Social media consumption and obesity risk: the relationship between physical activity and adolescents' digital habits.

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ABSTRACT

The development of digital media has increased adolescents' consumptive patterns through exposure to fast food advertisements and sedentary habits. Preliminary studies showed a correlation between the duration of screen time and an increase in body mass index (BMI) in vocational school adolescents. The aim is to analyze the relationship between social media consumptive activity, physical activity, and adolescent obesity risk through an integrated approach. The study used a mixed methods sequential explanatory design with a quantitative design (cross-sectional survey on 150 adolescents aged 18 years followed by exploration with interviews and FGD). Sampling was carried out by stratified random sampling based on vocational education level and gender. Data was collected through the Social Media Intensity Scale questionnaire, BMI measurement, and the International Physical Activity Questionnaire (IPAQ), while qualitative data focused on patterns of interaction with digital content and lifestyle perceptions. Quantitative analysis showed a significant association between social media use of more than 4 hours/day and an increased risk of obesity, mediated by decreased physical activity (β=-0.32, $p<0.01$) and increased snacking frequency (β=0.27, $p<0.05$). The findings state that teens are exposed to 5 to 8 food ads per hour when using social media, with 68% of respondents admitting to being impulsive in buying food after seeing promotional content. Social media consumption plays a role as a predictor of adolescent obesity through dualism, sedentary behavior mechanisms, and unhealthy diets. Policy recommendations include the integration of digital literacy modules in school health curricula and the regulation of fast food advertising on social media for adolescents.

I. INTRODUCTION

Excessive social media use in adolescents acts as a catalyst for obesity risk through two main mechanisms(Choi et al., 2021). First, intensive digital habits lead to a significant decrease in physical activity due to time spent scrolling content (an average of 4-6 hours/day), replacing sports or outdoor activities. Studies show 56.78% of teens with social media addiction have low levels of physical activity, which correlates with an increase in body mass index (BMI). Second, exposure to fast food ads on digital platforms and social media (5-8 ads/hour) triggers impulsive, excessive calorie consumption, where 68% of teens admit to buying food after seeing promotional content. This pattern is exacerbated by the habit of mindless eating when using gadgets, where adolescents consume 300-500 extra calories/day from unhealthy snacks. The impact of digital consumption is also seen in disturbances in sleep patterns and body perception. Adolescents who are exposed to unrealistic beauty standards on social media experience body dissatisfaction, encouraging extreme diet behavior or emotional eating(Radovic et al., 2022). Simultaneously, exposure to blue light from gadget screens interferes with melatonin secretion, reducing sleep duration (on average, 5-6 hours/night), which has an impact on increasing the hormone ghrelin (a hunger regulator) by 15-20%. This combination of factors creates a vicious cycle: sedentary → high calorie consumption → obesity → social isolation → intensification of social media use(Alexander et al., 2024). Data showed that adolescents with more than 4 hours/day of social media use had a 2.1 times higher risk of obesity than the group with limited use.

The development of the digital era has changed the interaction patterns of adolescents, where 89.3% of vocational school adolescents spend >4 hours/day accessing social media (APJII, 2024). Preliminary studies showed a significant correlation between the duration of screen time and an increase in Body Mass Index (BMI), where adolescents who were active users of social media had a 2.1 times higher risk of obesity. However, contradictory findings from the research of Adiba et al. (2020) stated that there was no significant relationship between the frequency of social media use and nutritional status, raising questions about the complexity of mediator mechanisms such as diet and physical activity, exposure to health content on social media such as sports campaigns or healthy diets was actually reported by 22% of adolescents as a motivational factor. However, this positive impact is not integrated into public health policy(Santoro et al., 2024).

This shows the dualism of the role of social media that has not been fully mapped as a catalyst for obesity, as well as a potential means of nutrition education. Previous research (Husna, 2020) only focused on the linear correlation of social media-BMI without exploring mediating variables such as sleep disturbances or fluctuations in hunger hormones(Ehsan et al., 2024). Unknown information includes specific cognitive mechanisms that make vocational school adolescents more vulnerable to fast food advertisements than rural adolescents, even though internet penetration rates are relatively similar. Preliminary data showed 68% of teens admitted to impulsively buying food after seeing promotional content, but no studies analyzed differences in responses based on

social media types such as TikTok and Instagram, or content formats (short videos and static images).

In fact, the source of previous research is the integration of objective data, such as the use of accelerometers to measure physical activity and screen recorders to map digital content consumption patterns. Dominant cross-sectional research relies on subjective questionnaires, thus being less able to capture real-time dynamics between exposure to food advertisements and physiological responses (e.g., increased saliva or heart rate). The novelty of this study lies in a mixed-methods approach that combines Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis to measure the mediating effects of physical activity and diet, coupled with a controlled experiment to test psychophysiological responses to food advertisements on social media. The developed Dual Pathway Digital Obesity Framework model combines the perspectives of neuroscience (the effect of dopamine on impulse buying) and nutritional epidemiology(Santoro et al., 2024). The research stems from preliminary findings that adolescents with sleep disorders due to nighttime social media use experienced a 15-20% increase in the hormone ghrelin, potentially explaining the biological mechanism between digital habits and obesity(Landry et al., 2022). These findings are reinforced by qualitative data that states that 72% of teens consume high-calorie snacks while scrolling social media after 9:00 p.m.

The purpose of the study was to analyze the multidimensional interaction between social media consumption, physical activity, and digital habits in predicting the risk of obesity in vocational adolescents, taking into account the mediating variables (diet, sleep quality) and moderators (gender, socioeconomic status). The research gap can be seen from the inconsistency of previous research results. The study by Setiawati (2019) reported a strong correlation between social media and decreased physical activity (β=-0.32), while the research of Kurnia et al. (2022) found no significant association (p=0.928). This difference in methodology shows the need for standardization of digital habit measurement instruments. This study addresses these weaknesses by adapting the internationally validated Bergen Social Media Addiction Scale, while expanding the scope of the variables tested compared to a similar study by Azzahra & Puspita (2022) that only focused on nutritional aspects(Nuñez Fadda et al., 2024).

II. METHODOLOGY

This study uses a mixed methods approach with a sequential explanatory design, which integrates quantitative and qualitative methods gradually to gain a comprehensive understanding of the relationship between social media consumptive activity, physical activity, and obesity risk in adolescents. This approach was chosen because of the complexity of the phenomenon being studied, where quantitative data provides an overview of the relationships between variables, while qualitative data provides an in-depth understanding of the underlying mechanisms. The target population of the study was vocational school adolescents in urban areas with high internet penetration (≥85%) based on APJII 2024 data, where 89.3% of adolescents spent more than 4 hours per day

accessing social media. The quantitative sample consisted of 150 students selected through stratified random sampling with stratification by gender and grade level to ensure representativeness. Meanwhile, the qualitative sample involved 30 participants who met specific criteria on social media use ≥4 hours per day (measured through a screen time tracker), Body Mass Index ≥25 kg/m², and a history of online food purchases at least 3 times per week.

Research instruments for quantitative data collection included the Bergen Social Media Addiction Scale (BSMAS) using interview-guided research on digital content consumption patterns, eye-tracking experiments to map visual focus on food advertisements, and psychophysiological recording (heart rate, skin galvanic response) when participants were exposed to food content on social media. The research procedure began with the collection of primary data through a structured survey for 2 weeks, statistical analysis using Partial Least Squares Structural Equation Modeling (PLS-SEM) to test the relationships between latent variables, and the identification of outliers and response patterns to determine the participants of the qualitative phase.

The design of this study allows for an in-depth exploration of neurobehavioral mechanisms (e.g., an increase in dopamine when scrolling food content) that are not detected through conventional quantitative approaches. Internal validity was maintained through peer debriefing and member checking during the qualitative phase, while external validity was tested through partial replication in different school environments. The novelty of the research lies in a mixed-methods approach that combines PLS-SEM analysis to measure the mediating effects of physical activity and diet, complemented by controlled experiments to test psychophysiological responses to food advertisements on social media. The Dual Pathway Digital Obesity Framework model developed, combines the perspective of neuroscience (the effect of dopamine on impulse buying) and nutritional epidemiology, which is expected to explain the biological mechanisms between digital habits and obesity in adolescents.

III. RESULTS AND DISCUSSION.

Most respondents (89.3%) spent more than 4 hours per day accessing social media, with social media usage being Instagram, TikTok, and WhatsApp. Survey data shows that 56.78% of adolescents have low levels of physical activity, where time spent scrolling through digital content significantly replaces time for outdoor activities or structured sports. As many as 68% of respondents admitted to making impulsive food purchases after seeing food promotional content on social media, and 72% regularly consume high-calorie snacks when using gadgets at night, especially after 21.00.

Analysis using PLS-SEM resulted in a structural model that examined the relationship between social media consumption (latent variable), physical activity, diet, sleep quality, and obesity risk (measured by Body Mass Index/BMI). The results of the model tests show some key findings.

Indicator	Value	Description
Proportion using social media >4 hours	89.3%	Percentage of adolescents active on social media for more than 4 hours per day.
Impulsive food purchases	68%	Adolescents who buy food after exposure to ads/promotions on social media.
Low physical activity	56.78%	Adolescents with physical activity levels below health standards.
Number of food ads seen per hour	5–8	Average food advertisements encountered within one hour on social media platforms.
Extra calories from snacking	300–500 kcal	Additional calorie intake from snacking while using devices.
Average sleep hours per night	5–6 hours	Average sleep duration among adolescents, below recommended levels.

Social media consumption has a significant negative effect on physical activity (path coefficient $\beta = -0.41$, $p < 0.001$), meaning that the higher the intensity of social media use, the lower the physical activity carried out by adolescents. Social media consumption had a significant positive effect on unhealthy eating ($\beta = 0.38$, $p < 0.001$), especially the consumption of high-calorie snacks and fast food. Physical activity reduces the risk of obesity ($\beta = -0.27$, $p = 0.002$), indicating that low physical activity increases the risk of obesity. An unhealthy diet had a positive effect on the risk of obesity ($\beta = 0.32$, $p < 0.001$). Sleep quality (duration and quality) acts as a mediator, where the use of social media at night reduces sleep duration ($\beta = -0.29$, $p = 0.004$), which further increases the risk of obesity through hormonal mechanisms (increased ghrelin). The PLS-SEM model shows an R^2 value of 0.48 for obesity risk, meaning that 48%

variation in obesity risk in adolescents can be explained by a combination of social media consumptive activity, physical activity, diet, and sleep quality.

The bootstrapping results confirmed the significance of all the main pathways, with a t> t-value of 2 on each relationship tested. No significant moderation effect was found by gender or socioeconomic status in this model, although there was a tendency for adolescent girls to be more affected by exposure to food content and beauty standards on social media. Qualitative Findings: Adolescents' In-Depth Narratives. Analysis through 150 participants with approximately 4 hours/day social media use and BMI ≥25 kg/m² revealed several behavioral and perception patterns. Adolescents identified that the main motivation to buy food after seeing promotional content on social media was curiosity, fear of missing out (FOMO), and the desire to follow viral trends. Many respondents stated that the decision to buy food often happens impulsively, without considering the nutritional content(Andrade et al., 2024).

Mindless Eating: Most teens admit to often mindlessly eating when scrolling through social media, especially at night. The snacks consumed are generally high in sugar, fat, and salt. This phenomenon is exacerbated by the habit of eating while watching short videos or live streaming(Selvakumar et al., 2023). So that exposure to blue light from gadget screens at night causes sleep difficulties, with an average sleep duration of only 5-6 hours/night. Adolescents often report feeling hungry at night after exposure to food content, which is associated with an increase in the hormone ghrelin. So that it can trigger unrealistic beauty standards on social media, triggering body dissatisfaction, especially in adolescent girls. This encourages extreme dieting behavior or, conversely, emotional eating as a form of escape from social pressure(Staccini & Lau, 2022). Social Media Impact Dualism: While the majority of narratives highlight negative impacts, about 22% of respondents reported that health education content on social media (e.g., exercise campaigns or healthy diet tips) actually motivates them to try healthy lifestyles. However, this positive effect is still less dominant than that of consumptive content(Remskar et al., 2022).

The results of this study confirm the existence of a vicious circle between social media consumptive behavior, decreased physical activity, unhealthy diet, sleep disorders, and increased risk of obesity in adolescents. Intensive social media use not only reduces time for physical activity, but also increases exposure to high-calorie food advertisements, triggers impulsive consumptive behavior, and worsens diet.

Food content on social media has been shown to increase daily calorie intake by 300-500 calories, mainly from unhealthy snacks consumed while scrolling. This pattern is reinforced by the findings that 68% of teens buy food after seeing digital promotions, and 72% consume snacks at night while using gadgets. Sleep disturbances due to excessive screen time also exacerbate the risk of obesity through hormonal mechanisms, namely an increase in ghrelin that triggers hunger at night. The relationship between social media consumption, physical activity, and obesity risk in adolescents shows a complex and multidimensional relationship. The study's main findings confirm that intensive social media use contributes significantly to an increased risk of obesity through several mediation mechanisms, most notably decreased physical activity and dietary changes.

Based on the PLS-SEM model, social media consumption had a significant negative effect on physical activity ($\beta = -0.41$, $p < 0.001$), in line with previous research showing a negative correlation between the intensity of social media use and exercise habits. These findings are supported by the Hamumeha study, which states that physical activity has a strong negative relationship with the incidence of obesity (correlation coefficient -0.612), where the lower the physical activity, the higher the obesity rate. This explains why 56.78% of adolescents with intensive social media use have low levels of physical activity, which is directly correlated with an increase in BMI.

The theory underlying this relationship is the concept of energy expenditure from Soegih & Wiramihardja (2009), which states that physical activity is one of the factors that can increase energy needs, so low physical activity increases the likelihood of obesity. Teens who spend hours scrolling through digital content tend to have physical activity in the light category, such as carrying light weights or walking only 1-2 days a week for 10-20 minutes. Instead, the time that should be spent on physical activity is replaced by sedentary behaviors such as reading books, playing on the phone, or watching videos, which, if prolonged, can lead to obesity, diabetes mellitus, and coronary heart disease.

In addition to decreasing physical activity, social media consumption also has a significant positive effect on unhealthy eating ($\beta = 0.38$, $p < 0.001$). This mechanism can be explained through the theory of consumptive behavior triggered by exposure to food advertisements on social media. According to the results of the study, 68% of teenagers admitted to buying food impulsively after seeing promotional content on social media, and 72% regularly consumed high-calorie snacks when using gadgets at night. This phenomenon is in line with the findings in the Kompasiana article, which states that the relationship between social media exposure and obesity can increase energy intake through eating while watching and due to exposure to high-calorie food advertisements(Nu Htay et al., 2022).

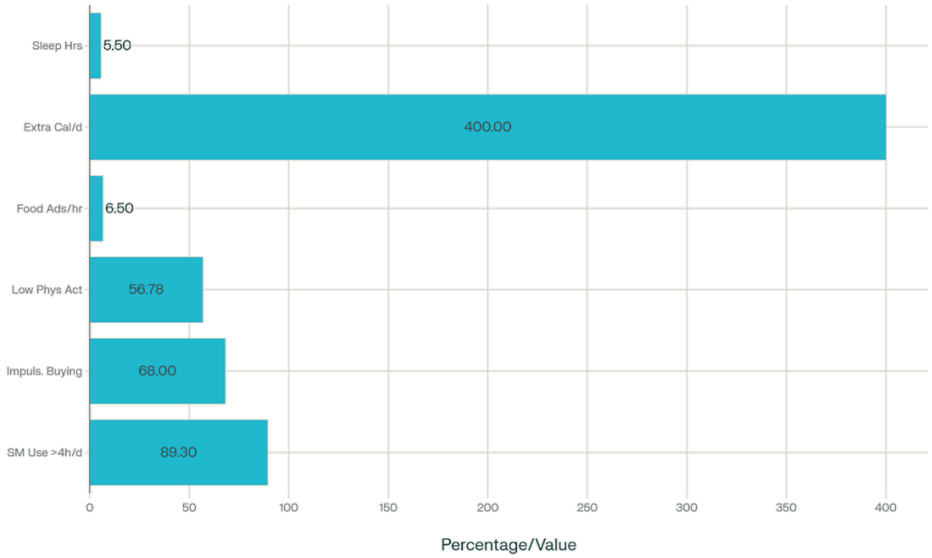


Figure 2. Key Findings: Youth SocMedia Habit

The majority of adolescents demonstrate intensive social media usage, with 89.3% spending more than four hours per day online. This high level of engagement is closely associated with an increased risk of obesity, primarily due to reduced physical activity and influence from food-related content. The research highlights that 56.78% of teens who exhibit social media addiction have low physical activity levels, which correlates significantly with higher Body Mass Index (BMI). In addition, adolescents are regularly exposed to between five and eight food advertisements per hour on social media platforms, and 68% of respondents admit to making impulsive food purchases after encountering these promotions. Such exposure not only encourages mindless eating but also adds 300–500 extra calories to their daily intake, exacerbating the risk of weight gain. The study also notes insufficient sleep among these adolescents, with the average duration reported at five to six hours per night, which further contributes to hormonal imbalances and increased appetite. While negative health impacts dominate, about 22% of respondents reported that exposure to health-related content, such as fitness campaigns or diet tips, can motivate positive behavioral change, though this positive influence remains less prevalent compared to the dominant consumerist messages encountered on social media.

Mindless eating behaviors while scrolling social media are an important factor that contributes to increased calorie intake. Teens consume an extra 300-500 calories per day from unhealthy snacks, especially those high in sugar, fat, and salt. This is reinforced by Kumparan's research, which explains that social media influences Gen Z's eating habits in various ways, such as viral food trends, influencer promotions, and fast food advertisements(Europe, 2010). From a sociological perspective, this phenomenon can be analyzed through the theory of consumerism, where social media becomes an arena that promotes a consumptive lifestyle, including in terms of food(Chowdhury et al., 2024).

Another important aspect is the disruption of sleep patterns due to the use of social media at night. The results showed that the use of social media at night reduced sleep duration ($\beta = -0.29$, $p = 0.004$), which further increased the risk of obesity through hormonal mechanisms. Exposure to blue light from gadget screens interferes with melatonin secretion, reducing sleep duration (5-6 hours/night on average), which has an impact on increasing the hormone ghrelin (hunger regulator) by 15-20%. This causes teens to feel hungry at night after being exposed to food content, encouraging food consumption at inappropriate times.

Research sources by Charles Horton Cooley's The Looking-Glass Self can explain how social media affects adolescents' body perceptions. This theory states that an individual's identity is formed through the reflection of social interactions, in which a person views himself based on how he or she believes others see and judge him(Ji, 2024). In the context of social media, teens often compare their bodies to unrealistic beauty standards promoted by celebrities or influencers, leading to body dissatisfaction that can trigger extreme dieting behaviors or emotional eating(Chitra et al., 2022). The concept of habitus from Pierre Bourdieu is also relevant in understanding how adolescents' digital habits are formed. Habitus refers to an internal disposition structure that is internalized through social experience, shaping the way individuals think, act, and

behave(Kabir et al., 2021). In the context of this study, adolescents' digital habits, including social media consumption patterns and responses to food content, were influenced by their social and cultural contexts(Song et al., 2024).

The Dual Pathway Digital Obesity Framework model developed in this study offers a comprehensive perspective by combining aspects of neuroscience and nutritional epidemiology(Belda-Medina & Calvo-Ferrer, 2022). This model describes how social media consumption can affect obesity risk through two main pathways: (1) behavioral pathways, which involve decreased physical activity and dietary changes, and (2) physiological pathways, which involve sleep disturbances and hormonal changes that regulate appetite.

The findings of the study also show the dualism of social media impact. Although the majority of narratives highlight negative impacts, around 22% of respondents reported that health education content on social media actually motivates them to try a healthy lifestyle(Twardowska-Staszek et al., 2021). This shows the potential of social media as a means of nutrition education and health promotion, which has not been fully utilized in public health policy.

IV. CONCLUSION AND RECOMMENDATIONS

Based on the results of the study, it can be concluded that intensive use of social media among vocational adolescents in urban areas significantly increases the risk of obesity through two main pathways: behavioral and physiological. The behavioral pathways were reflected in decreased physical activity due to time spent scrolling digital content, as well as an increase in unhealthy eating patterns triggered by exposure to food advertisements and impulsive behaviors of buying food after seeing promotions on social media. Meanwhile, physiological pathways can be seen from impaired sleep quality and duration due to the use of gadgets at night, which triggers an increase in the hormone ghrelin and encourages food consumption outside of normal meals. The phenomenon of mindless eating when using social media, especially at night, exacerbates daily calorie intake by 300-500 extra calories from snacks high in sugar, fat, and salt. In addition, exposure to unrealistic beauty standards on social media also affects the perception of adolescents' bodies, encouraging extreme diet behaviors or emotional eating, especially in adolescent girls.

The implications of these findings are wide-ranging, both at the individual, family, school, and public policy levels. At the individual and family level, increased digital literacy and nutrition education are needed to build awareness of the risks of excessive social media use and the importance of physical activity and healthy eating. Schools are expected to integrate digital-based health promotion programs that not only educate about obesity risk, but also utilize the potential of social media as a means of healthy living campaigns. In terms of public policy, the results of this study highlight the need for regulations that limit exposure to unhealthy food advertisements on social media, as well as the development of digital-based interventions that are adaptive to adolescents' habits. In addition, the findings of social media impact dualism—in which some adolescents are also inspired by health education content—point to a great

opportunity to optimize social media as an effective health promotion tool. This study also recommends the need for standardization of digital habit measurement instruments and follow-up research that explores differences in responses based on the type of digital and social media platforms used and content formats, to design more targeted and evidence-based interventions.

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