried out using the "Minimum Residue" methodology through an "Oblimin" rotation, with the aim of identifying the underlying structure of the evaluated dimensions. The extracted factors were based on the loading and uniqueness criteria. The analysis identifies two distinct latent constructs underlying the observed variables. Factor 1 is characterized by substantial loadings on the dimensions of dietary composition, food consumption patterns, hydration habits, and psychological and social factors. This suggests the presence of an underlying construct that encapsulates a constellation of behaviors and influences related to dietary practices and socio-psychological dynamics, reflecting their interconnected role in shaping health outcomes. Factor 2 is defined by significant contributions from the dimensions of nutritional knowledge and cardiovascular health perception, indicating an underlying construct centered on the comprehension and awareness

of health-related information, with a particular focus on perceptions of cardiovascular health. Together, these factors highlight the multifaceted nature of health behaviors and perceptions in the post-COVID-19 context, providing a foundation for further investigation into their implications for cardiovascular risk.

Elucidation of Oneness:

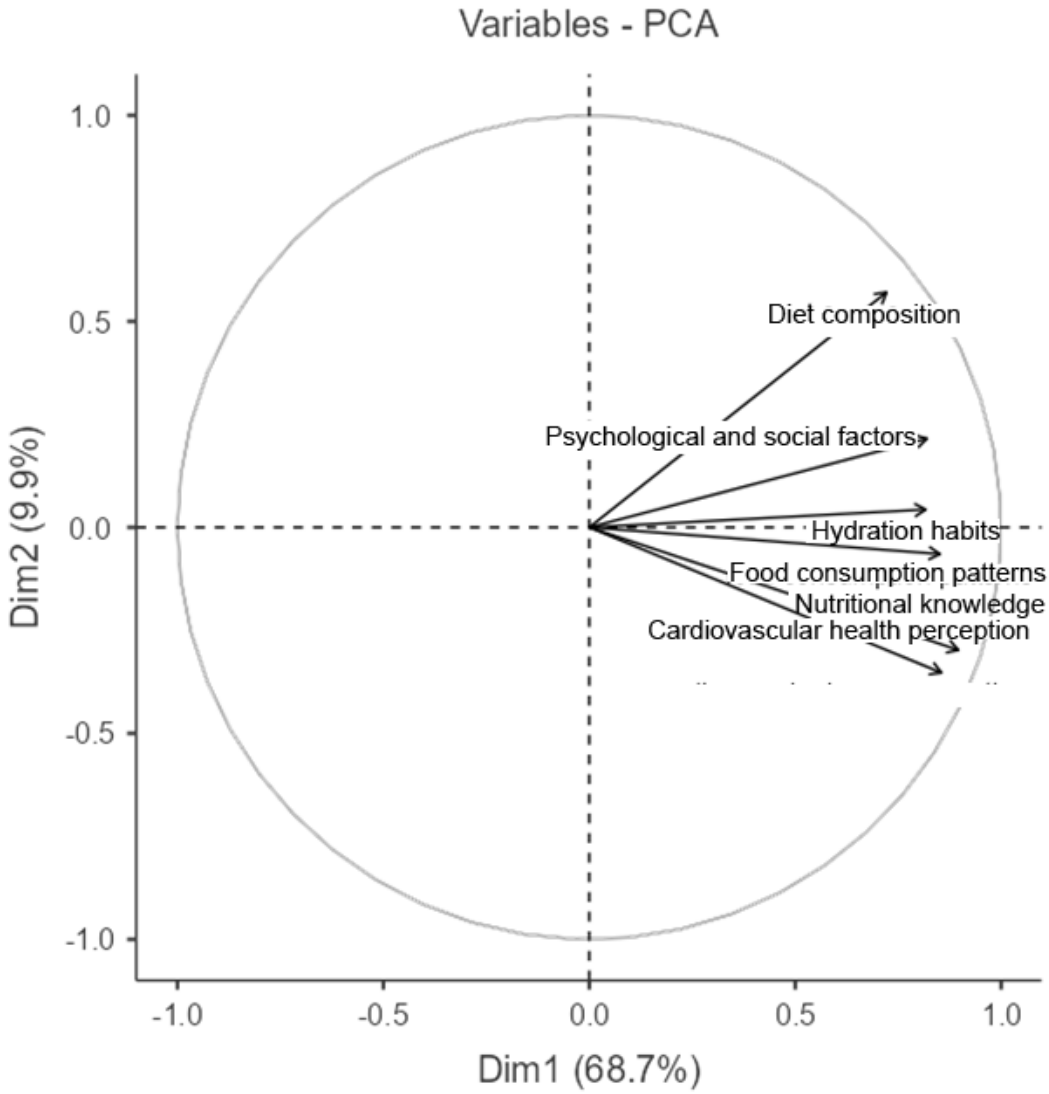

Figure 1. PCA variables.

Principal Component Analysis (PCA) was employed to reduce data dimensionality and identify key components underlying the dataset. The analysis extracted two principal components, collectively accounting for 78.6% of the total variance, as depicted in the biplot (see Figure 1). The first principal component (Dim1) explained 68.7% of the variance, while the second component (Dim2) contributed 9.9%.

The dimensions of "dietary composition" and "psychological and social factors" exhibited strong positive correlations with Dim1, indicating their significant influence on this component and its substantial contribution to the explained variance. Similarly, "hydration habits" and "food consumption patterns" demonstrated positive correlations with Dim1, reinforcing their alignment with this component. In contrast, "nutritional knowledge" and "cardiovascular health perception" showed stronger correlations with Dim2, suggesting that these dimensions are more closely associated with the latent factors captured by this component.

The biplot visualization further elucidated these relationships, with the direction and length of variable arrows indicating the nature and strength of correlations. Notably, a positive correlation was observed between "dietary

composition" and "psychological and social factors," as evidenced by their arrows aligning in the same direction. These findings highlight the distinct roles of dietary, psychological, and health perception dimensions in explaining variance within the dataset, providing a robust framework for understanding their interrelationships in the context of post-COVID-19 health outcomes.

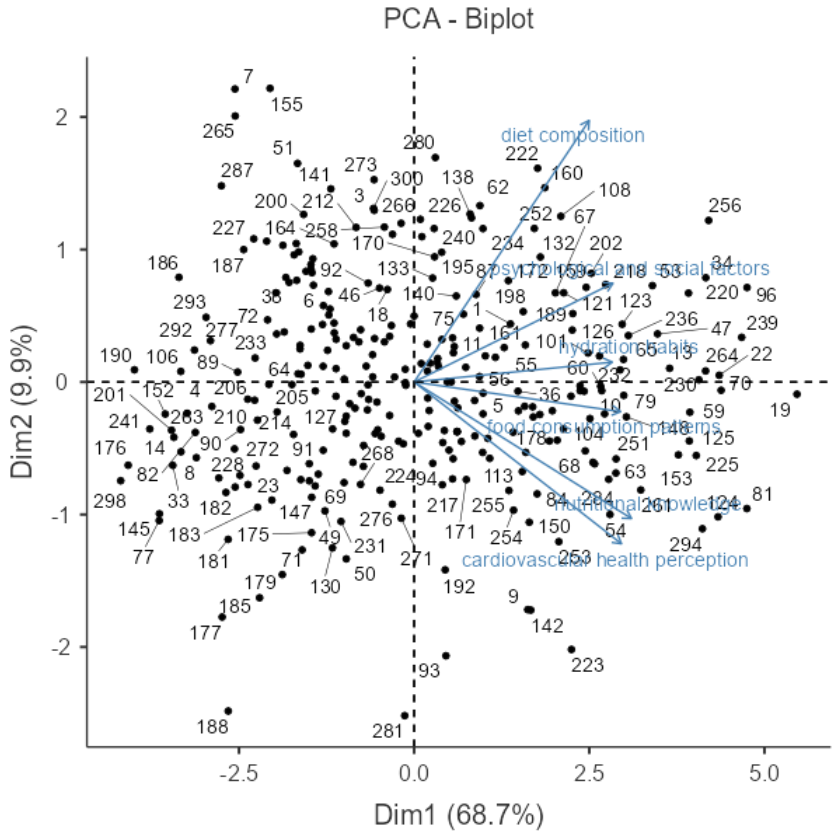

Figure 2. BIPLOT.

The biplot presented in Figure 2 illustrates the projections of observations and original variables onto the plane defined by the two principal components, which collectively account for 78.6% of the total variance in the dataset. The first principal component (Dim1) explains 68.7% of the variance and exhibits strong associations with the variables "dietary composition," "psychological and social factors," and "hydration habits." This suggests the presence of a latent construct related to overarching patterns of nutritional behavior and health practices.

The second principal component (Dim2), contributing 9.9% to the variance, is primarily associated with "nutritional knowledge" and "cardiovascular health perception." This indicates a secondary component that captures variations in individuals' understanding and awareness of health, particularly concerning cardiovascular outcomes. While the majority of variance is attributable to a general factor encompassing dietary and health behaviors, Dim2 highlights distinct differences in health-related knowledge and perceptions among participants.

Principal Component Analysis (PCA) effectively reduced the dimensionality of the dataset, identifying two key components that elucidate underlying data patterns. In the biplot, closely clustered observations reflect similarities in behaviors and perceptions, while the orientation and length of variable arrows indicate their contributions to the principal components. These findings provide a robust foundation for future research, offering valuable insights for advancing nutritional interventions and health promotion strategies in post-COVID-19 populations.

4. DISCUSSION

The COVID-19 pandemic has profoundly reshaped public health landscapes, underscoring the interplay between chronic diseases and complications arising from viral infections [9]. A critical area of concern is the association

between dietary patterns, nutritional habits, and the rising prevalence of cardiovascular diseases (CVD) among post-COVID-19 populations in Ecuador [37]. This issue is particularly significant given the increasing burden of CVD as a leading cause of morbidity and mortality in the country.

Nutrition is a cornerstone in the prevention and management of cardiovascular conditions [38]. Diets high in saturated fats, refined sugars, and low in dietary fiber are strongly associated with heightened risks of hypertension, obesity, and dyslipidemia, all of which predispose individuals to cardiovascular complications [39]. In Ecuador, traditional dietary patterns have shifted, with a notable increase in the consumption of ultra-processed foods rich in fats and sugars, driven by urbanization and pandemic-related changes in dietary behaviors [40].

During the pandemic, significant alterations in dietary habits were observed, influenced by factors such as confinement, psychological stress, economic instability, and reduced access to fresh, nutrient-rich foods [41]. Both global and local studies indicate that many individuals have adopted unhealthy dietary practices, characterized by increased consumption of processed and fast foods, coupled with reduced physical activity, leading to weight gain and metabolic disturbances [42]. These shifts have exacerbated cardiovascular risk factors, heightening the vulnerability of post-COVID-19 individuals to health complications [43].

COVID-19 infection has been linked to cardiovascular complications, since the virus has the ability to induce systemic inflammation and cause direct damage to the cardiovascular system, aggravating pre-existing conditions or generating new complications [9]. In Ecuador, the high prevalence of non-communicable pathologies, such as hypertension and diabetes, increased the susceptibility of individuals to suffer severe complications during COVID-19 infection [39], which consequently left cardiovascular sequelae in patients who have recovered [44]. Consequently, the impact of the pandemic on the cardiovascular system transcends the acute infection, generating long-term effects, particularly in patients with dietary and metabolic risk factors [40].

Post-pandemic, the public health landscape in Ecuador has shown an increase in concerns regarding the management of cardiovascular pathologies [41]. The post-COVID population, particularly those with pre-existing comorbidities, is exposed to an increased probability of suffering from cardiovascular complications due to persistent chronic inflammation [43], vascular deterioration, and general weakness of the immune system. In this context, dietary patterns play a crucial role [45]. Nutritional rehabilitation and the implementation of cardioprotective diets (rich in fruits, vegetables, fiber, and healthy fats) are essential to reduce the prevalence of cardiovascular diseases post-COVID-19, an issue that should be a priority in public health policies.

The management of cardiovascular conditions in the post-COVID era demands a multidisciplinary approach, which not only includes medical intervention [46] but also the promotion of appropriate nutritional strategies. In the Ecuadorian context, the implementation of food education campaigns that promote the adoption of healthier diets is required, restricting the consumption of ultra-processed foods and promoting local foods enriched with nutrients, such as fish, tubers, and fruits of tropical origin [47].

Additionally, early intervention in high-risk groups, in conjunction with the establishment of physical activity and stress management programs [48], will be essential to regulate cardiovascular risk factors, which will contribute to the decrease in the incidence of post-COVID diseases. Health experts, particularly nutritionists and cardiologists, play a crucial role in this process [49], playing a crucial role in adapting therapeutic diets for patients with COVID-19, with the aim of optimizing their health prognosis.

5. CONCLUSIONS

The dimensions of dietary composition, food consumption patterns, and psychological and social factors exhibited Cronbach's alpha values exceeding 0.9, indicating excellent internal consistency and confirming the reliability of the items in measuring their respective constructs. The dimensions of nutritional knowledge and cardiovascular health perception demonstrated moderate reliability, with acceptable but lower Cronbach's alpha values, potentially reflecting greater response variability or the presence of overlapping subdimensions. The application of oblimin

rotation in Exploratory Factor Analysis (EFA) revealed inter-factor correlations, supporting the multidimensional nature of the dietary and behavioral constructs under investigation.

Principal Component Analysis (PCA) identified two principal components, collectively explaining 78.6% of the total variance. The biplot visualization confirmed that dietary composition and psychological and social factors were strongly associated with the first principal component, while nutritional knowledge and cardiovascular health perception aligned more closely with the second component, highlighting distinct contributions to the variance structure.

5.1. Implications

These findings elucidate the complex interplay between nutritional, psychological, and behavioral factors influencing cardiovascular health among post-COVID-19 university students in Ecuador. The high internal consistency of the assessed scales underscores their potential applicability in developing targeted public health interventions. The multivariate approach employed enhances understanding of post-pandemic health challenges, particularly in Latin American contexts where comprehensive analytical models are limited, offering a framework for addressing cardiovascular risks in similar populations.

5.2. Limitations

The study's cross-sectional design precludes causal inferences regarding the relationships between variables. The sample, drawn exclusively from health sciences students at a single Ecuadorian university, may limit the generalizability of findings to broader populations. Additionally, reliance on self-reported data introduces the potential for response bias, which may affect the accuracy of the results.

5.3. Future Research Directions

Future research should adopt longitudinal designs to examine temporal changes in dietary and health behaviors. Expanding the sample to encompass diverse demographic and regional groups within Ecuador would strengthen external validity. Further psychometric refinement of dimensions with moderate reliability, such as nutritional knowledge, could enhance measurement precision. Incorporating biological markers and clinical assessments would provide a more comprehensive evaluation of cardiovascular risk factors in post-COVID-19 populations, enriching the evidence base for targeted interventions.

Funding: This study received no specific financial support.
Institutional Review Board Statement: The Ethical Committee of the International Research Network Galileo, Galileo Foundation, Ecuador has granted approval for this study on 8 November 2024 (Ref. No. red-2024-0012).
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

REFERENCES

[1] D. H. Jiang and R. G. McCoy, "Planning for the post-COVID syndrome: How payers can mitigate long term complications of the pandemic," *Journal of General Internal Medicine*, vol. 35, no. 10, pp. 3036–3039, 2020. https://doi.org/10.1007/s11606-020-06042-3

[2] A. Kapur and M. Hod, "Maternal health and non-communicable disease prevention: An investment case for the post COVID-19 world and need for better health economic data," *International Journal of Gynecology and Obstetrics*, vol. 150, no. 2, pp. 151–158, 2020. https://doi.org/10.1002/ijgo.13198

[3] A. Morocho Macas, N. E. V. Serpa, R. F. V. Aguirre, and C. D. U. Urgiles, "Prevalence of stress among dental students at a private university in Ecuador (Post COVID-19)," *African Journal of Biological Sciences (South Africa)*, vol. 6, no. 5, pp. 1554–1565, 2024.

[4] S. Demarie, C. Galvani, and V. L. Billat, "Horse riding competitions pre and post COVID-19: Effect of anxiety, SRPE and HR on performance in eventing," *International Journal of Environmental Research and Public Health*, vol. 17, no. 22, p. 8648, 2020. https://doi.org/10.3390/ijerph17228648

[5] P. Almazini and A. M. Soesanto, "Global longitudinal strain and myocardial work index in post COVID-19 syndrome with mild symptoms: A case series," *Acta Medica Indonesiana*, vol. 55, no. 3, pp. 327–331, 2023.

[6] L. G. Tereshchenko *et al.*, "Risk of cardiovascular events after COVID-19," *American Journal of Cardiology*, vol. 179, pp. 102–109, 2022. https://doi.org/10.1016/j.amjcard.2022.06.023

[7] M. Orden-Mejia, M. Carvache-Franco, A. Huertas, W. Carvache-Franco, N. Landeta-Bejarano, and O. Carvache-Franco, "Post-COVID-19 tourists' preferences, attitudes and travel expectations: A study in Guayaquil, Ecuador," *International Journal of Environmental Research and Public Health*, vol. 19, no. 8, p. 4822, 2022. https://doi.org/10.3390/ijerph19084822

[8] K. M. Van Der Sluijs *et al.*, "Long term cardiovascular health status and physical functioning of nonhospitalized patients with COVID-19 compared with non COVID-19 controls," *American Journal of Physiology—Heart and Circulatory Physiology*, vol. 324, no. 1, pp. H47–H56, 2023. https://doi.org/10.1152/ajpheart.00335.2022

[9] A. Zhou, Y. Xia, P. Pi, Z. Wang, H. Huang, and Y. Wang, "Relationship between infection, physical and mental health and exercise habits of some Chinese residents after recovery from COVID 19," *Sports Medicine and Health Science*, vol. 6, no. 3, pp. 260–265, 2024. https://doi.org/10.1016/j.smhs.2024.04.005

[10] M. Ayala-León *et al.*, "Consensus document of the Mexican society of cardiology for post-COVID-19 cardiovascular clinical follow-up," *Archives of Cardiology of Mexico*, vol. 93, pp. 115–133, 2023. https://doi.org/10.24875/ACM.21000287

[11] R. Kalil-Filho *et al.*, "Post COVID-19 cardiopulmonary symptoms: Predictors and imaging features in patients after hospital discharge. ," *Arquivos Brasileiros de Cardiologia*, vol. 120, no. 5, p. e20220642, 2023.

[12] M. F. G. Villalva, I. A. C. Piza, E. K. C. Pataron, and C. R. M. Coello, "Administrative management and the competitiveness of microenterprises during and after the Covid-19 emergency," *Universidad y Sociedad*, vol. 12, no. S1, pp. 100-105, 2020.

[13] L. J. R. Rodríguez, O. L. M. Escobar, and M. Z. M. Rosado, "Commercial strategies to improve management in the Ecuadorian micro enterprises post COVID-19," *Universidad y Sociedad*, vol. 12, no. S1, pp. 191–196, 2020.

[14] C. E. Zambrano and M. S. A. Arias, "And prices of hard corn pre and post covid 19 in productivity in Ecuador," *Universidad y Sociedad*, vol. 13, no. 4, pp. 143–150, 2021.

[15] R. M. D. Eric, D. O. M. Del Rosario, and L. S. José Antonio, "Are there opportunities for sustainable tourism in the Province of Manabí Ecuador after COVID-19? The case study of Puerto López," *International Journal of Sustainable Development and Planning*, vol. 16, no. 8, pp. 1415–1423, 2021.

[16] C. M. Llerena, R. González, and L. Martínez, "Developing localized nutrition strategies: Integrating dietary habits and cultural contexts," *Journal of Global Health and Nutrition*, vol. 14, no. 3, pp. 145–160, 2021.

[17] G. L. E. González, S. E. J. Freire, S. E. C. Diaz, and L. S. A. Perez, "Digital transformation and resilience in higher education: Impact on strategic management and human talent in Ecuador," *Health, Science and Technology—Conference Series*, vol. 3, p. 811, 2024. https://doi.org/10.56294/sctconf2024811

[18] T. H. Abi Nassif, K. N. Daou, T. Tannoury, and M. Majdalani, "Cardiac involvement in a child post COVID-19: A case from Lebanon," *BMJ Case Reports CP*, vol. 14, no. 6, p. e242084, 2021. https://doi.org/10.1136/bcr-2021-242084

[19] G. Wallukat *et al.*, "Functional autoantibodies against G protein coupled receptors in patients with persistent long COVID-19 symptoms," *Journal of Translational Autoimmunity*, vol. 4, p. 100100, 2021. https://doi.org/10.1016/j.jtauto.2021.100100

[20] A. Nanditha *et al.*, "Management of hyperglycemia in COVID-19 and post-COVID-19 syndrome-proposed guidelines for India," *The Journal of the Association of Physicians of India*, vol. 69, no. 9, pp. 11-12, 2021.

[21] A. G. Mainous, B. J. Rooks, and F. A. Orlando, "Risk of new hospitalization post COVID-19 infection for non COVID-19 conditions," *Journal of the American Board of Family Medicine*, vol. 34, no. 5, pp. 907–913, 2021. https://doi.org/10.3122/jabfm.2021.05.210170

[22] R. Martínez, L., J. H. Villafañe, S. Cercadillo García, S. A. Argüello, V. M. Rosa, and S. E. A. Romero, "Multicomponent exercise program to improve the immediate sequelae of COVID-19: A prospective study with a brief report of 2-year follow-up," *International Journal of Environmental Research and Public Health*, vol. 19, no. 19, p. 12396, 2022. https://doi.org/10.3390/ijerph191912396

[23] M. A. Masadeh, M. M. M. Qowar, and R. Binsaddig, *The impact of emotional intelligence on the effectiveness of decision making—a field study: The Jordanian microfinance sector* (Artificial Intelligence and Economic Sustainability in the Era of Industrial Revolution 5.0). Cham: Springer Nature Switzerland, 2024.

[24] M. I. Ruiz-Fincias and R. O. Grimaldo-Santamaría, "Multivariate analysis of the feeling of insecurity generated by national and foreign minors," *International Humanities Review*, vol. 20, no. 1, pp. 1-12, 2023.

[25] S. N. A. A. Tajuddin, K. A. Bahari, F. M. Al Majdhoub, N. K. Maliki, and S. B. Baboo, "Developing and measuring an assessment instrument for media literacy among digital natives using Digital Intelligence (DQ) framework," *Journal of Media Literacy Education*, vol. 16, no. 2, pp. 29–45, 2024. https://doi.org/10.23860/JMLE-2024-16-2-3

[26] M. Gallant, K. Mercier, C. Rioux Perreault, S. Lemaire Paquette, and A. Piché, "Prevalence of persistent symptoms at least 1 month after SARS CoV-2 Omicron infection in adults," *Journal of the Association of Medical Microbiology and Infectious Disease Canada*, vol. 8, no. 1, pp. 57–63, 2023. https://doi.org/10.3138/jammi-2022-0026

[27] F. Legler *et al.*, "Long term symptom severity and clinical biomarkers in post COVID-19/chronic fatigue syndrome: Results from a prospective observational cohort " *EClinicalMedicine*, vol. 63, p. 102146, 2023. https://doi.org/10.1016/j.eclinm.2023.102146

[28] B. Zheng *et al.*, "Determinants of recovery from post COVID-19 dyspnoea: Analysis of UK prospective cohorts of hospitalized COVID-19 patients and community based controls," *The Lancet Regional Health—Europe*, vol. 29, p. 100635, 2023. https://doi.org/10.1016/j.lanepe.2023.100635

[29] J. Nol, G. Isouard, and J. Mirecki, "Digital repeat analysis; setup and operation," *Journal of Digital Imaging*, vol. 19, no. 2, pp. 159–166, 2006. https://doi.org/10.1007/s10278-005-8733-1

[30] L. Lacomba-Trejo, S. Valero Moreno, M. F. Coello, I. Montoya Castilla, and M. Pérez Marín, "Mental health, suicide risk and the important role of self esteem in adolescents before and during coexistence with COVID-19 in Ecuador," *Latin American Journal of Psychology*, vol. 55, pp. 130–139, 2023.

[31] J. Zhou, E. Dimmock, E. Cottrill, and H. Ng, "Post–COVID-19 vaccine myopericarditis in a transgender man undergoing gender affirming testosterone therapy," *Annals of Internal Medicine Clinical Cases*, vol. 3, no. 1, pp. 1-3, 2024.

[32] X. Fan and Y. Wang, "Development and validation of a questionnaire scale: Using structural equation modeling for construct validity," *Journal of Measurement and Evaluation*, vol. 18, no. 2, pp. 123–135, 2022.

[33] P. Redweik, A. P. Cláudio, M. B. Carmo, J. M. Naranjo, and J. J. Sanjosé, "Digital preservation of cultural and scientific heritage: Involving university students to raise awareness of its importance," *Virtual Archeology Review*, vol. 8, no. 16, pp. 22–34, 2017. https://doi.org/10.4995/var.2017.4629

[34] B. M. S. Hasan and A. M. Abdulazeez, "A review of principal component analysis algorithm for dimensionality reduction," *Journal of Soft Computing and Data Mining*, vol. 2, no. 1, pp. 20–30, 2021. https://doi.org/10.30880/jscdm.2021.02.01.003

[35] Y. Lim, J. Kwon, and H. S. Oh, "Principal component analysis in the wavelet domain," *Pattern Recognition*, vol. 119, p. 108096, 2021. https://doi.org/10.1016/j.patcog.2021.108096

[36] A. I. Voda, N. Florea, R. Ciulu, C. L. Costuleanu, and C. Gradinaru, "Digital strategy assessment in education: What actions need to be addressed? The perception of students in social sciences and humanities," *Transformations in Business and Economics*, vol. 21, no. 2, pp. 462–478, 2022.

[37] Y. Çulha, F. Büyükyılmaz, and M. G. Çulha, "The effect of long term COVID-19 on aetiological factors related to nocturia," *Journal of Clinical Nursing*, vol. 33, no. 3, pp. 1161–1168., 2024. https://doi.org/10.1111/jocn.17037

[38] H. S. Ahn *et al.*, "Post COVID-19 vaccination myocarditis: A histopathologic study on a monocentric series of six cases," *Diagnostics*, vol. 14, no. 2, p. 219, 2024. https://doi.org/10.3390/diagnostics14020219

[39] K. Müller, M. Ottiger, I. Poppele, A. Wastlhuber, M. Stegbauer, and T. Schlesinger, "Physical health in patients with post-COVID-19 6 and 12 months after an inpatient rehabilitation: An observational study," *Journal of Clinical Medicine*, vol. 13, no. 13, p. 3988, 2024. https://doi.org/10.3390/jcm13133988

[40] P. L. Viale *et al.*, "A retrospective Italian analysis on the characteristics of invasive fungal infections in the intensive care unit setting: CHARTER IFI study," *Mycoses*, vol. 67, no. 8, pp. e13779, 2024. https://doi.org/10.1111/myc.13779

[41] A. Eligulashvili *et al.*, "Long term outcomes of hospitalized patients with SARS CoV 2/COVID-19 with and without neurological involvement: 3 year follow up assessment," *PLoS Medicine*, vol. 21, no. 4, p. e1004263, 2024. https://doi.org/10.1371/journal.pmed.1004263

[42] S. L. R. Jimenez, M. A. G. Perez, E. N. C. Gallegos, L. A. V. Jimenez, N. A. A. Cueva, and M. B. S. Cabrera, "Application of remote monitoring of biosignals and geolocation with a wearable for patients with sequelae of the coronavirus," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 33, no. 1, pp. 135–150, 2024. https://doi.org/10.11591/ijeecs.v33.i1.pp135-150

[43] S. Nikhat and M. Fazil, "Shortening the long-COVID: An exploratory review on the potential of Unani medicines in mitigating post-COVID-19 sequelae," *Phytomedicine Plus*, vol. 4, no. 2, p. 100570, 2024. https://doi.org/10.1016/j.phyplu.2024.100570

[44] N. Seylanova *et al.*, "Core outcome measurement set for research and clinical practice in post-COVID-19 condition (long-COVID) in children and young people: An international Delphi consensus study "PC-COS Children," *European Respiratory Journal*, vol. 63, no. 3, p. 2301761, 2024. https://doi.org/10.1183/13993003.01761-2023

[45] E. C. Oelsner *et al.*, "Epidemiologic features of recovery from SARS-CoV-2 infection," *JAMA Network Open*, vol. 7, no. 6, p. e2417440, 2024. https://doi.org/10.1001/jamanetworkopen.2024.17440

[46] A. Bielecka-Dabrowa *et al.*, "The effect of sex on the risk of long COVID and cardiovascular complications in healthy patients without comorbidities: Data from a polish long COVID cardiovascular (PoLoCOV-CVD) study," *Journal of Clinical Medicine*, vol. 13, no. 6, p. 1559, 2024. https://doi.org/10.3390/jcm13061559

[47] M. Chlabicz, L. Johnson, P. Ramirez, and T. Silva, "Promoting healthier diets through education campaigns: Reducing ultra-processed food consumption and encouraging nutrient-rich local foods," *Journal of Nutritional Health*, vol. 15, no. 1, pp. 50–67, 2024.

[48] S. S. Thankachen *et al.*, "Colchicine to reduce coronavirus disease-19-related inflammation and cardiovascular complications in high risk patients post acute infection with SARS CoV-2—a study protocol for a randomized controlled trial," *Trials*, vol. 25, no. 1, pp. 1-11, 2024. https://doi.org/10.1186/s13063-024-08205-7

[49] D. A. Holdsworth *et al.*, "Cardiopulmonary exercise testing excludes significant disease in patients recovering from COVID-19," *BMJ Mil Health*, vol. 170, no. 4, pp. 308-314, 2024. https://doi.org/10.1136/military-2022-002193