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The Correlation between Ultra-Processed Food Consumption and Increased Risk of Chronic Disease in the Context of a Modern Lifestyle

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ABSTRAK

Changes in food consumption patterns in the urbanization era have increased the proportion of ultra-processed foods (UPFs) in the daily diet, which is associated with an increased prevalence of chronic diseases. This study aims to analyze the relationship between UPF consumption and the risk of chronic diseases in the context of modern lifestyles in Indonesia. The study design used a quantitative cross-sectional approach in 420 respondents aged 20–59 years in urban areas, who were selected purposively. Data were collected through the NOVA classification-based Food Frequency Questionnaire, the International Physical Activity Questionnaire, the Perceived Stress Scale, and examinations of chronic disease risk indicators by health workers. Analysis was performed using multivariate logistic regression. The results showed that high UPF consumption increased the risk of chronic diseases by 4.66 times compared to low consumption ($p<0.001$). Other significant factors included low physical activity (OR=2.42) , poor sleep patterns (OR=1.91), high stress (OR=2.05), age ≥40 years (OR=2.31), smoking (OR=1.96), and family history of disease (OR=2.48). Gender and socioeconomic status were not significant. In conclusion, high UPF consumption, exacerbated by unhealthy lifestyle behaviors , significantly increases the risk of chronic disease. Comprehensive public health interventions are needed, including nutrition education, physical activity promotion, stress management, and UPF marketing controls.

Keywords: *Ultra-processed foods, Modern lifestyle , Chronic diseases, Physical activity, Logistic regression.*

INTRODUCTION

Changes in global food consumption patterns in recent decades have shown a worrying trend, marked by the increasing proportion of ultra-processed foods (UPFs) in people's daily diets (Monteiro, 2019). UPFs are industrially processed food products that often consist of extracted ingredients such as oils, sugars, starches, isolated proteins, and synthetic additives to enhance flavor, color, texture, and shelf life (Pagliai et al., 2021). Examples of UPFs include fast food, sweetened soft drinks, packaged snacks, processed meats, and instant products. UPFs are generally high in energy density, high in added sugars, saturated fat, and sodium, but low in dietary fiber, vitamins, minerals, and phytonutrients (Chen et al., 2020).

The increasingly widespread consumption of UPFs is inextricably linked to the influence of modern lifestyles characterized by rapid urbanization, increased economic activity, changes in family structures, and the development of digital technology. This transformation has triggered changes in eating behavior, leading to a more instant, practical approach, and a reliance on packaged foods (Khandpur et al., 2022). Furthermore, long work hours and an increasingly sedentary lifestyle reduce the time available to prepare fresh meals at home (Hall & Guo, 2020). Consequently, people prefer ready-to-eat food products readily accessible in supermarkets, fast food restaurants, and online delivery platforms. Increased consumption of UPFs has been linked to various health problems, particularly chronic diseases such as obesity, type 2 diabetes mellitus, hypertension, cardiovascular disease, and certain cancers (Fiolet et al., 2018; Srour & al., 2020). The biological mechanisms underlying this association involve increased systemic inflammation, dysfunctional glucose and lipid metabolism, and disruption of the gut microbiota balance due to high exposure to additives such as emulsifiers and artificial sweeteners (Paquet, 2021). UPFs also contribute to excess calorie intake due to their hyper-palatable nature, thus stimulating unconscious overconsumption (Hall, 2019).

The context of modern lifestyles further amplifies the negative effects of UPF on health. A longitudinal study in Europe showed that individuals with high UPF consumption and low physical activity had a threefold greater risk of obesity compared to individuals with low UPF consumption and high physical activity (Pagliai et al., 2021). This is in line with research in Asia that found a synergistic relationship between UPF-based diets and sedentary behavior and an increased risk of type 2 diabetes (Chen et al., 2020). Furthermore, poor sleep patterns, chronic work stress, and high digital media exposure contribute to unhealthy eating behaviors, including an increased preference for foods high in sugar and fat (Elizabeth et al., 2020) . In Indonesia, this trend poses a serious public health challenge. The Basic Health Research Report shows an increase in the prevalence of obesity, hypertension, and diabetes mellitus over the past decade, largely

influenced by changes in diet and lifestyle (RI, 2023). Although several studies have explored the link between unhealthy diets and chronic disease in Indonesia (Rahmawati, 2021), specific studies on the role of UPFs in the context of modern lifestyles are limited. Most domestic research focuses on sugar, fat, or sodium intake separately, without considering the complexity of UPFs as an industrial food category with multidimensional health effects.

International research provides a consistent picture of the adverse effects of UPFs, but differences in cultural, social, and economic contexts may influence results across countries (Khandpur et al., 2022; Patel Y.; Sohal, N., 2023). For example, in developed countries, UPF consumption is often associated with a Western diet rich in processed meats and sugar-sweetened beverages, while in developing countries, UPFs are often found in instant noodles, powdered drinks, and flour-based snacks. These differences may influence the nutritional composition and the resulting risk of chronic disease (Machado et al., 2021) . Furthermore, some previous studies have tended to separate analyses of UPF consumption from lifestyle factors, despite their interplay. For example, UPF consumption is often associated with low physical activity, poor sleep patterns, and high stress, all of which can worsen metabolic profiles (Hall & Guo, 2020) . These separate analyses potentially obscure understanding of the complex interactions between diet and lifestyle in shaping chronic disease risk.

Research gaps identified in the literature review include the limited number of studies in Indonesia that comprehensively examine UPF consumption in relation to modern lifestyles. There are also limited studies that integrate UPF dietary variables with behavioral determinants such as physical activity, sleep patterns, and stress within a single framework for analyzing chronic disease risk. There is also a lack of studies that simultaneously address biological and behavioral mechanisms, which are crucial for designing effective public health interventions. Based on these gaps, this study is novel in three main aspects: 1) Local context: analyzing the relationship between UPF consumption and chronic disease risk within the framework of modern lifestyles in Indonesia, which has not been widely studied in depth. 2) Integrative approach: combining UPF dietary analysis with modern lifestyle factors (physical activity, sleep patterns, stress) to understand risk interactions holistically. 3) Policy orientation: providing relevant, evidence-based recommendations for public health interventions in the era of urbanization and digitalization. Considering the background, problems, and research gaps, this study aims to analyze the relationship between ultra-processed food consumption and increased risk of chronic disease in the context of modern lifestyles, taking into account the interaction of biological and behavioral factors that influence public health.

METHODS

This study used a quantitative approach with a cross-sectional design to analyze the relationship between ultra-processed food (UPF) consumption and the risk of chronic disease within a modern lifestyle . The study population was 20–59 years old in urban Indonesia, with a purposive sampling technique involving 420 respondents who met the inclusion criteria, such as living there for ≥1 year, consuming UPF at least three times a week, and being willing to complete a questionnaire. Data were collected through a structured questionnaire, including a NOVA classification-based Food Frequency Questionnaire (FFQ) for UPF consumption, the International Physical Activity Questionnaire (IPAQ) for physical activity, the Perceived Stress Scale (PSS) for stress levels, and questions related to sleep patterns and smoking habits. Measurements of chronic disease risk indicators included body mass index (BMI), waist circumference, blood pressure, fasting blood sugar levels, and lipid profiles, conducted by health workers. Secondary data were obtained from the Basic Health Research report (Ministry of Health of the Republic of Indonesia, 2023) and publications related to UPF trends in Indonesia to strengthen the context of the analysis.

Data analysis was conducted descriptively to describe the characteristics of respondents and the distribution of variables, followed by a Chi-square test to examine the relationship between UPF consumption and chronic disease indicators. Multivariate logistic regression analysis was used to identify independent factors influencing the risk of chronic diseases, with modern lifestyle as a covariate and confounding factors such as age, gender, socioeconomic status, and family history of disease as control variables. The significance level was set at $p<0.05$ with a 95% confidence interval, using SPSS software version 26. Instrument reliability testing was performed with Cronbach's alpha (target ≥0.7) , while external validity was maintained through the representation of a diverse urban population. Research ethics were guaranteed through ethics committee approval, respondents' informed consent, and confidentiality of personal data. This approach is expected to produce strong quantitative evidence to formulate nutrition and public health policy recommendations in the era of urbanization and digitalization .

The following is a graphic of the conceptual framework of this research:

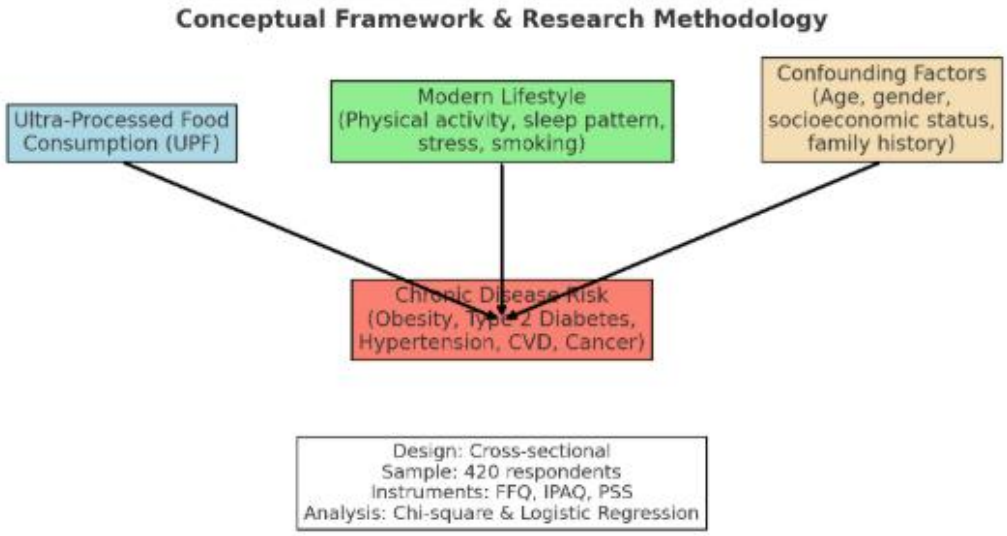

Figure 1. Research Concept Framework Graph

RESULTS AND DISCUSSION

1. Respondent Characteristics

Table 1. Respondent Characteristics

Characteristics	Category	Number (n)	Percentage (%)
Gender	Man	182	43.3
	Woman	238	56.7
Age	20-29 years old	110	26.2
	30-39 years	142	33.8
	40-49 years	98	23.3
	50-59 years	70	16.7
Socioeconomic Status	Low	124	29.5
	Intermediate	208	49.5
	Tall	88	21.0
Physical Activity Level	Low	194	46.2
	Currently	148	35.2
	Tall	78	18.6
UPF Consumption Level	Low	96	22.9
	Currently	152	36.2
	Tall	172	40.9

Of the 420 respondents, the majority were female (56.7 %), with the largest age group being 30–39 years (33.8%). Most had middle socioeconomic status (49.5 %). Low physical activity was found in almost half of the respondents (46.2 %). High UPF consumption levels occupied the largest proportion (40.9 %), indicating that the habit of consuming ultra-processed foods is quite common in the urban population studied.

2. The Relationship Between UPF Consumption Levels and the Risk of Chronic Diseases

Table 2. Relationship between UPF Consumption Levels and the Risk of Chronic Diseases

UPF Consumption Level	No Risk n (%)	Risky n (%)	Total	p-value
Low	78 (81.3)	18 (18.7)	96	
Currently	98 (64.5)	54 (35.5)	152	
Tall	82 (47.7)	90 (52.3)	172	< 0.001

* Chi-Square Test

The proportion of respondents at risk of chronic disease increased with higher UPF consumption. At low consumption, only 18.7 % were at risk, while at high consumption, the figure jumped to 52.3%. A chi-square test showed this relationship to be statistically significant ($p<0.001$), indicating a strong association between UPF consumption and chronic disease risk.

3. Multivariate Logistic Regression Analysis

Table 3. Multivariate Logistic Regression Results

Variables	OR	95% Cl	p-value
High UPF consumption	4.66	2.45 – 8.86	<0.001*
Low physical activity	2.42	1.38 – 4.25	0.002*
Bad sleep patterns	1.91	1.10 – 3.34	0.021*
High stress	2.05	1.21 – 3.48	0.008*
Age ≥40 years	2.31	1.23 – 4.36	0.009*
Smoke	1.96	1.11 – 3.45	0.021*
Family history of disease	2.48	1.45 – 4.23	0.001*
Male gender)	1.54	0.93 – 2.56	0.098
Low socioeconomic status	1.48	0.82 – 2.67	0.195

After controlling for confounding variables, high UPF consumption increased the risk of chronic disease 4.66 - fold compared to low consumption ($p<0.001$). Other significant factors were low physical activity (OR=2.42) , poor sleep patterns (OR=1.91), high stress (OR=2.05), age ≥40 years (OR=2.31), smoking (OR=1.96), and family history of disease (OR=2.48). Gender and socioeconomic status were not significant. The model had a good fit (Hosmer–Lemeshow p=0.48) , indicating reliable analysis results.

The results of this study indicate a significant association between ultra-processed food (UPF) consumption and the risk of chronic disease in the urban population of productive age in Indonesia. Specifically, high UPF consumption was shown to increase the risk of chronic disease by up to 4.66 times compared to low consumption, after controlling for confounding variables. This finding aligns with the study's objectives, which are to analyze the association between UPF consumption and the risk of chronic disease within a modern lifestyle framework, while also exploring the role of behavioral factors such as physical activity, sleep patterns , stress, and smoking habits.

UPF Consumption as a Major Risk Factor for Chronic Diseases

The proportion of respondents at risk of chronic disease increased with increasing levels of UPF consumption, from 18.7 % at low consumption to 52.3% at high consumption. This phenomenon can be explained by the UPF content, which is generally high in energy, added sugars, saturated fat, and sodium, and low in fiber, vitamins, and minerals (Nardocci & al., 2019). This combination leads to excess calories and increased systemic inflammation, which are key mechanisms for the development of obesity, type 2 diabetes, and cardiovascular disease (Mendonça & al., 2017). A Brazilian study also found that every 10% increase in the proportion of calories from UPF was associated with an 18% increase in the risk of obesity (Louzada & al., 2018) . Meanwhile, a French study by Srour & al., (2020) showed a linear relationship between UPF consumption and an increased risk of all-cause mortality, even after adjusting for overall diet quality. This confirms that the health effects of UPF do not only come from their nutritional composition, but also from the structure of the food matrix that is damaged due to intensive processing, as well as the presence of synthetic additives that can affect the body's metabolism (Fardet, 2018) .

Low Physical Activity and Its Interaction with UPF

Low physical activity has been shown to be a significant predictor of chronic disease risk (OR=2.42) . This finding is consistent with the Global Burden of Disease Study, which found that physical inactivity is one of the ten leading

risk factors for premature death worldwide (Guthold & al., 2018). In the context of UPF consumption, low physical activity exacerbates the negative impact of a high-energy diet on metabolic status. An Australian cohort study found that individuals with high UPF consumption and low physical activity had a 3.4-fold greater risk of abdominal obesity compared to those with low UPF consumption and high physical activity (Rangan & al., 2021). This interaction suggests that chronic disease control interventions should combine the promotion of a healthy diet with increased physical activity, rather than focusing solely on one or the other.

Poor Sleep Patterns and Metabolic Risks

Poor sleep patterns also emerged as a significant factor (OR=1.91) . Inadequate sleep duration or poor sleep quality can disrupt the regulation of hunger (ghrelin) and satiety (leptin) hormones, leading to increased calorie intake, particularly from foods high in sugar and fat (Taheri & al., 2004). Experimental studies have shown that even a week of sleep restriction can increase insulin resistance and fasting blood glucose levels (Buxton & al., 2012). In modern urban populations, poor sleep patterns are often associated with busy lifestyles , late-night digital device use, and work stress (Zuraikat & al., 2020). This combination of factors may increase the preference for UPF due to its easy accessibility and instant gratification.

High Stress Levels and UPF Consumption Behavior

High stress increased the risk of chronic disease (OR=2.05) in this study. The biological mechanism involves activation of the hypothalamic–pituitary–adrenal (HPA) axis, which increases cortisol, triggers visceral fat accumulation, nd increases the desire to consume sweet or high-fat foods as a form of emotional eating (Adam & Epel, 2007). A study in the United States by Barrington et al., (2014)) found that chronic work stress was associated with higher fast food consumption and lower fruit and vegetable consumption. This supports the finding that stress is not only a physiological factor but also influences eating behavior, especially in environments that facilitate access to UPF.

Age , Smoking, and Family History of Disease

Age ≥40 years (OR=2.31) is a significant risk factor, as the aging process brings physiological changes such as decreased insulin sensitivity, blood vessel stiffness, and decreased muscle mass (Seals et al., 2016) . Smoking (OR=1.96) increases the risk through synergistic pro-inflammatory and atherogenic effects with poor diet (Chiolero et al., 2008) . Family history of disease (OR=2.48) reflects

the contribution of shared genetic and environmental factors, which may modify the impact of UPF consumption on health (Khera & Kathiresan, 2016).

Insignificant Variables

Gender and socioeconomic status did not show a significant association after being controlled for in the multivariate model. This may be due to the homogeneity of UPF consumption patterns across demographic groups in urban Indonesia, where access to these products is relatively equitable. A similar study in Mexico also showed a similar pattern , with high UPF consumption across all income levels (Cediel et al., 2021).

Public Health Implications

These findings indicate the need for intervention policies that include:

1. Evidence-Based Nutrition Education – Educate the public about the health risks of UPF, referring to guidelines such as the NOVA classification (Moubarac et al., 2014).
2. Marketing Control and Nutrition Labeling – Regulates UPF advertising targeting children, and requires warning labels on products high in sugar, fat, and sodium (Taillie et al., 2020).
3. Promotion of Physical Activity and Healthy Sleep Patterns – Occupational and community health programs to integrate exercise and stress management into everyday life.
4. Access to Fresh Food – Increasing the availability of fruits, vegetables, and minimally processed foods in urban areas at affordable prices (Swinburn et al., 2019)

CONCLUSION

This study demonstrates that ultra-processed food (UPF) consumption is significantly associated with an increased risk of chronic disease in productive - age urban populations in Indonesia. Individuals with high UPF consumption are nearly five times more likely to experience chronic disease than those with low UPF consumption. Modern behavioral factors such as low physical activity, poor sleep patterns, high stress levels, smoking habits, age ≥40 years, and a family history of disease also increase this risk. These results emphasize that controlling chronic disease in the era of urbanization and digitalization requires a comprehensive approach that not only reduces UPF consumption but also increases physical activity, improves sleep patterns, manages stress, and controls

other behavioral risk factors. These findings provide a scientific basis for the formulation of more effective nutrition and public health policies in Indonesia

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