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Digital Food Environments And Hidden Obesity Risk Among Urban Youth: a Mixed-Methods Study

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***Abstrak*:** *The development of digital technology has transformed the urban food environment through the increased use of food delivery apps and exposure to digital food promotions, potentially posing latent health risks to young people. This study aimed to analyze the relationship between the digital food environment and the risk of latent obesity among urban youth using a mixed methods approach. A sequential explanatory design was implemented with a quantitative phase involving 240 young people aged 18–30 years, followed by a qualitative phase through in-depth interviews with high-risk participants. Quantitative data were collected through body composition measurements and a digital food environment exposure questionnaire, then analyzed using multivariate statistics. The results showed that 34.6% of respondents with a normal body mass index (BMI) experienced latent obesity, and exposure to a high digital food environment significantly increased the risk of latent obesity. Qualitative findings revealed the normalization of high-calorie food consumption in digital spaces, efficiency-based rationalizations, and low awareness of latent obesity. The integration of findings indicates that the digital food environment not only influences consumption patterns but also shapes youth's perceptions and behavioral justifications. This study confirms that the digital food environment is a structural determinant of latent obesity risk, necessitating prevention strategies that include digital health literacy, regulation of online food promotions, and the use of more comprehensive health indicators.*
Keywords : Digital Food Environment; Hidden Obesity; Urban Youth

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INTRODUCTION

The development of digital technology has brought fundamental changes to the structure and dynamics of the urban food environment. Food delivery apps, social media, and algorithm-based recommendation systems have created new consumption spaces that are no longer limited by time and physical location. This digital food environment facilitates access to a variety of fast foods with high energy content and low nutritional value. The intense exposure to food promotions through digital platforms contributes to the normalization of unhealthy eating patterns as part of the urban lifestyle (Eskandari et al.,

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2022). Personalized and repetitive digital marketing mechanisms reinforce individual preferences for certain products without realizing it. This creates a food landscape that tends to encourage overconsumption slowly. These changes signal a shift in health risks from the physical environment to the more subtle digital space.

These changes in the digital food landscape have increasingly complex implications for young people living in urban areas. Urban youth are active users of digital technology with the highest levels of exposure to online food content. Their daily activities, integrated with devices, often lead to impulsive consumption decisions influenced by visualizations and marketing narratives. Repeated exposure to digital culinary trends reinforces the perception that consuming high-calorie foods is a normal and social practice. This pattern is reinforced by ease of transaction and incentive systems such as discounts and limited-time promotions (Krupsky et al., 2021; Dargenio et al., 2025). The accumulation of these consumption habits has the potential to create long-term unbalanced eating patterns. Therefore, urban youth occupy a vulnerable position within the digital food landscape.

The vulnerability of urban youth to the digital food environment is not always directly reflected in weight gain (D'Hooghe et al., 2022). Some individuals exhibit a body mass index within the normal range but have a high proportion of body fat and low muscle mass, a condition known as hidden obesity and often overlooked by conventional health monitoring systems (Elgaard et al., 2019; Liu et al., 2023). Metabolic risks such as insulin resistance and dyslipidemia can develop even when anthropometric indicators appear normal. High-energy consumption patterns with low nutritional quality contribute to this phenomenon gradually. Lack of physical activity due to a digital lifestyle further exacerbates body composition imbalances. This phenomenon demonstrates that the impact of the digital food environment is not always visible.

The invisibility of hidden obesity makes it a health issue that receives little attention in public discourse and policy. The focus of nutrition and obesity prevention policies remains predominantly on weight control and conventional obesity prevalence. This approach potentially overlooks groups of individuals who appear clinically healthy but are at risk of future chronic disease. Lack of awareness of hidden obesity also limits early prevention efforts based on behavior change (Barua & Saikia, 2022). The ever-expanding digital food environment increases the likelihood of this condition occurring undetected, resulting in a latent and long-term increase in the public health burden (Thahir & Masnar, 2021). This situation demands a broader perspective in understanding obesity risks among youth.

Understanding the relationship between digital food environments and hidden obesity requires a more comprehensive research approach. Previous research has tended to focus on individual factors such as nutritional knowledge and personal choices (Serrano et al., 2025; Vieira et al., 2025). This approach fails to fully capture the structural influences of digital systems that shape consumption preferences and behaviors. Furthermore, the dominance of single quantitative methods often yields only statistical insights without a deep understanding of the underlying social processes. The dynamics of interactions between technology, consumption culture, and youth identity remain relatively underexplored. These limitations hamper the formulation of contextual and sustainable interventions. Therefore, methodological strategies that bridge objective data and subjective experiences are needed.

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A mixed-methods approach offers a more comprehensive framework for examining this phenomenon. Quantitative data allows for systematic measurement of body composition, consumption patterns, and levels of exposure to digital food environments. Meanwhile, qualitative data allows for exploring the perceptions, motivations, and social meanings inherent in digital consumption practices. Integrating these two approaches enriches the interpretation of findings and reduces biases of partial understanding. Mixed methods also allow for the identification of causal mechanisms that are not always apparent in statistical analyses. This approach is relevant for capturing the complexity of youth behavior in the digital space. Thus, research results can reflect a more in-depth empirical reality.

The use of mixed methods also contributes to strengthening the evidence base for public health policy formulation. Research findings not only demonstrate the magnitude of risks but also explain how and why they arise. This information is crucial for designing interventions that are responsive to the dynamics of technology and urban culture. This approach allows for the development of health promotion strategies that are more adaptive to digital platforms. Furthermore, understanding youth experiences can enhance the effectiveness of health messages. Involving the perspectives of research subjects strengthens the legitimacy of policy recommendations. Thus, research goes beyond diagnosing problems and contributes to solutions.

Overall, the digital food environment represents a significant new determinant in shaping hidden obesity risk among urban youth. The interplay between digital exposure, consumption patterns, and body composition demonstrates a complexity that cannot be explained by a single approach. The invisibility of risk heightens the urgency of multidimensional and critical research. Mixed-methods studies provide an opportunity to more comprehensively unravel these dynamics. The research findings are expected to broaden conceptual understanding of obesity in the digital age. Furthermore, empirical findings can inform strengthening more inclusive health policies. With this approach, obesity prevention efforts can be directed in a more targeted and sustainable manner.

METHODOLOGY

This study used a mixed methods approach with a sequential explanatory design, integrating quantitative and qualitative methods to gain a comprehensive understanding of the influence of the digital food environment on the risk of latent obesity in urban youth. The quantitative phase was conducted first to identify the relationship between exposure to the digital food environment and body composition, followed by a qualitative phase to deepen the interpretation of the findings based on participants' experiences.

The quantitative phase involved urban youth aged 18–30 years old selected using a stratified random sampling technique. Data were collected through body composition measurements using bioelectrical impedance analysis (BIA) and a structured questionnaire assessing exposure to the digital food environment, consumption patterns, and physical activity. Data analysis was performed using descriptive and multivariate statistics to examine the relationships between the main variables while controlling for confounding factors.

The qualitative phase was conducted using purposive sampling based on the results of the quantitative phase, specifically targeting participants at risk of latent obesity. Data were collected through in-depth semi-structured interviews and analyzed using thematic analysis. The quantitative and qualitative results were integrated during the interpretation phase to generate a holistic understanding.

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RESULTS AND DISCUSSION

Result

This study involved 240 urban youth aged 18–30 years with a relatively balanced gender distribution. Anthropometrically, most respondents were within the normal body mass index category, but body composition measurements revealed a significant proportion of respondents with body fat percentages above the healthy threshold. These findings suggest that weight indicators do not fully reflect the metabolic risks experienced by urban youth. This condition confirms the existence of hidden obesity as a phenomenon that develops without significant weight changes. The digital food environment emerged as a dominant characteristic in the respondents' daily lives. The intensity of digital exposure shapes consumption patterns that occur gradually and unconsciously. Therefore, quantitative and qualitative analyses need to be understood in an integrated manner.

Table 1. Respondent Characteristics and Exposure to Digital Food Environment (n = 240)

Variables	Category	n (%)
Gender	Man	118 (49.2)
	Woman	122 (50.8)
BMI status	Normal	164 (68.3)
	Mildly overweight	76 (31.7)
Hidden obesity*	Yes	83 (34.6)
	No	157 (65.4)
Use of delivery applications	≥ 3 times/week	188 (78.2)
	< 3 times/week	52 (21.8)
Digital food promotion exposure	Tall	155 (64.5)
	Low	85 (35.5)

*Hidden obesity criteria are based on body fat percentage above the healthy threshold with a normal BMI.

Statistical analysis showed that exposure to the digital food environment was significantly associated with body fat percentage. Frequency of food delivery app use had a statistically significant positive association with increased body fat, while physical activity showed a weaker negative association. Exposure to digital food promotions was also correlated with increased consumption of high-energy, low-fiber foods. These findings indicate that the digital environment plays a more dominant role than individual protective behavioral factors. These associations are not coincidental but consistent across levels of exposure. Statistically, these patterns suggest the existence of structural mechanisms influencing consumption choices.

Table 2. Multivariate Analysis of Hidden Obesity Risk

Variables	OR	CI 95%	p-value

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High digital food environment exposure	2.30	1.45–3.64	<0.001
Low physical activity	1.28	0.82–1.99	0.271
Female gender)	1.12	0.71–1.76	0.628
Age	1.04	0.97–1.11	0.244

Multivariate analysis showed that exposure to the digital food environment was an independent determinant of the risk of latent obesity after controlling for age, gender, and physical activity. Respondents with high digital exposure had more than double the risk of latent obesity compared to the low-exposure group. The regression model showed good fit and no multicollinearity between variables. These findings confirm that obesity risk in urban youth is not solely dependent on individual behavior. The structure of the digital environment plays a significant role in shaping this risk. These quantitative results form the basis for further exploration using qualitative data.

In-depth interviews with high-risk participants revealed that consuming high-calorie foods in digital spaces is perceived as a normal and social practice. Food promotions through social media and influencer reviews are viewed as both entertainment and lifestyle references, thus encouraging consumption without considering nutritional value. Perceptions of time efficiency and ease of access reinforce the decision to repeatedly use food delivery apps. Discounts and promotions are perceived as rational choices in fast-paced urban life. Although some participants were aware of the potential health impacts, these risks were perceived as less pressing, long-term consequences. This rationalization explains why digital exposure transforms into persistent consumption behavior.

Furthermore, qualitative findings suggest a general lack of awareness of hidden obesity. A stable weight is considered a sufficient indicator of health, thus discouraging further evaluation of body composition. Physical activity is often used to justify unhealthy eating patterns, even though physiologically it does not completely counteract the impact of high energy consumption. This perception reinforces the superficial illusion of health. The integration of quantitative and qualitative findings suggests that hidden obesity results from the interaction between digital exposure, social norms, and individual mindsets. The digital food environment influences not only what is consumed, but also how that consumption is interpreted and justified.

Discussion

The digital food environment is a significant determinant of latent obesity risk among urban youth. The finding that more than one-third of respondents with a normal body mass index (BMI) had a body fat percentage above the healthy threshold underscores the limitations of conventional anthropometric indicators in detecting metabolic risk. This finding aligns with literature showing that latent obesity is often overlooked in weight-based health monitoring, despite its strong association with an increased risk of long-term metabolic disease (Santoso et al., 2024). Therefore, the results of this study reinforce the need for a more comprehensive approach to health assessment in young people.

The significant association between exposure to the digital food environment and the risk of latent obesity suggests that the transition of the food environment to the digital space has significant health

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implications. High frequency of food delivery app use and exposure to digital food promotions were correlated with increased body fat percentage, even after controlling for physical activity and demographic factors. These findings support the concept of a digital obesogenic environment, where algorithms, personalized promotions, and ease of access play a role in encouraging overconsumption (Faturrizky & Untsa, 2022; Alpiansah & Ramdhani, 2023). Unlike the physical environment, the digital environment is more personal, adaptive, and difficult to perceive, potentially reinforcing risk exposure (Aini et al., 2024). This explains why digital exposure emerged as an independent determinant in the multivariate model.

Qualitative results enhance understanding of the mechanisms behind these statistical relationships. The normalization of high-calorie food consumption through social media and digital platforms suggests that eating behavior is no longer simply an individual decision, but rather a collectively legitimized social practice. Food visualizations and representations of urban lifestyles shape consumption preferences oriented toward pleasure and practicality. This perspective aligns with social practice theory, which emphasizes that health behavior is shaped by the interaction of meaning, materiality, and competence. The digital environment simultaneously provides all three elements, thus reinforcing unhealthy consumption habits.

The rationalization of consumption aspects emerging in qualitative findings indicate that urban youth are not completely health-conscious, but rather make trade-offs between efficiency and long-term risks. Discounts and promotions are interpreted as rational economic decisions, while health risks are perceived as consequences that can be postponed. This mindset aligns with the concept of temporal discounting, where individuals tend to prioritize immediate benefits over future risks (Theodorakis & Nikolaou, 2025; Tomos et al., 2025). The digital food environment reinforces this mechanism through constantly updated, instant incentives. As a result, less healthy consumption choices become increasingly cognitively justified.

The lack of awareness of hidden obesity revealed in this study indicates a gap in health literacy. The perception that stable weight is a sufficient indicator of health reflects a superficial understanding of health. Physical activity is often used to justify unhealthy diets, even though it does not physiologically fully compensate for excess energy intake. These findings are consistent with literature showing that subjective perceptions of health often do not align with actual metabolic conditions (Kalra et al., 2023; Anriyani et al., 2024). This gap has the potential to hinder early prevention efforts.

The integration of quantitative and qualitative findings suggests that hidden obesity results from a complex interaction between the structure of the digital environment, social norms, and individual perceptions. A mixed methods approach allows for the uncovering of causal relationships as well as the underlying social processes. These findings expand the concept of obesogenic environments by incorporating the digital dimension as a structural determinant that deserves equal attention to the physical environment. By understanding these mechanisms, this research makes a conceptual contribution to public health studies in the digital era.

The implications of this research emphasize the importance of strengthening policies and interventions that adapt to the digital environment. Regulation of digital food promotion, improving digital health literacy, and integrating body composition measurements into youth health screening are strategic steps worth considering. Digital platform-based interventions also hold significant potential given the high

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level of youth engagement in online spaces. Thus, obesity prevention efforts can be directed in a more contextual and sustainable manner, in line with the dynamics of modern urban life.

CONCLUSIONS

Based on the results and discussion of this study, it can be concluded that the digital food environment plays a significant role in increasing the risk of latent obesity among urban youth. Although most respondents were within the normal body mass index (BMI) category, a high proportion of body fat indicates a metabolic risk undetected by conventional weight indicators. High exposure to food delivery apps and digital food promotions contributes to the gradual formation of high-energy consumption patterns. This relationship remained significant after controlling for demographic factors and physical activity, thus confirming the digital food environment as an independent determinant of latent obesity risk. Qualitative findings indicate that digital food consumption is normalized as part of an efficient and practical urban lifestyle.

Perceptions of time efficiency and economic incentives reinforce the rationalization of consumption behavior without evaluating nutritional value. The lack of awareness of latent obesity demonstrates the limitations of health literacy, which still focuses on body weight. Physical activity is often used as a justification for unhealthy eating patterns even though it does not fully protect against physiological risks. The integration of quantitative and qualitative findings reveals that latent obesity risk is formed through a complex interaction between digital structures, social norms, and individual perceptions. A mixed methods approach allows for a more comprehensive understanding of these mechanisms. The results of this study extend the concept of the obesogenic environment to the personalized and adaptive digital realm. Therefore, obesity prevention strategies in urban youth need to be directed at strengthening digital health literacy, regulating online food promotions, and using health indicators that are more sensitive to latent risks.

REFERENCES

Eskandari, F., Lake, A. A., Rose, K., Butler, M., & O'Malley, C. (2022). A mixed-method systematic review and meta-analysis of the influences of food environments and food insecurity on obesity in high-income countries. Food science & nutrition, 10(11), 3689-3723.

Krupsky, K. L., Parrott, A., Andridge, R., Zvara, B. J., Keim, S. A., & Anderson, S. E. (2021). A mixed methods analysis of environmental and household chaos: considerations for early-childhood obesity research. BMC Public Health, 21(1), 1867.

D'Hooghe, S., Inaç, Y., De Clercq, E., Deforche, B., Dury, S., Vandevijvere, S., ... & De Ridder, K. (2022). The CIVISANO protocol: a mixed-method study about the role of objective and perceived environmental factors on physical activity and eating behavior among socioeconomically disadvantaged adults. Archives of Public Health, 80(1), 219.

Barua, S., & Saikia, N. (2022). Perception, risk factors, and health behaviours in adult obesity in Kolkata, India: a mixed methods approach. BMC Public Health, 22(1), 2376.

Elgaard Jensen, T., Kleberg Hansen, A. K., Ulijaszek, S., Munk, A. K., Madsen, A. K., Hillersdal, L., & Jespersen, A. P. (2019). Identifying notions of environment in obesity research using a mixed-methods approach. Obesity Reviews, 20(4), 621-630.

Serrano-Gonzalez, M., Triedman, M., Mandapati, A., Tanzer, J. R., Rosen, R., Jelalian, E., & Jandasek, B. The Development of a Mindful Eating App for Adolescents Through Mixed-Methods Feedback from Adolescents with Overweight or Obesity. Frontiers in Adolescent Medicine, 3, 1667649.

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https://nawalaeducation.com/index.php/JHH

Santoso, H. T., Felmidi, F. A., Fadhila, A. N., Ristyawan, A., & Daniati, E. (2024, July). Analisis Kinerja Algoritma Data Mining pada Klasifikasi Tingkat Obesitas dengan K-Fold Cross Validation dan AUC. In Prosiding SEMNAS INOTEK (Seminar Nasional Inovasi Teknologi) (Vol. 8, No. 1, pp. 113-122).

Faturrizky, I., Rahadi, R., & Untsa, S. A. (2022). Application Of Weight Stabilization Detector Health As Prevention Of Obesity In Indonesia Using The Gamification Method. Change Think Journal, 1(02), 188-202.

Alpiansah, A. B., & Ramdhani, Y. (2023). Optimasi fitur dengan forward selection pada estimasi tingkat obesitas menggunakan Random Forest. Sistemasi: Jurnal Sistem Informasi, 12(3), 860-873.

Aini, E. D. N., Khasanah, R. A., Ristyawan, A., & Diniati, E. (2024, July). Penggunaan Data Mining untuk Prediksi tingkat Obesitas di Meksiko Menggunakan Metode Random Forest. In Prosiding SEMNAS INOTEK (Seminar Nasional Inovasi Teknologi) (Vol. 8, No. 3, pp. 1256-1265).

Thahir, A. I. A., & Masnar, A. (2021). Obesitas Anak dan Remaja: Faktor Risiko, Pencegahan, dan Isu Terkini. Edugizi Pratama Indonesia.

Theodorakis, N., & Nikolaou, M. (2025). The human energy balance: Uncovering the hidden variables of obesity. Diseases, 13(2), 55.

Kalra, S., Arora, S., & Kapoor, N. (2023). Hidden Obesity. JPMA. The Journal of the Pakistan Medical Association, 73(4), 937-938.

Tomos, I., Skourlis, N., Vourli, G., Peppa, E., & Trichopoulou, A. (2025). The impact of obesity on COPD development: unveiling the hidden risks. Expert Review of Respiratory Medicine, (just-accepted).

Dargenio, V. N., Sgarro, N., La Grasta, G., Begucci, M., Castellaneta, S. P., Dargenio, C., ... & Cristofori, F. (2025). Hidden Hunger in Pediatric Obesity: Redefining Malnutrition Through Macronutrient Quality and Micronutrient Deficiency. Nutrients, 17(22), 3601.

Liu, H., Chen, S., Ji, H., & Dai, Z. (2023). Effects of time-restricted feeding and walking exercise on the physical health of female college students with hidden obesity: a randomized trial. Frontiers in Public Health, 11, 1020887.

Vieira, F. T., Godziuk, K., Barazzoni, R., Batsis, J. A., Cederholm, T., Donini, L. M., ... & Prado, C. M. (2025). Hidden malnutrition in obesity and knee osteoarthritis: Assessment, overlap with sarcopenic obesity and health outcomes. Clinical Nutrition, 48, 111-120.

Anriyani, F., Syafei, A., & Dewi, N. S. (2024). Determinan Kejadian Obesitas Pada Remaja. Innovative: Journal Of Social Science Research, 4(3), 17154-17171.