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Aims and Scope

The *Korean Journal of Health Promotion (KJHP)* is an open access, multidisciplinary journal dedicated to publishing high-quality research in various areas of the medical, nursing, nutritional, physical educational, epidemiological, and public health sciences associated with health promotion and disease prevention. *KJHP*, which has been published continuously since 2001, is an official journal of the Korean Society for Health Promotion and Disease Prevention.

The aim of the *KJHP* is to advance and disseminate new knowledge and scientific information in all the areas associated with health promotion and disease prevention. KJHP publishes original articles, narrative reviews, systematic reviews and meta-analyses, letters to the editor, and perspectives in English.

Abbreviation
The correct abbreviation for abstracting and indexing purposes is *Korean J Health Promot*.

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Contents

Scaling Up Maternal Mental Health Care: Evaluating Community-Based Interventions in Ethiopia: A Systematic Review

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ABSTRACT

Background: Maternal mental health is a critical component of overall well-being, influencing both mothers and their children. In Ethiopia, maternal mental health disorders are prevalent but remain under-addressed due to limited healthcare infrastructure, social stigma, and a shortage of trained mental health professionals. Community-based interventions (CBIs) have shown promise in improving maternal mental health outcomes in low- and middle-income countries.

Methods: This systematic review evaluates the effectiveness of CBIs in improving maternal mental health outcomes in Ethiopia, identifying key intervention strategies and challenges. Following PRISMA guidelines, a comprehensive literature search was conducted across multiple databases (PubMed, Scopus, Google Scholar, and CINAHL) for studies published between 2000 and 2023. Eligible studies included randomized controlled trials, quasi-experimental studies, cohort studies, and qualitative research on CBIs targeting maternal mental health in Ethiopia. A total of 65 studies were screened, with 29 meeting the inclusion criteria. Data were synthesized narratively to highlight key themes.

Results: CBIs included peer-support groups, health extension worker (HEW)-led home visits, integrated maternal health services, and community awareness programs. Peer-support groups reduced depressive symptoms by 40% to 50% by fostering emotional resilience and reducing social isolation. HEW-led interventions improved mental health literacy and increased help-seeking behaviors by 25%. Integrating mental health care into routine maternal services enhanced screening rates by 60%. However, key barriers included stigma, lack of HEW mental health training, and resource constraints.

Conclusions: CBIs are effective in improving maternal mental health in Ethiopia. Scaling up successful programs requires enhanced HEW training, community engagement, and integration into existing healthcare frameworks. Addressing social stigma and sustainability challenges is crucial for long-term impact.

Keywords: Community health services, Mental health, Maternal welfare, Ethiopia

INTRODUCTION

Maternal mental health is a crucial aspect of overall maternal well-being, influencing not only the mental health of the mother but also the physical and emotional development of her child. These conditions can lead to severe maternal outcomes, such as suicide, and adversely impact child development, causing cognitive and emotional delays [1,2]. Maternal mental health is

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a global public health concern, with estimates suggesting that around 10% to 20% of women worldwide experience mental health disorders during the perinatal period [3].

Community-based interventions have significantly improved maternal and mental health outcomes, especially in low- and middle-income countries. In Ethiopia, the Community Health Extension Program has expanded access to primary healthcare services, focusing on maternal and child health, although challenges in achieving universal coverage remain, particularly in rural areas [4]. Additionally, integrating mental health care into primary health services has proven effective, addressing the mental health needs of vulnerable populations, including pregnant women [5]. In South Africa, maternal healthcare utilization is influenced by both individual and community-level factors, emphasizing the importance of addressing social determinants of health to improve maternal outcomes [6].

Previous systematic reviews have demonstrated the effectiveness of community-based interventions (CBIs) such as peer-support groups, community health worker-led home visits, and mental health awareness programs in Ethiopia [7]. For instance, a meta-analysis in South Asia found that CBIs reduced perinatal depression by 30% to 50%. Another review from Latin America highlighted that task-shifting mental health interventions to trained community health workers led to improved maternal mental health outcomes and increased service accessibility [8].

In Ethiopia, the burden of maternal mental health issues is exacerbated by limited healthcare infrastructure, the scarcity of trained mental health professionals, and societal stigmas around mental health. The healthcare system in Ethiopia is largely rural-based, relying heavily on community health workers, known as health extension workers (HEWs), to provide most of the health care services, including maternal care. While HEWs have contributed to improving maternal health outcomes, maternal mental health has largely been neglected.Cultural perceptions of mental health in Ethiopia, especially regarding women, are shaped by deep-rooted beliefs that often lead to under-reporting of symptoms and a reluctance to seek care [9,10]. In addition, factors like poverty, gender inequality, and limited social support compound the mental health crisis, particularly in rural regions [11-13]. Several studies have demonstrated the effectiveness of community-based models such as peer support groups and training community health workers to identify and address mental health issues, improving maternal health outcomes [14,15].

In Ethiopia, where over 110 million people reside, the burden of maternal mental health disorders remains high and largely unaddressed. Studies indicate that up to 30% of Ethiopian women experience perinatal depression [16,17]. This systematic review aims to fill the gap in the literature by evaluating the effectiveness of CBIs in improving maternal mental health in Ethiopia.

METHODS

Review protocol
This systematic review aims to identify and evaluate CBIs designed to improve maternal mental health outcomes in Ethiopia. The review follows the guidelines of PRISMA to ensure a rigorous and reproducible process [18].

Search strategy
A comprehensive literature search was conducted to identify relevant studies published between 2000 and 2023. The search was performed across PubMed, Scopus, Google Scholar, and CINAHL. The search terms used keywords such as 'maternal mental health,' 'community-based interventions,' and 'Ethiopia.'

Eligibility criteria
Primary and secondary research studies published as randomized controlled trials, quasi-experimental studies, cohort studies, or qualitative research that evaluates CBIs were included.

Study selection process
Two authors of this study independently reviewed and selected relevant studies based on the above mentioned selection criteria. We included only full-text journal publications and excluded unpublished online clinical trial results, and abstracts.

Data extraction and quality assessment
In each study, we extracted the following items: author name, year of publication, study participants, type of interventions. The study quality for individual studies were assessed based on Cochrane risk of bias tool [19].

Data synthesis and analysis
Given the diversity of study designs and interventions, a narrative synthesis was used to summarize the findings of the included studies. This approach allowed for the integration of quantitative and qualitative data across studies.

RESULTS

This systematic review included 65 studies examining the impact of CBIs on maternal mental health. After removing 15 duplicates, the remaining 50 articles underwent an eligibility evaluation based on their titles and abstracts by two authors. Among them, 21 articles that did not meet the predefined selection criteria were excluded. A total of 29 articles were included in the final analysis (Table 1, Fig. 1) [1-29].

Main findings

The interventions assessed in these studies encompassed a variety of community-based strategies tailored to maternal mental health. The most common interventions included peer-support groups, where women received social and emotional support from trained community members, and HEW-led interventions. A smaller subset of studies examined integrated maternal health services, where mental health care was embedded into routine antenatal and postnatal health care services [20-22].

Effectiveness of community–based interventions

Peer support groups

Women who participated in structured peer support programs showed a 40% to 50% reduction in depressive symptoms over a 6-month period. Similarly, mothers who engaged in peer-led psycho-social interventions reported significant improvements in self-esteem, emotional resilience, and social functioning. These interventions proved to be particularly valuable in combating social isolation, which is a major contributing factor to perinatal depression in Ethiopia [7,21]. The success of peer support groups was largely attributed to culturally relevant, community-driven engagement. The informal social support played a crucial role in normalizing maternal mental health struggles, reducing stigma, and encouraging affected women to seek further assistance when needed [22].

Health extension worker–led home visits

HEW-led home visits were another effective intervention for improving maternal mental health outcomes. The primary benefits of home visits included early identification of depressive symptoms, improved access to maternal mental health education, and better emotional support from trained health workers [23-27]. The role of HEWs in providing psycho-social counseling, mental health screenings, and referrals to specialized ser-

vices was particularly significant in rural Ethiopia, where formal mental health services remain largely inaccessible. Studies also highlighted that HEW-led interventions improved maternal mental health literacy, leading to a 25% increase in help-seeking behaviors among perinatal women [27,28].

Community awareness programs

One of the most significant findings was that involving religious and community leaders in awareness initiatives contributed to a 30% reduction in mental health stigma [10]. In Ethiopian communities, traditional beliefs and cultural perceptions of mental illness often act as barriers to seeking help, with many women attributing mental health symptoms to spiritual causes rather than medical conditions. By integrating faith-based and community-driven educational efforts, these programs helped shift community attitudes and normalized discussions on maternal mental health [11,14].

Integrated maternal health services

Several studies examined the impact of integrating mental health care into existing maternal health services. These studies found that when mental health screenings and counseling were included as part of routine antenatal and postnatal care, depression screening rates improved by 60% [16]. This study reported that pregnant women who received integrated mental health support had better birth outcomes and reduced stress levels compared to those who received standard care [22]. The integration of mental health interventions into maternal healthcare was particularly effective in addressing stigma, as women were more likely to engage with mental health services when they were discreetly embedded within broader healthcare checkups [21].

Barriers to implementation

It was found that many Ethiopian women were reluctant to discuss or acknowledge symptoms of depression and anxiety due to fears of being labeled as mentally ill. In some cases, women and their families preferred to seek help from traditional healers and religious leaders rather than health care professionals, further delaying diagnosis and treatment [13]. Another major challenge was the limited training of HEWs in mental health care. These studies reported that HEWs often lacked specialized knowledge on identifying and managing maternal mental health conditions, leading to inconsistent service delivery [2]. Additionally, resource constraints and lack of funding affected

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Table 1. List of studies reviewed in the study

First author	Year	Study design	Study participants	Types of intervention	Main findings
Dennis [1]	2017	Systematic review	Women in LMICs	Antenatal & postnatal depression	High prevalence of antenatal and postnatal depression in LMICs
Tol [2]	2020	Systematic review & meta-analysis	LMIC populations	Maternal mental health interventions	Positive impact on child-related outcomes
Giebel [3]	2024	Review	LMIC populations	Community-based mental health interventions	Key lessons for program development
Assefa [4]	2019	Review	General population in Ethiopia	Community health extension program	Successes and challenges in primary health care
Hailemariam [5]	2019	Systematic review	Ethiopia	Mental health integration into primary care	Effective implementation strategies identified
Yaya [6]	2018	Multilevel analysis	Mothers in South Africa	Maternal healthcare service utilization	Individual & community factors influencing service use
Berhanu [7]	2017	Cluster-randomized trial	Rural Ethiopian women	Community-based maternal care package	Increased health facility use, reduced stillbirth rate
Dadi [8]	2020	Umbrella review	Global antenatal population	Antenatal depression	Association with adverse birth outcomes
Fekadu [9]	2016	Mixed methods	Rural Ethiopia	Scalable mental healthcare plan	Development of an intervention framework
Hanlon [10]	2010	Cross-sectional	Ethiopian postpartum women	Sociocultural practices & mental health	Association with postnatal common mental disorders
Rahman [11]	2013	Systematic review & meta-analysis	LMIC perinatal women	Common perinatal mental disorder interventions	Effective in reducing symptoms
Tenaw [12]	2024	Systematic review & meta-analysis	Teenage mothers	Psycho-social interventions for postpartum depression	Effective in prevention
Jackson [13]	2016	Cross-sectional	Pregnant women in rural Ethiopia	Role of health extension workers	Facilitated health facility linkage for delivery
Fekadu [14]	2015	Cohort study	Rural Ethiopian population	Mental illness & mortality risk	Higher mortality in severe mental illness cases
Hanlon [15]	2016	RCT	Ethiopia	Task-sharing for severe mental disorders	Non-inferior outcomes to specialist care
Karim [16]	2018	Dose-response study	Ethiopian communities	Community-based data for decision-making	Improved maternal & newborn health practices
Addisu [17]	2022	Systematic review & meta-analysis	Ethiopian women	Maternal health care utilization	Identified barriers and facilitators
Liberati [18]	2009	Guidline		PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration	
Higgins [19]	2019	Chapter 8	Systematic reviews	Cochrane handbook for systematic reviews of interventions. 2nd ed. John Wiley & Sons; 2019. p. 205-28	Assessed the quality of studies included.
Tadesse [20]	2023	Systematic review protocol	Ethiopia	Maternal morbidity & mortality framework	Proposed intervention strategies
Tomlinson [21]	2018	Cluster RCT	South Africa	Home visiting by community health workers	Reduced antenatal depression, improved child outcomes
Tesfaye [22]	2010	Validation study	Ethiopian postpartum women	Screening for postnatal depression	Validated EPDS & Kessler scales
Surkan [23]	2011	Systematic review & meta-analysis	Developing countries	Maternal depression & child growth	Depression negatively impacts child growth
Rtbey [24]	2024	Systematic review & meta-analysis	Ethiopian women	Perinatal depression & risk factors	High prevalence & associated factors
Ayen [25]	2024	Systematic review & meta-analysis	Ethiopian pregnant women	Depression during pregnancy	Key risk factors identified
Bitew [26]	2020	Qualitative study	Rural Ethiopia	Psycho-social interventions for antenatal depression	Stakeholder perspectives on intervention feasibility
Ahmed [27]	2022	Systematic review	LMICs	Role of community health workers	Improved health equity outcomes
Scroggins [28]	2024	Systematic review	Perinatal women	Community-based perinatal mental health interventions	Effective approaches identified
Zenebe [29]	2023	A cluster-randomized control trial	Southern Ethiopian community	Data for decision-making intervention on maternal and newborn health care practices in Ethiopia	Stakeholder perspectives on intervention feasibility

CHW, community health worker; EPDS, Edinburgh Postnatal Depression Scale; LMIC, low- and middle-income country; RCT, randomized controlled trial.
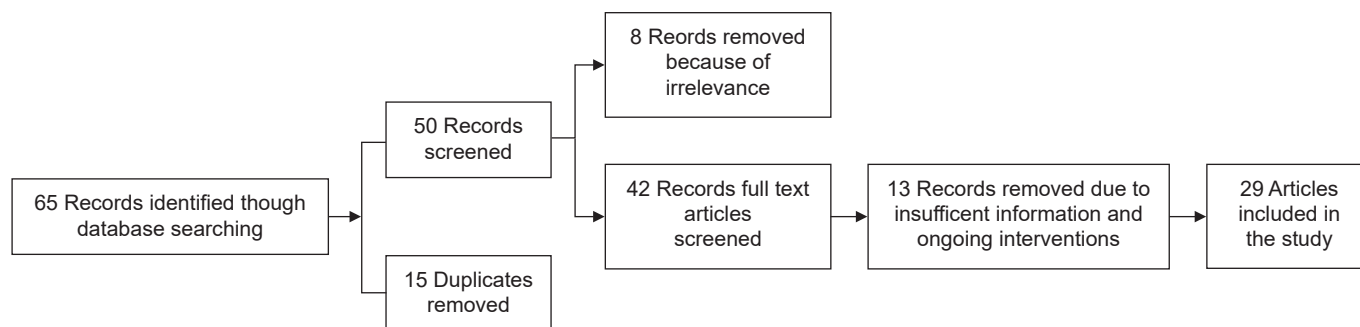
Fig. 1. Flow diagram for identification of relevant studies.

the sustainability of many community-based programs, particularly those relying on external non-governmental organization (NGO) support [11].

Factors influencing success

Several factors contributed to the success of CBIs. Integration with Ethiopia's national health extension program ensured higher program sustainability and uptake [9]. Additionally, strong community engagement, particularly the involvement of husbands, local leaders, and religious figures, led to higher acceptance and participation rates. Furthermore, studies found that collaboration with international organizations improved the training of health care workers, availability of mental health resources, and long-term sustainability of interventions [20].

DISCUSSION

The findings of this review align with global evidence on community-based maternal mental health interventions, particularly in LMICs. Studies in South Asia and Sub-Saharan Africa have also shown that peer-support groups and home-based maternal mental health interventions significantly reduce perinatal depression and anxiety [2,8]. For example, a study in Pakistan found that women who participated in community-led psycho-social support groups experienced a 50% reduction in depressive symptoms, a result comparable to findings in Ethiopia [12]. Additionally, research from Bangladesh and Uganda has demonstrated that community-based home visits by trained health workers improved mental health outcomes and newborn health [23]. The success of HEW-led home visits in Ethiopia is consistent with findings in South Africa, where home visits reduced maternal depression and improved infant health outcomes [21].

The role of community awareness programs in Ethiopia also mirrors findings from India and Nigeria, where village-level mental health campaigns led to increased help-seeking behavior and reduced stigma [28]. The integration of maternal mental health into primary health care services, as demonstrated in Ethiopia, has also been reported in Brazil and Kenya, where embedding mental health care within existing maternal health services significantly increased mental health screening and treatment rates [27].

However, a key difference between Ethiopia and some other LMICs is the heavy reliance on HEWs for mental health service delivery, despite minimal mental health training. Unlike Pakistan and India, where community health workers receive structured mental health training, Ethiopian HEWs face knowledge gaps and training limitations, which hinder intervention effectiveness [10]. Addressing this gap through capacity-building programs for HEWs could enhance Ethiopia's maternal mental health intervention strategies.

Integration of mental health into maternal health care services

In Ethiopia and other low-resource settings, maternal health care has traditionally focused on physical health outcomes, such as prenatal nutrition, safe delivery, and neonatal care, while maternal mental health has been largely overlooked. However, mental health disorders, particularly perinatal depression and anxiety, have profound consequences not only for mothers but also for child development and family well-being. Thus, embedding mental health services into maternal healthcare is a necessary step toward improving both maternal and child health outcomes [12]. Incorporating validated mental health screening tools into routine checkups would allow healthcare workers to identify at-risk mothers early, preventing the escalation of symptoms into severe psychiatric conditions. These screenings should not be one-time assessments but should be conducted

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at multiple points throughout pregnancy and the postpartum period to track changes in mental health status over time [13].

Evidence from other low-income settings suggests that simple interventions, such as stress management techniques, relaxation exercises, and coping strategies, can help reduce maternal distress and improve overall well-being. Providing mental health education during group prenatal sessions can also help normalize discussions about mental health, encouraging mothers to seek help when needed [11,23]. Studies included in this review have shown that when maternal mental health interventions are community-driven, participation and adherence rates are significantly higher, as mothers feel more comfortable engaging in familiar, culturally accepted settings rather than seeking help from formal mental health institutions [2].

Expanding community–based peer support programs

Women who participated in structured peer-led psycho-social interventions reported a 40% to 50% reduction in depressive symptoms, improved self-esteem, and enhanced social functioning. The success of these programs highlights the importance of social support networks in addressing maternal mental health challenges [11]. One potential avenue for expansion is the integration of peer-support initiatives into existing community structures, such as health centers, churches, mosques, and local women's groups. Religious and community institutions play a central role in Ethiopian society, and leveraging these networks can help increase participation and reduce stigma surrounding mental health [12].

By leveraging existing community structures, training peer mentors, involving HEWs, securing funding, and reducing stigma, Ethiopia can scale up these successful interventions and create a stronger support system for mothers nationwide. This expansion would not only improve the mental health and well-being of mothers but also have far-reaching benefits for child health, family stability, and overall community development [29].

Understanding why some interventions were more effective than others

The effectiveness of HEW-led home visits in reducing postpartum depression by 35% can be attributed to several key factors. One of the primary reasons is early identification and intervention, as HEWs are trained to recognize symptoms of perinatal mental health disorders before they escalate [11]. By conducting home visits, HEWs provide personalized support in a familiar environment, reducing the stigma that often prevents women

from seeking mental health care at formal health facilities [13]. Moreover, HEWs provide basic psycho-education and emotional support, equipping mothers with coping strategies and encouraging them to seek additional care if needed [6]. These factors collectively contribute to the success of home-based interventions, making them a scalable and sustainable approach to addressing maternal mental health in Ethiopia.

On the other hand, the effectiveness of other CBIs, such as peer-support groups and awareness programs, appears to be more context-dependent. While peer-support groups have been shown to reduce maternal depression by 40% to 50%, their impact may vary depending on group cohesion, cultural perceptions, and logistical challenges [11,28].

Strengths and limitations

One of the key strengths of this systematic review is its comprehensive approach to evaluating CBIs for maternal mental health in Ethiopia. By including a wide range of study designs this review provides a holistic understanding of the effectiveness and implementation challenges of these interventions.

One notable limitation is it does not fully address the long-term sustainability of these programs. Many CBIs rely on NGO funding or pilot-phase implementation, raising concerns about scalability and long-term governmental commitment. More research is needed to assess cost-effectiveness and explore sustainable funding models for nationwide expansion.

Conclusion

Peer support groups, HEW-led home visits, community awareness programs, and integrated maternal health services have all proven effective in reducing perinatal depression and anxiety. These interventions are particularly valuable in Ethiopia's low-resource settings, where access to formal mental health care remains limited. Despite their effectiveness, challenges such as stigma, insufficient mental health training for HEWs, and resource constraints continue to hinder widespread implementation. The findings of this review emphasize the importance of embedding mental health services within maternal healthcare frameworks.

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AUTHOR CONTRIBUTIONS

CONFLICTS OF INTEREST

FUNDING

DATA AVAILABILITY

The data presented in this study are available upon reasonable request from the corresponding author.

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Association between Caffeinated Beverages Consumption and Sleep Quality of Urban Workers

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ABSTRACT

Background: The stimulatory effects of caffeine contribute to poor sleep quality. However, the relationship between caffeinated beverages and sleep quality, considering frequency or types of caffeinated beverages, were not extensively studied.
Methods: Data were collected from 160 urban workers (75 men [46.9%] aged 20–69 years; with an average age of 41.8±12.3 years) using a structured, self-administered online questionnaire. Sleep quality, time, satisfaction; types and frequency of caffeinated beverages (number of cups per week; Q1: 0 cup, Q4: 14 or more cups per week), demographics, and health behaviors were asked. Sleep quality were evaluated using the Korean version of the Pittsburgh Sleep Quality Index (PSQI-K). Multiple regression analysis was conducted on the association between the frequency of caffeinated beverages consumption and sleep quality.
Results: The most frequently consumed beverages were unsweetened coffee (22.8%) and the most common time for caffeine was between 12 pm to 5 pm (58.2%). The average sleep quality score based on the PSQI-K was 6.0±2.0 overall, 5.3±1.6 in Q1, and 6.6±2.2 in Q4 (frequent caffeinated beverage drinkers), indicating poorer sleep quality in Q4 (P=0.022). In Q1, 13.3% rated their sleep quality as 'very good,' while in Q4, only 2.5% gave the same rating. Poor sleep quality was significantly associated with the frequency of caffeinated beverages per week (β=0.232, P=0.004) and self-reported stress level (β=0.256, P=0.002).
Conclusions: Frequent consumption of caffeinated beverages appears to be associated with poor sleep quality among urban workers. While reducing caffeine intake may contribute to improvements in sleep quality as a health promoting behavior, this hypothesis requires validation through future studies employing personalized intervention approaches.

Keywords: Caffeine, Sleep quality, Sleep duration

INTRODUCTION

Irregular sleep habits can result in fatigue, anxiety, stress, anger, and depression, and may lead to sleep disorders such as hypersomnia or insomnia [1]. Sleep quality refers to the total sleep duration, time required to fall asleep, sleep efficiency by calculating the proportion of the time spent actually sleeping after going to bed, hypnagogic latency, the time it takes to fall asleep, mid-sleep awakening, enuresis during sleep, and the subjective evaluation of fatigue, mood, and overall sleep satisfaction [2].

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Poor sleep quality increases the risk of cognitive dysfunction, including impairments in memory and concentration, which can reduce both productivity and quality of life [3].

According to data from the Korean National Health Insurance Corporation, the number of patients visiting medical institutions due to sleep disorders rapidly increases, reaching 910,606 in 2018 and 1,097,282 in 2021. Medical expenses also continue to increase, by approximately from 119.9 billion won in 2017 to 252.8 billion won in 2021, more than doubling in 5 years [4].

Sleep disorders arise from a combination of various factors including lighting, temperature, humidity, sleep environment such as bedding, physical activity, eating habits, stress, presence of disease, pain, seasonal changes, and age. Among these factors, the consumption of caffeinated beverages is particularly notable as a dietary habit that adversely affects sleep quality.

Coffee consumption in South Korea is reported to be over 400 cups per capita annually [5]. Changes in lifestyle and cultural preferences have led to a rise in habitual coffee consumption and the intake of other caffeinated beverages. According to data from the Korea Customs Service [6], the annual coffee import amount is 200,000 tons in 2022, an increase of 9.5% compared to the previous year, reaching the highest level ever. Similarly, the number of coffee and beverage establishments has doubled, increasing from 49,000 in 2018 to 99,000 in 2022 [7]. Additionally, the consumption of high-caffeine beverages, commonly referred to as 'energy drinks' has risen due to their rapid stimulating effects compared to coffee.

Caffeine, the primary active ingredient in coffee, stimulates the central nervous system and can produce adverse effects when consumed in excess. Accordingly, the Ministry of Food and Drug Safety [8] recommends that adults limit their caffeine intake to less than 400 mg per day.

Previous studies have demonstrated that caffeine's stimulating effects can negatively impact sleep quality [9]. For example, a study investigating the relationship between anxiety, depression, and sleep quality in nursing students reported that 15.6% of participants experienced insomnia as a side effect of consuming high-caffeine beverages [10]. Among shift workers, sleep quality was found to be better in individuals consuming less than one cup of caffeinated beverages per day compared to those consuming two to three cups daily [11].

However, research exploring the relationship between sleep quality and specific drinking patterns—such as the types of caffeinated beverages consumed, the frequency of consumption, and the usual time of day for caffeine intake—remains limited.

In this study, we examined the relationship between the sociodemographic and health-related characteristics of urban workers and their caffeinated beverage consumption patterns, including beverage types and frequencies, and their sleep quality.

METHODS

Participants
This study used the G*POWER program on subjects to analyze the relationship between urban workers' caffeinated beverage intake and sleep quality. The relationship between independent variables and sleep quality was analyzed with a medium effect size (0.15). The sample size was calculated with a power of 95% and a significance level of 0.05, and 146 participants were required. The survey was conducted on a total of 198 respondents in August 2023, assuming that 26% of participants might drop out due to missing data.

A final 160 respondents were selected after excluding 38 respondents with missing values in the main variables of interest. Participants were asked to voluntarily join through the URL and QR code, which contained the purpose of the study and research consent form. Consent to participate in the study was obtained by selecting the consent button through an online survey.

To protect the rights and interests of the subjects of this study, approval was obtained according to the review procedure from the Institutional Review Board of Severance Hospital, Yonsei University Health System, on August 8, 2023 (4-2023-0787).

Data collection
The evaluation items for this study included 14 questions on sleep quality, six questions on caffeine beverage consumption caffeine awareness, and sociodemographic characteristics, and 29 health-related characteristic survey questions, consisting of a total of 49 questions.

Sleep quality evaluation tool
For sleep quality, the 15-item 'Korean Version of the Pittsburgh Sleep Quality Index (PSQI-K),' which is a validated Korean translation of the PSQI, was used. This includes one question on average daily sleep duration, one question on sleep latency, eight questions on sleep disturbance, one question on sleep effi-

ciency, one question on subjective sleep quality, one question on taking sleeping pills, one question on drowsiness during social activities, and one question on work concentration. The subjective sleep quality was evaluated for each question: 'very good' 0 points, 'fairly good' 1 point, 'quite bad' 2 points, 'very bad' 3 points, and a total score of 21. For the evaluation of sleep problems, 'no sleep problem for a month (none)' 0 points, 'less than once a week' 1 point, '1–2 times a week' 2 points, '3 or more times a week,' 'I couldn't fall asleep within 30 minutes of going to bed for a month' with a score of 3, a higher score means poorer sleep quality [12].

Caffeine beverage intake frequency and caffeine awareness survey

Caffeine intake frequency was collected as number of cups per week and divided into four groups, 0 drinks per week Q1, 1–6 drinks Q2, 7–13 drinks Q3, and 14 or more drinks per week Q4. 11 types of caffeinated beverages data were collected including sweetened coffee, sweetened decaffeinated coffee, unsweetened coffee, energy drink (Table 1). Usual times of caffeinated beverages drinking, reasons for consuming caffeinated beverages, perception on caffeine related to sleep quality, and intention to reduce or quit caffeinated drinks to improve sleep quality were also investigated.

Survey of sociodemographic and health-related characteristics

The survey was conducted by classifying the participants' gender and age, type of occupation, whether they were full-time or not, and monthly household income. By entering the height and weight as health-related characteristics of the survey participant, the body mass index (BMI) of the participants was calculated. According to the standards of the Korean Society for the Study of Obesity (2022), less than 18.5 kg/m^2 is considered underweight, 18.5 to 22.9 kg/m^2 is classified as normal, 23.0 to 24.9 kg/m^2 as overweight, and over 25 kg/m^2 as obese [13].

The health-related characteristics of the survey participants were investigated by dividing them into former smokers, current smokers, and non-smokers. Alcohol drinking was examined by dividing the number of days on which alcohol was consumed over the past 30 days and the average daily amount. In the past 7 days, the number of days performing physical activity of moderate or higher intensity that resulted in sweating, the number of days walking more than 10 minutes per week, and the average sedentary time per day were measured in minute. For stress levels, participants were asked to select one of the following options: "I feel very much," "I feel a lot," "I feel a little," "I do not feel very much," or "I do not feel at all."

Statistical analysis

The findings obtained in this study were statistically analyzed using the IBM SPSS/WIN 21 program (IBM Corp.) and statistical significance was based on a two-sided test with a significance level of 0.05. The relationship between sleep quality, sociodemographic characteristics, and health-related characteristics was analyzed in the four groups of urban workers who consumed caffeinated beverages. Univariate analysis was performed using descriptive statistics, t-test, and ANOVA. If there

Table 1. Multiple responses on the types of caffeinated beverage consumption frequency by number of cups per week among the participants

Types of caffeinated beverages	Caffeine beverages intake frequency, cups per week (n=115)			Total
	Q2 1 to 6 (n=53)	Q3 7 to 13 (n=22)	Q4 14 or more (n=40)	
Sweetened coffee (sweetened Americano)	39 (10.1)	11 (10.6)	2 (8.0)	52 (10.1)
Sweetened decaffeinated coffee	10 (2.6)	2 (1.9)	0 (0.0)	12 (2.3)
Sweetened milk instant coffee (coffee mix)	30 (7.7)	7 (6.7)	4 (16.0)	41 (7.9)
Sweetened milk-based coffee (vienna latte, caramel macchiato, canned coffee, etc.)	56 (14.4)	5 (4.8)	0 (0.0)	61 (11.8)
Sweetened capsule coffee	8 (2.1)	3 (2.9)	0 (0.0)	11 (2.1)
Unsweetened coffee (Americano)	61 (15.7)	42 (40.4)	15 (60.0)	118 (22.8)
Unsweetened milk coffee (cafe latte, etc.)	42 (10.8)	7 (6.7)	0 (0.0)	49 (9.5)
Unsweetened decaffeinated coffee	18 (4.6)	4 (3.8)	1 (4.0)	23 (4.4)
Unsweetened capsule coffee	21 (5.4)	5 (4.8)	3 (12.0)	29 (5.6)
Green tea, black tea, cola, chocolate, nutritional drink	76 (19.6)	12 (11.5)	0 (0.0)	88 (17.0)
Energy drink (high caffeine)	27 (7.0)	6 (5.8)	0 (0.0)	33 (6.4)
Total number of intake cases	388 (75.0)	104 (20.1)	25 (4.9)	517 (100.0)

Values are presented as number (%).

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was a significant difference after analysis of variance, post-hoc analysis was performed using the Tukey test.

Multiple regression analysis was performed as a multivariate analysis to determine the relationship between urban workers' weekly caffeine intake frequency and sleep quality. The multiple regression model was adjusted for age, gender, BMI, physical activity, walking time, sedentary time, and stress.

RESULTS

The participants in this study were 160 adults, including 75 men (46.9%) and 85 women (53.1%). Age distribution was as follows: 22.5% (n=36) were aged 20–29 years, 21.3% were aged 30–39 years, 25.0% were aged 40–49 years, 23.1% were aged 50–59 years, and 8.1% were aged 60–69 years. The average age was 41.8±12.3 years, with men having a higher average age of 43.4±12.4 years (ranging from 20 to 69 years) and women at 40.3±12.0 years. Regarding occupation, participants were categorized as follows: managers (14.5%, n=23), experts and related

workers (23.8%), office workers (31.4%), service workers (8.2%), distribution and sales workers (5.7%), financial consultants (3.8%), and others (12.6%), with office workers being the most prevalent. The average BMI was 23.2±3.1 kg/m². Of the participants, 20.0% (n=32) were overweight, and 25.6% (n=41) were classified as obese (Table 2).

Table 1 presents the results of the division of caffeinated beverage consumption by type from multiple responses, categorized into three groups based on the number of cups consumed per week, among participants who drank more than one cup of caffeinated beverages per day on average. The most frequently consumed beverage was unsweetened coffee ('Americano') at 22.8%, followed by green tea, black tea, cola, chocolate, and nutritional drink at 17.0%, and sweetened milk-based coffee (such as vienna latte, caramel macchiato, canned coffee, etc.) at 11.8%.

In the group that consumed 1–6 cups of caffeinated beverages per week, 19.6% consumed green tea and similar beverages, 15.7% consumed unsweetened coffee, and 14.4% consumed sweetened milk-based coffee. In the group consuming 7–13 cups

Table 2. Sociodemographic characteristics of study participants

Variable	Category	Total	Men	Women
Age range (yr)	20–29	36 (22.5)	17 (22.7)	19 (22.4)
	30–39	34 (21.3)	11 (14.7)	23 (27.1)
	40–49	40 (25.0)	21 (28.0)	19 (22.4)
	50–59	37 (23.1)	18 (24.0)	19 (22.4)
	60–69	13 (8.1)	8 (10.7)	5 (5.9)
Average age (yr)		41.8±12.3	43.4±12.4	40.3±12.0
BMI (kg/m²)		23.2±3.1	25.0±2.8	21.6±2.4
Obesity	Underweight (BMI, <18.5 kg/m²)	6 (3.8)	0 (0.0)	6 (7.1)
	Normal weight (BMI, 18.5–22.9 kg/m²)	81 (50.6)	21 (28.0)	60 (70.6)
	Overweight (BMI, 23.0–24.9 kg/m²)	32 (20.0)	20 (26.7)	12 (14.1)
	Obesity (BMI, ≥25.0 kg/m²)	41 (25.6)	34 (45.3)	7 (8.2)
Occupation[a]	Managers	23 (14.5)	14 (18.7)	9 (10.7)
	Experts and related workers	38 (23.8)	20 (26.6)	18 (21.4)
	Office workers	50 (31.4)	18 (24.0)	32 (38.1)
	Service workers	13 (8.2)	4 (5.3)	9 (10.7)
	Distribution and sales workers	9 (5.7)	5 (6.7)	4 (4.8)
	Financial consultants	6 (3.8)	5 (6.7)	1 (1.2)
	Others	20 (12.6)	9 (12.0)	11 (13.1)
Average monthly household income per month (Korean million won)	Less than 1	1 (0.6)	1 (1.3)	0 (0.0)
	1 to 1.99	9 (5.6)	5 (6.7)	4 (4.7)
	2 to 3.99	47 (29.4)	13 (17.3)	34 (40.0)
	3 to 5.99	36 (22.5)	19 (25.3)	17 (20.0)
	6 to 7.99	23 (14.4)	10 (13.3)	13 (15.3)
	8 to 9.99	14 (8.8)	7 (9.3)	7 (8.2)
	10	30 (18.8)	20 (26.7)	10 (11.8)
Total		160 (100.0)	75 (46.9)	85 (53.1)

Values are presented as number (%) or mean±standard deviation.
BMI, body mass index.
[a]1 missing value in women.

per week, unsweetened coffee was the most common beverage at 40.4%. Finally, 4.9% of intake cases were allocated in the 'more than 14 cups of caffeinated beverages a week' group, with unsweetened coffee being the most frequently consumed beverage at 60.0% (Table 1).

Caffeine beverage intake frequency and sleep quality are presented in Table 3. The majority of participants (64.4%) reported an average sleep duration of '6 hours or more, but less than 8 hours,' followed by 'less than 6 hours' at 29.4%, and 'more than 8 hours' at 6.3%.

In the analysis of sleep status, which included average daily sleep duration, subjective sleep quality assessment, frequency of drowsiness, and decreased work engagement, no significant correlation was found between caffeine intake frequency and sleep quality. However, in Q4 (frequent coffee drinkers), 2.5% rated their sleep quality as 'very good,' and 27.5% as 'pretty bad.' In contrast, in Q1 (0 cups per week), 13.3% rated their sleep quality as 'very good,' and only 11.1% as 'pretty bad.' Particu-

larly, the average sleep quality score in Q1 was 5.3±1.6, while in Q4, the sleep quality was poor as 6.6±2.2 (P=0.022).

Multiple regression analysis was performed to determine the influence of caffeine consumption on sleep quality (Table 4). Hierarchical regression analysis was performed to determine the influence of caffeine consumption frequency on sleep quality. Model 1 included beverage frequency, which gave an explanatory power of 4.4%, and showed that office workers with high caffeine consumption frequency had significantly lower sleep quality than urban workers with low frequency (β=0.223, P=0.005).

Model 2 included caffeine consumption frequency, gender, age, BMI, smoking status, drinking status, days of physical activity during the week, days of walking during the week, average sitting time per day, and stress. As a result of the multicollinearity test, the Variance Inflation Factor value was greater than 10, indicating that all variables had no multicollinearity problems. Model 2 had an explanatory power of 8.2%, and showed that

Table 3. Sleep quality by quartiles of consumption frequency of caffeine beverages intake, cups per week

Sleep quality[a]	Category	Total	Caffeine beverages intake frequency quartiles for cups per week (n=160)				χ^2 (P-value)
			Q1 0 (n=45)	Q2 1 to 6 (n=53)	Q3 7 to 13 (n=22)	Q4 14 or more n=40	
Daily average sleep hour (hr)	Less than 6	47 (29.4)	10 (22.2)	18 (34.0)	7 (31.8)	12 (30.0)	3.311 (0.769)
	6 to less than 8	103 (64.4)	32 (71.1)	31 (58.5)	13 (59.1)	27 (67.5)	
	8 or more	10 (6.3)	3 (6.7)	4 (7.5)	2 (9.1)	1 (2.5)	
Sleep difficulty frequency	Not in the past month (not there)	35 (21.9)	13 (28.9)	13 (24.5)	3 (13.6)	6 (15.0)	5.297 (0.808)
	Less than once a week (less than once a week)	76 (47.5)	22 (48.9)	24 (45.3)	10 (45.5)	20 (50.0)	
	About 1–2 times a week (1–2 times a week)	38 (23.8)	7 (15.6)	13 (24.5)	7 (31.8)	11 (27.5)	
	3 or more times a week (3 or more times a week)	11 (6.9)	3 (6.7)	3 (5.7)	2 (9.1)	3 (7.5)	
Sleep quality assessment	Very good	15 (9.4)	6 (13.3)	7 (13.2)	1 (4.5)	1 (2.5)	10.093 (0.343)
	Quite good	111 (69.4)	33 (73.3)	34 (64.2)	16 (72.7)	28 (70.0)	
	Pretty bad	33 (20.6)	5 (11.1)	12 (22.6)	5 (22.7)	11 (27.5)	
	Very bad	1 (0.6)	1 (2.2)	-	-	-	
Taking medicine frequency	Not in the past month	155 (96.9)	44 (97.8)	50 (94.3)	22 (100.0)	39 (97.5)	2.008 (0.571)
	Less than once a week	5 (3.1)	1 (2.2)	3 (5.7)	-	1 (2.5)	
Drowsiness frequency	Not in the past month	50 (31.3)	19 (42.2)	13 (24.5)	7 (31.8)	11 (27.5)	9.519 (0.391)
	Less than once a week	58 (36.3)	15 (33.3)	22 (41.5)	10 (45.5)	11 (27.5)	
	About 1–2 times a week	36 (22.5)	9 (20.0)	11 (20.8)	4 (18.2)	12 (30.0)	
	3 times a week	16 (10.0)	2 (4.4)	7 (13.2)	1 (4.5)	6 (15.0)	
Decreased work engagement	There was nothing at all	62 (38.8)	24 (53.3)	17 (32.1)	9 (40.9)	12 (30.0)	9.817 (0.366)
	There was very little	72 (45.0)	18 (40.0)	26 (49.1)	9 (40.9)	19 (47.5)	
	There was somewhat	23 (14.4)	3 (6.7)	8 (15.1)	4 (18.2)	8 (20.0)	
	There were very many	3 (1.9)	-	2 (3.8)	-	1 (2.5)	
Quality of sleep[a]		6.0±2.0	5.3±1.6	6.0±2.0	6.2±2.2	6.6±2.2	3.286 (0.022)

Values are presented as number (%) or mean±standard deviation.
[a]Sleep quality was measured using the Korean version of the Pittsburgh Sleep Quality Index. For each question, 0 points are very good, 1 point is quite good, 2 points are quite bad, and 3 points are very bad. The total score is 21 points, with a higher score indicating poorer sleep quality.

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Table 4. Results of regression analysis of factors affecting sleep quality (n=160)

Variable[a]	Model 1					Model 2				
	B	SE	β	t	P-value	B	SE	β	t	P-value
Caffeine beverage intake frequency	0.175	0.061	0.223	2.877	0.005	0.182	0.062	0.232	2.954	0.004
Gender						0.106	0.394	0.026	0.268	0.789
Age						0.002	0.014	0.009	0.110	0.912
Body mass index						0.027	0.206	0.012	0.133	0.895
Smoking status						0.239	0.424	0.047	0.563	0.574
Drinking alcohol or not						−0.002	0.414	0.000	−0.006	0.995
Physical activity						0.058	0.100	0.046	0.577	0.565
Walking						0.138	0.077	0.147	1.797	0.074
Time spent sitting						−0.024	0.050	−0.038	−0.482	0.630
Stress						0.592	0.184	0.256	3.223	0.002
F (P)	8.277 (0.005)					2.415 (0.011)				
R^2	0.050					0.139				
Adj. R^2	0.044					0.082				

Model 1 included beverage frequency; Model 2 included caffeine consumption frequency, gender, age, body mass index, smoking status, drinking status, days of physical activity during the week, days of walking during the week, average sitting time per day, and stress.
Adj., adjusted; B, beta; SE, standard error.
[a]Reference group: gender, man; smoking status, non-smoking; drinking status, non-drinking.

sleep quality was lower when beverage frequency was higher (β=0.232, P=0.004) and stress was higher (β=0.256, P=0.002).

The reasons for consuming caffeinated beverages, categorized by quartiles of caffeine beverage intake frequency measured in cups per week, are described in Appendix Table 1. "It's just a habit" was the most common reason (47.5%), followed by "I drink it to change my mood" (26.9%), "I drink it to avoid sleepiness" (18.8%), and other reasons (6.9%). However, there were no statistically significant differences among the quartiles. The most common time for caffeine was between noon to 5 pm (58.2%).

The survey results on the intention to reduce or quit caffeine beverage intake to improve sleep quality (Appendix Table 2) included participants' awareness that consuming caffeinated beverages affects sleep quality. A total of 141 participants (88.1%) responded with "I know." Regarding their intention to reduce or quit caffeinated beverage intake, 19.4% had 'no intention at all,' 40.0% said "it is difficult right now, but I will think about it," 26.9% said "I will try to reduce it gradually," and 13.8% indicated "I will take action immediately to improve the quality of my sleep." A total of 129 participants (80.6%) indicated a willingness to reduce their caffeine intake to improve sleep quality.

For those who responded that they had 'no intention at all' to quit caffeinated beverages to improve sleep quality, 74.2% said, "I sleep well regardless of caffeine intake" while 16.1% stated, "Drinking caffeinated beverages has become a habit and is hard to quit."

DISCUSSION

This study analyzed the relationship between the frequency of caffeinated beverage intake and sleep quality through an online survey targeting adult urban workers. Results indicate that frequent consumption of caffeinated beverages was significantly associated with poor sleep quality, even after adjusting for related variables.

The recommended daily caffeine intake for adults is less than 400 mg. According to the Ministry of Food and Drug Safety, caffeine concentrations in common beverages include 62.7 mg in unsweetened coffee, 25.3 mg in green or black tea, 34.8 mg in cola, 37.5 mg in tonic water, 41.6 mg in unsweetened coffee milk, 67.4 mg in sweetened coffee (e.g., mixed or canned coffee), and 58.1 mg in high-caffeine beverages [14]. Exceeding the recommended intake is a risk when consuming multiple servings of these beverages. While caffeine has been reported to have protective effects, such as reducing the risk of hypertension, it has also been linked to increased cardiovascular disease mortality, highlighting conflicting conclusions regarding its health outcomes [15]. Therefore, it is needed to explore the long-term health effects of consuming various kinds of caffeinated beverages.

This study focused on the negative impact of caffeine on sleep quality, which is as crucial as sleep duration. Sleep quality plays a significant role in improving workers' productivity and achieving a better work-life balance [14]. Previous research has indicated that individuals sleeping less than 9 hours are 1.3

times more likely to report good subjective health [16]. In this study, we also reported the association between frequent coffee drinking and poor sleep quality.

There was no significant correlation between the frequency of caffeine consumption and indicators such as daily sleep duration, frequency of sleep difficulties, or overall sleep quality assessment. However, in the subjective sleep quality assessment, 2.5% of Q4 (respondents with a high frequency of consumption) answered that their sleep quality was very good, while 13.3% of Q1 responded as same. In addition, 27.5% of Q4 and 11.1% of Q1 responded that their sleep quality was 'pretty bad.' Looking at these results, it is thought that there may be a certain tendency between caffeinated beverages and sleep quality, although it was not significant. The number of subjects in this survey may not have been sufficient to test the difference in these sub-domain items rather than the overall sleep quality.

Also, although not reported in this paper, among the sleep quality sub-items results of the authors, in the case of 'could not fall asleep within 30 minutes after going to bed,' 20.0% of the Q4 responded that they had difficulty more than three times a week, while it was 11.1% in Q1 ($P=0.035$; data not shown). Therefore, it is thought that there was a significant correlation as there were differences in some of these sleep quality sub-items, with the total score average was poorer in Q4.

Despite the recognized impact of caffeine on sleep, changing caffeine consumption behavior appears to be challenging. In this study, 80.6% of respondents expressed an intention to reduce or stop consuming caffeinated beverages to improve sleep quality, while 19.4% reported no such intention. The most cited reasons for consuming caffeinated beverages was "It's just a habit" (47.5%). Culturally ingrained practices, such as drinking coffee after meals and the widespread use of coffee coupons as gifts, contribute to the difficulty in changing these behaviors [17].

This study has several limitations. First, the data were obtained through convenience sampling and may not be representative of all urban workers. However, the sample size was sufficient to achieve the statistical power required for the analysis, ensuring the reliability of the findings. Second, this was a cross-sectional study that analyzed the relationship between caffeine intake and sleep quality, making it impossible to establish causality.

Third, a dietary intake survey was not conducted to accurately quantify caffeine content in each beverage. Although weekly caffeine intake frequency was assessed, the actual caffeine content of beverages was not measured. Additionally, highly caffeinated and high-energy drinks were not separately classified. Decaffeinated beverages were included in the analysis, as they still contain small amounts of caffeine (2–4 mg), which may cause insomnia in caffeine-sensitive individuals [18]. Future studies should aim to quantify caffeine levels in beverages more precisely.

Fourth, sleep quality was assessed using the PSQI-K, a validated tool; however, the subjectivity of self-reported data cannot be ruled out. Objective methods, such as polysomnography, could not be employed in this study. Polysomnography is necessary for future research to ensure the objectivity of measurements, including electrocardiogram, electromyogram, oxygen saturation, sleep apnea, and brain wave activity during sleep [19]. Advances in digital healthcare technology may offer promising alternatives for measuring sleep quality with objective data through sensors mounted on mattresses and pillows at home for monitoring with wearable devices such as a smartwatch. Analytic methods were developed for the sleep stages, sleep duration, and sleep efficiency of deep sleep, rapid eye movement sleep, and light sleep by measuring heart rate [10]. This can be used as a tool to reduce individual subjective judgments and errors and evaluate sleep quality with more objective data [20].

Palpitations occur in people who are genetically slow to metabolize caffeine. It is known that the half-life time for decomposing and excreting caffeine, that is, the sensitivity and reaction phenomenon, are different for each individual. A study suggested a possibility of myocardial infarction among the slow metabolizers of coffee [21]. Personalized assessments of caffeine tolerance, including recognition of individual variations in caffeine half-life, time to decompose and excrete caffeine components, could help improve sleep quality.

Although the relationship between caffeinated beverage consumption and insomnia or sleep quality has been studied among nursing students [10] and shift workers [11], research on the types of caffeinated beverages and consumption behaviors among young to middle-aged urban workers who frequently drink coffee is limited.

In this study, we reported the association between frequent caffeinated beverage and poor sleep quality, measured using the PSQI-K, in urban workers. Additionally, we provided a detailed analysis of caffeine consumption behaviors, including the types of caffeinated beverages consumed and their consumption frequency.

To enhance sleep quality, reducing the frequent intake of caf-

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feinated beverages may serve as an effective component of sleep hygiene strategies. Future research is warranted to explore the impact of various types of caffeinated beverages, incorporating precise quantification and behavioral interventions. "The quality of sleep is the quality of life." Since sleep quality constitutes a third of our lives, managing caffeinated beverage consumption should be regarded as a health-promoting behavior to prevent insomnia and enhance overall well-being.

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AUTHOR CONTRIBUTIONS

Heejin KIMM had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. All reviewed this manuscript and agreed to individual contributions.

Conceptualization: BIH, JYL, and HK. Data curation: BIH, HJL, and RH. Formal analysis: BIH, JYL, and RH. Methodology: MR, SHJ, and HK. Supervision: MR, SHJ, and HK. Writing–original draft: BIH, HK. Writing–review & editing: all authors.

CONFLICTS OF INTEREST

No existing or potential conflict of interest relevant to this article was reported.

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DATA AVAILABILITY

The data presented in this study are available upon reasonable request from the corresponding author.

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APPENDICES

Appendix Table 1. Reasons for consuming caffeinated beverages and the usual times of consumption by quartile of caffeine beverage intake frequency

| Variable | Category | Total | Caffeine beverages intake frequency quartiles for cups per week (n=160) | | | | χ^2 (P-value) |
			Q1 0 (n=45)	Q2 1 to 6 (n=53)	Q3 7 to 13 (n=22)	Q4 14 or more (n=40)	
Reasons for consuming caffeinated beverages	It's just a habit.	76 (47.5)	20 (44.4)	26 (49.1)	11 (50.0)	19 (47.5)	7.468 (0.588)
	To change my mood	43 (26.9)	16 (35.6)	11 (20.8)	7 (31.8)	9 (22.5)	
	To avoid sleepiness	30 (18.8)	5 (11.1)	11 (20.8)	4 (18.2)	10 (25.0)	
	Other reasons	11 (6.9)	4 (8.9)	5 (9.4)	0 (0.0)	2 (5.0)	
Usual times of caffeinated beverage drinking[a]	Early in the morning to noon	24 (35.8)	46 (41.4)	22 (40.7)	36 (35.6)	128 (38.4)	–
	Noon to 5 pm	39 (58.2)	48 (43.2)	21 (38.9)	47 (46.5)	155 (46.5)	
	After 5 pm	4 (6.0)	17 (15.3)	11 (20.4)	18 (17.8)	50 (15.0)	

Values are presented as number (%).
[a]Multiple responses.

Appendix Table 2. Intention to reduce or quit caffeinated beverage consumption to improve sleep quality

Variable	Category	Total	Men	Women
Awareness that consuming caffeinated beverages affects sleep quality	I know.	141 (88.1)	66 (88.0)	75 (88.2)
	I do not know.	19 (11.9)	9 (12.0)	10 (11.8)
Willingness to reduce or quit consuming caffeinated beverages to improve sleep quality	Not at all.	31 (19.4)	15 (20.0)	16 (18.8)
	It's difficult right now, but I'll think about it.	64 (40.0)	26 (34.7)	38 (44.7)
	I will try to reduce it gradually.	43 (26.9)	22 (29.3)	21 (24.7)
	I will take action immediately to improve the quality of my sleep.	22 (13.8)	12 (16.0)	10 (11.8)
The reason for having no intention to reduce or quit consuming caffeinated beverages for sleep quality	I sleep well regardless of caffeine intake.	23 (74.2)	13 (86.7)	10 (62.5)
	I feel good when I drink caffeinated beverages.	3 (9.7)	1 (6.7)	2 (12.5)
	Drinking caffeinated beverages has become a habit and is hard to quit.	5 (16.1)	1 (6.7)	4 (25.0)
Total		160 (100.0)	75 (46.9)	85 (53.1)

Values are presented as number (%).

Health–Related Behaviors of Middle–Aged Cancer Survivors: A Comparative Study with Matched Non-Cancer Controls Using the Korea National Health and Nutrition Examination Survey VI–VII (2013–2018) Data

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ABSTRACT

Background: Middle-aged cancer survivors lack specific health guidelines compared to young and old cancer survivors. Their increased prevalence necessitates the establishment of tailored health guidelines. This study aimed to investigate the health-related behaviors of middle-aged cancer survivors compared to those of the general population.

Methods: This cross-sectional study analyzed 17,332 adults aged 40–65 years who participated in the sixth and seventh Korea National Health and Nutrition Examination Survey (2013–2018). Data on cancer screening, alcohol consumption, smoking, physical activity, sedentary time, and dietary management were collected via self-reported questionnaires. Propensity score matching (1:5) revealed 591 middle-aged cancer survivors and 2,955 non-cancer controls. Descriptive statistics, chi-square tests, and logistic regression analyses were conducted to compare the demographic characteristics and health-related behaviors of both groups.

Results: Multivariate analysis revealed that middle-aged cancer survivors were significantly less likely to consume alcohol (odds ratio [OR]: 0.64; 95% confidence interval [CI]: 0.51–0.81) and smoke (OR: 0.65; 95% CI: 0.43–0.99) and more likely to engage in aerobic physical activity (OR: 1.33; 95% CI: 1.08–1.64) and practice dietary management (OR: 1.47; 95% CI: 1.17–1.84) than the non-cancer controls. However, no significant differences in cancer screening adherence and sedentary time were observed between both groups.

Conclusions: Overall, this study provides fundamental data for the development of tailored health guidelines and patient education programs for cancer survivors.

Keywords: Cancer survivors, Middle aged, Health behavior, Propensity score

INTRODUCTION

In addition to the National Cancer Screening Program, various private health screening programs have significantly increased the early cancer detection rate in South Korea [1]. Compared to that in 1999, cancer incidence rate more than doubled in 2019, especially among individuals over 40 years of age [2]. Subsequently, early detection and treatment improved the 5-year survival rate of patients with cancer to 70.7%, leading to a growing population of approximately 2.15 million cancer survivors [2].

Maintaining a healthy lifestyle after primary cancer treatment is crucial to prevent recurrence in cancer survivors. Various lifestyle interventions, such as regular physical activity and dietary modifications, improve the life quality of cancer survivors [3,4]. Prevention of secondary cancer and chronic diseases is necessary to reduce the mortality rate, further emphasizing the importance of lifestyle management, including regular health screening, smoking cessation, moderate alcohol consumption, aerobic exercise, and balanced diet [5,6].

Compared to the young and old cancer survivors, middle-aged cancer survivors face unique challenges in resuming their daily lives after treatment. Many return to work and shoulder family responsibilities while managing the long-term complications of cancer treatment, such as pain, fatigue, and depression. These survivors exhibit a higher risk of developing secondary cancers and chronic diseases than the general population, making good health-related behaviors critical to ensure long-term survival [7]. However, comprehensive health management guidelines specific to middle-aged cancer survivors are limited, with existing recommendations often generalized for all patients with cancer regardless of age [8,9]. Furthermore, long-standing lifestyle habits are difficult to change following cancer diagnosis and adherence to recommended health-related behaviors is often suboptimal in patients with cancer [10]. Therefore, we analyze health-related behaviors that could be recommended to middle-aged cancer survivors, which have not been addressed in previous studies.

This study aimed to assess the health-related behaviors of middle-aged cancer survivors in South Korea using the Korea National Health and Nutrition Examination Survey (KNHANES) data. By comparing their health-related behaviors with those of non-cancer controls, this study provides fundamental data for the development of tailored health guidelines and patient education programs for cancer survivors.

METHODS

Study design and participants

This retrospective study used secondary data from KNHANES to compare the health-related behaviors of middle-aged cancer survivors and non-cancer controls. This study was approved by the Institutional Review Board (IRB) of the Hwasun Chonnam National University Hospital (IRB No. CNUHH-2022-108). The dataset was officially approved as national statistics (approval No. 117002) and collected according to the National Health

Promotion, Statistics, and Personal Information Protection Acts. KNHANES VI (2013–2015) and VII (2016–2018) data were analyzed. Out of 47,217 survey participants, only 17,332 individuals aged 40–65 years were included in this study. Participants who answered "don't know" or refused to answer the questions related to cancer diagnosis (n=1,917) and health-related behaviors (n=2,232) were excluded from the study, resulting in a final sample size of 13,183 individuals. Among these individuals, only 750 had a history of cancer, with 12,433 individuals having no cancer history. To maintain a homogenous sample, individuals diagnosed within the past 2 years were excluded due to ongoing acute treatment and post-treatment effects, such as emotional stress, anxiety, depression, fatigue, and physical impairments [11]. Consequently, the final sample included 591 middle-aged cancer survivors diagnosed within the last 2 years (Fig. 1).

Variables

Study variables included sociodemographic characteristics, such as age, sex, marital status, education level, employment status, household income, and residential area, body mass index (BMI), comorbidities, activity limitations, stress level, and self-reported health status. According to the criteria established by the Korean Society for the Study of Obesity, the participants were categorized as underweight (<18.5 kg/m^2), normal weight ($18.5–24.9$ kg/m^2), or obese (≥25.0 kg/m^2) based on their BMI
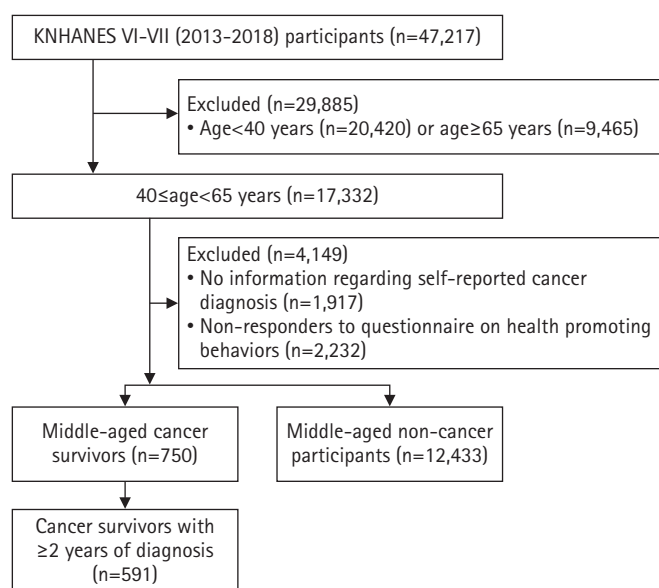

Fig. 1. Flowchart of the study participants. KNHANES, Korea National Health and Nutrition Examination Survey.

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[12]. The participants were further categorized as married or non-married (single, divorced, or separated) based on their marital status and as <high school, high school graduate, or ≥college graduate based on their education level. Additionally, the participants were classified as employed or unemployed based on their employment status and categorized into four groups (low, middle-low, middle-high, and high income) based on their household income. Based on their residential area, they were categorized as urban or rural. Comorbidities included physician-diagnosed conditions, such as hypertension, dyslipidemia, cardiovascular diseases, arthritis, chronic respiratory diseases, diabetes, thyroid diseases, depression, chronic kidney disease, and liver diseases (hepatitis B, hepatitis C, and cirrhosis). Activity limitations were assessed with the question, "Do you have any limitations in your daily life and social activities due to current health problems or physical/mental disabilities?" The responses were categorized as "Yes" or "No." Stress level was assessed with the question, "How much stress do you usually experience in daily life?" The responses were categorized as none, mild, moderate, or severe. Self-reported health status was assessed with the question, "How would you rate your overall health?" The responses were categorized as good, fair, or poor.

Health–related behaviors

Health-related behaviors were assessed based on the key lifestyle factors associated with cancer prevention and survival. Cancer screening adherence was defined as having undergone screening within the past 2 years, including both self-paid screening at comprehensive health centers and that provided by the National Health Insurance Corporation. Participant responses for screening adherence were categorized as "Yes" or "No." Alcohol consumption was assessed based on the "monthly drinking rate" indicated in the KNHANES data, with participant responses classified as "Yes" if they consumed alcohol at least once per month or "No" if they were lifetime abstainers or consumed alcohol less than once per month. Based on their smoking status, the participants were classified as "current smokers" or "non-smokers/former smokers who quit smoking." Physical activity was assessed according to the World Health Organization guidelines, with moderate-intensity activity defined as at least 150 minutes activity per week, vigorous-intensity activity as at least 75 minutes activity per week, or equivalent combination of both moderate and vigorous activities (1 minute of vigorous activity=2 minutes of moderate activity) [13]. Sedentary time was evaluated based on the self-reported daily sitting time, with

prolonged sedentary time (>7 hr/day) classified as a risk factor for increased mortality [14]. Patient responses to the dietary control question, "Do you control your diet for special health reasons?" were categorized as "Yes" or "No."

Statistical analyses

As the KNHANES data were collected using a complex sampling design rather than complete enumeration, survey weights, stratification variables, and cluster variables were incorporated into the statistical analyses. For the sociodemographic characteristics, unweighted numbers and weighted percentages were used as categorical variables, whereas means and standard errors were used as continuous variables.

Propensity score matching (PSM) was performed using a non-random package in R, version 4.1.0 to minimize the selection bias [15]. Each middle-aged cancer survivor was matched with five non-cancer controls based on variables potentially influencing the health-related behaviors, including age, sex, BMI, marital status, education level, employment status, household income, residential area, comorbidities, activity limitations, stress level, and self-reported health status. Univariate analyses were conducted using chi-square tests, whereas multivariate analyses were performed using binary logistic regression. Multivariate logistic regression models were developed using two approaches to evaluate the health-related behaviors before and after PSM. Model 1 was adjusted for PSM and significant variables ($P<0.1$) identified via the univariate analyses of health-related behaviors, whereas Model 2 was adjusted for PSM and all covariates. Two-tailed P-value <0.05 was considered statistically significant. All statistical analyses, except PSM, were performed using SPSS ver. 28.0 (IBM Corp.).

RESULTS

Patient characteristics before and after propensity score matching

Patient characteristics before and after PSM are presented in Table 1. Among the 13,024 participants, mean age of the 591 cancer survivors, including 136 males (26.3%) and 455 females (73.7%), was 53.8 years. Before matching, mean age of 12,433 non-cancer participants, including 5,071 males (47.8%) and 7,362 females (52.2%), was 51.2 years. After 1:5 PSM, the final sample comprised 591 cancer survivors and 2,955 non-cancer controls. Prior to matching, significant differences in baseline characteristics, including age, sex, BMI, education level, em-

Table 1. Characteristics of the study population before and after 1:5 PSM

Characteristic	Before matching			After 1:5 PSM		
	Case (n=591)	Control (n=12,433)	*P*-value	Case (n=591)	Control (n=2,955)	*P*-value
Age (yr)	53.8±0.3	51.2±0.1	<0.001	53.8±0.3	53.5±0.2	0.268
Sex			<0.001			0.687
Male	136 (26.3)	5,071 (47.8)		136 (26.3)	626 (25.4)	
Female	455 (73.7)	7,362 (52.2)		455 (73.7)	2,329 (74.6)	
BMI (kg/m²)			0.005			0.843
<18.5	22 (3.8)	302 (2.4)		22 (3.8)	119 (4.2)	
18.5–25.0	396 (66.5)	7,734 (61.8)		396 (66.5)	1,981 (67.2)	
≥25.0	173 (29.6)	4,397 (35.9)		173 (28.6)	855 (28.6)	
Marital status			0.909			0.551
Married	496 (85.1)	10,569 (85.3)		496 (85.1)	2,463 (84.0)	
Single/divorced/separated	95 (14.9)	1,864 (14.7)		95 (14.9)	492 (16.0)	
Education level			<0.001			0.908
<High school	199 (32.6)	3,405 (24.4)		199 (32.6)	1,031 (31.6)	
High school	233 (40.1)	4,685 (39.1)		233 (40.1)	1,141 (40.9)	
≥College	159 (27.3)	4,343 (36.6)		159 (27.3)	783 (27.5)	
Employment status			<0.001			0.855
Employed	259 (42.5)	3,555 (26.5)		259 (42.5)	1,293 (42.1)	
Unemployed	332 (57.5)	8,878 (73.5)		332 (57.5)	1,662 (57.9)	
Household income level			0.002			0.932
Low	98 (15.2)	1,298 (9.9)		98 (15.2)	459 (14.3)	
Middle-low	137 (21.5)	2,945 (23.1)		137 (21.5)	674 (22.0)	
Middle-high	167 (29.9)	3,683 (30.3)		167 (29.9)	863 (30.8)	
High	189 (33.4)	4,507 (36.7)		189 (33.4)	959 (32.9)	
Residential area			0.971			0.639
Urban	267 (46.7)	5,622 (46.8)		267 (46.7)	1,302 (45.4)	
Rural	324 (53.3)	6,811 (53.2)		324 (53.3)	1,653 (54.6)	
Comorbidities			<0.001			0.688
0	253 (45.4)	6,594 (55.1)		253 (45.4)	1,302 (46.4)	
≥1	338 (54.6)	5,839 (44.9)		338 (54.6)	1,653 (53.6)	
Activity limitations			<0.001			0.537
Yes	64 (11.2)	804 (6.2)		64 (11.2)	326 (10.2)	
No	527 (88.8)	11,629 (93.8)		527 (88.8)	2,629 (89.8)	
Stress level			0.479			0.948
None	28 (4.8)	517 (4.2)		28 (4.8)	146 (5.1)	
Mild	110 (17.5)	2,469 (20.0)		110 (17.5)	523 (18.0)	
Moderate	377 (63.9)	7,607 (61.3)		377 (63.9)	1,903 (64.2)	
Severe	76 (13.7)	1,840 (14.4)		76 (13.7)	383 (12.7)	
Self-reported health status			<0.001			0.897
Good	109 (19.4)	3,662 (30.1)		109 (19.4)	569 (19.7)	
Fair	305 (51.1)	6,695 (53.8)		305 (51.1)	1,532 (51.9)	
Bad	177 (29.5)	2,076 (16.1)		177 (29.5)	854 (28.4)	

Values are presenred as mean±standard error or unweighted numbers (weighted %).
BMI, body mass index; PSM, propensity score matching.

ployment status, household income, comorbidities, activity limitations, and self-reported health status, were observed between both groups (*P*<0.05). However, after matching, no significant difference in any characteristic was observed between both groups (*P*>0.05), confirming successful matching.

Cancer types

Among the 591 middle-aged cancer survivors, thyroid cancer (n=152; 25.7%) was the most common, followed by breast (n=114; 19.3%), other (n=95; 16.1%), cervical (n=78; 13.2%), stomach (n=76, 12.9%), colon (n=39; 6.6%), liver (n=10; 1.7%), and lung (n=10; 1.7%) cancers. Notably, 17 participants (2.9%) were diagnosed with multiple primary cancers. The time

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elapsed since diagnosis was ≥2 years but <5 years in 201 participants (34.0%) and ≥5 years in 390 participants (66.0%) (Table 2).

Comparison of health-related behaviors before and after propensity score matching

Health-related behaviors of both groups before and after PSM are presented in Table 3. After matching, significant differences in alcohol consumption, physical activity, and diet were observed between both groups. In total, 217 middle-aged cancer survivors (39.0%) consumed alcohol compared to the 1,325 controls (48.5%) (P<0.001). Moreover, 288 cancer survivors (50.7%) engaged in moderate or vigorous physical activity, and 1,276 controls (44.0%) adhered to the recommended physical activity guidelines (P=0.011). Dietary management was significantly different between both groups, with only 211 cancer survivors (35.8%) showing diet adherence compared to the 797 controls (26.5%) (P<0.001). However, no significant differences in cancer screening adherence, smoking status, and sedentary time were noted between both groups.

Logistic regression analysis of health-related behaviors

Next, multivariate logistic regression analyses were conducted to examine the differences in health-related behaviors between middle-aged cancer survivors and non-cancer controls (Table 4). In Model 1, which was adjusted for PSM and significant covariates (P<0.1) determined via univariate analyses, middle-aged cancer survivors were significantly less likely to consume alcohol (odds ratio [OR]: 0.64; 95% confidence interval [CI]: 0.51–0.81) and smoke (OR: 0.64; 95% CI: 0.42–0.97) but more likely to engage in physical activity (OR: 1.33; 95% CI: 1.08–1.63) and practice dietary management (OR: 1.47; 95% CI: 1.17–1.83) than the non-cancer controls. No significant differences in cancer screening adherence and sedentary time were observed

Table 2. Cancer types of the cancer survivors included in this study

	Value
Total	591
Single primary cancer	
Thyroid	152 (25.7)
Breast	114 (19.3)
Cervix	78 (13.2)
Stomach	76 (12.9)
Colon	39 (6.6)
Lung	10 (1.7)
Liver	10 (1.7)
Others[a]	95 (16.1)
Double primary cancer	17 (2.9)
Years since diagnosis	
2–5	201 (34.0)
≥5	390 (66.0)

Values are presented as number only, number (%).
[a]Cancers other than stomach, liver, colon, breast, cervix, lung, and thyroid cancers.

Table 3. Health-related behaviors of the study population before and after 1:5 PSM

	Before matching			After 1:5 PSM		
	Case (n=591)	Control (n=12,433)	P-value	Case (n=591)	Control (n=2,955)	P-value
Cancer screening			0.032			0.104
Yes	435 (73.9)	8,806 (69.1)		435 (73.9)	2,120 (70.1)	
No	156 (26.1)	3,627 (30.9)		156 (26.1)	835 (29.9)	
Alcohol consumption			<0.001			<0.001
Yes	217 (39.0)	6,887 (58.5)		217 (39.0)	1,325 (48.5)	
No	374 (61.0)	5,546 (41.5)		374 (61.0)	1,630 (51.5)	
Smoking			<0.001			0.068
Yes	49 (10.3)	2,346 (21.6)		49 (10.3)	345 (13.7)	
No	542 (89.7)	10,087 (78.4)		542 (89.7)	2,610 (86.3)	
Physical activity			0.101			0.011
Yes	288 (50.7)	5,588 (46.6)		288 (50.7)	1,276 (44.0)	
No	303 (49.3)	6,845 (53.4)		303 (49.3)	1,679 (56.0)	
Sedentary time			0.482			0.185
≥7 hr	302 (51.6)	6,146 (49.9)		302 (51.6)	1,413 (48.3)	
<7 hr	289 (48.4)	6,287 (50.1)		289 (48.4)	1,542 (51.7)	
Dietary management			<0.001			<0.001
Yes	211 (35.8)	3,146 (24.6)		211 (35.8)	797 (26.5)	
No	380 (64.2)	9,287 (75.4)		380 (64.2)	2,158 (73.5)	

Values are presented as unweighted numbers (weighted %).
PSM, propensity score matching.

Table 4. Multivariate analyses of the health-related behaviors of the cancer survivors and non-cancer controls

	Model 1[a]		Model 2[b]	
	OR (95% CI)	P-value	OR (95% CI)	P-value
Cancer screening (yes)	1.22 (0.97–1.53)	0.089	1.22 (0.97–1.53)	0.092
Alcohol consumption (yes)	0.64 (0.51–0.81)	<0.001	0.64 (0.52–0.81)	<0.001
Smoking (yes)	0.64 (0.42–0.97)	0.034	0.65 (0.43–0.99)	0.043
Physical activity (yes)	1.33 (1.08–1.63)	0.008	1.33 (1.08–1.64)	0.008
Sedentary time (≥7 hr)	1.15 (0.94–1.40)	0.175	1.15 (0.94–1.40)	0.176
Dietary management (yes)	1.47 (1.17–1.83)	<0.001	1.47 (1.17–1.84)	<0.001

BMI, body mass index; CI, confidence interval; OR, odds ratio; PSM, propensity score matching.
[a]Model 1 was adjusted for PSM and significant covariates ($P<0.1$) identified via the univariate analyses of all health-related behaviors. For cancer screening adherence, significant covariates included sex, marital status, education level, household income level, comorbidities, activity limitations, and self-reported health status. For alcohol consumption, significant covariates included age, sex, BMI, education level, employment status, comorbidities, activity limitations, and self-reported health status. For smoking status, significant covariates included sex, BMI, marital status, employment status, household income level, residential area, activity limitations, stress level, and self-reported health status. For physical activity, significant covariates included age, marital status, education level, household income level, residential area, activity limitations, stress level, and self-reported health status. For sedentary behavior, significant covariates included age, sex, education level, household income level, stress level, and self-reported health status. For dietary management, significant covariates included sex, BMI, employment status, comorbidities, and activity limitations. [b]Model 2 was adjusted for PSM and all covariates.

between both groups.

Model 2, which was adjusted for PSM and all covariates, showed the same results, with middle-aged cancer survivors exhibiting lower odds of alcohol consumption (OR: 0.64; 95% CI: 0.52–0.81) and smoking (OR: 0.65; 95% CI: 0.43–0.99) and higher odds of engaging in physical activity (OR: 1.33; 95% CI: 1.08–1.64) and practicing dietary management (OR: 1.47; 95% CI: 1.17–1.84) than the non-cancer controls. However, no significant differences in cancer screening adherence and sedentary time were noted between both groups. All logistic regression models incorporated sampling weights to account for the complex survey design of KNHANES.

DISCUSSION

This study investigated the differences in the health-promoting behaviors of middle-aged cancer survivors and non-cancer participants. Notably, cancer survivors exhibited lower odds of alcohol consumption and smoking and higher odds of aerobic physical activity and diet adherence than the non-cancer controls. However, no significant differences in cancer screening adherence and sedentary time were observed between both groups.

Owing to the increasing number of cancer survivors, secondary cancer prevention has become a major public health concern [16]. Various risk factors, including smoking, alcohol consumption, poor nutrition, and physical inactivity, contribute to primary and secondary cancer development [17]. Specifically, middle-aged cancer survivors are more vulnerable to car-

diovascular comorbidities, such as hypertension, obesity, and smoking-related diseases, than the old cancer survivors [18]. Therefore, adopting and maintaining good health-related behaviors are essential to improve the long-term health outcomes and sustain functional independence in middle-aged cancer survivors.

Continuous smoking and alcohol consumption even after cancer diagnosis are strongly associated with the increased risk of chronic diseases and metabolic syndrome [19,20] and high likelihood of cancer recurrence and development of secondary malignancies [21,22]. Therefore, healthcare professionals emphasize the importance of smoking cessation and reduced alcohol consumption to prolong the survival of middle-aged cancer survivors. In this study, cancer survivors exhibited lower odds of smoking and alcohol consumption than the non-cancer controls, consistent with previous reports [23-25]. Dietary habits and physical activity play crucial roles in addressing nutritional deficiencies, preserving the muscle mass, and managing metabolic imbalances after cancer treatment [26]. Consumption of a nutritionally balanced diet is associated with a low mortality risk in cancer survivors [27]. Cancer survivors in their 50s have greater awareness of food safety than those in other age groups [28]. Although this study did not assess the specific dietary patterns, middle-aged cancer survivors showed dietary adherence more consistently than the controls. Regular aerobic physical activity is associated with improved physical function, reduced psychological distress, and enhanced overall quality of life [29]. In this study, middle-aged cancer survivors engaged in physical activity more than the controls. These reports highlight the

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need for structured guidelines focusing on minimizing the risk of exercise-related injuries to ensure the safe and effective implementation of exercise programs for cancer survivors.

Secondary primary cancer, which is distinct from cancer recurrence and metastasis, is a newly diagnosed malignancy in individuals with cancer history. Cancer survivors exhibit a significantly higher risk of secondary cancer development than the general population [5]. Despite this increased risk, many survivors do not undergo the recommended secondary cancer screening, often due to limited awareness and healthcare access [30,31]. A previous study reported higher cancer screening adherence in middle-aged cancer survivors than in the general population due to improved information dissemination [7]. In contrast, this study revealed no significant difference in cancer screening adherence between the middle-aged cancer survivors and non-cancer controls. This suggests that external factors, such as healthcare accessibility, insurance coverage, and socioeconomic barriers, influence cancer screening adherence more than individual awareness. Future studies should explore these determinants to facilitate the establishment of targeted interventions to promote cancer screening. Moreover, considering the lack of standardized secondary cancer screening guidelines, healthcare providers should emphasize the importance of routine screening to facilitate the early detection and timely treatment of patients.

Sedentary behaviors, defined as activities requiring energy expenditure <1.5 metabolic equivalents while sitting, reclining, or lying down, are growing health concerns for cancer survivors [32]. Prolonged sedentary time >10 hr/day is associated with increased all-cause mortality and reduced quality of life in cancer survivors [33-35]. Therefore, the World Health Organization [36] recommends engaging in physical activities of any intensity in sedentary time. Simple behavioral modifications, such as using stairs instead of elevators, engaging in brief high-intensity exercises, and minimizing screen time, reduce the sedentary time and improve the overall health of individuals. Notably, this study indicated no significant difference in sedentary time between the middle-aged cancer survivors and non-cancer controls, possibly due to its greater focus on engaging in moderate–vigorous physical activity than on specific efforts to reduce sedentary time. Therefore, future studies should investigate whether reducing sedentary time independent of physical activity levels improves the long-term health outcomes of cancer survivors. Moreover, use of wearable technology with real-time activity tracking can provide objective data on sedentary time and its impact on cancer survival.

This study has several strengths. Use of a large nationally representative dataset and PSM reduced the selection bias, thereby improving the reliability of the findings. Unlike previous studies that grouped different age ranges and cancer types, this study specifically focused on the middle-aged cancer survivors, thereby providing specific insights into this population. As middle-aged individuals are actively engaged in the workforce and often serve as caregivers, good health-related behaviors are particularly important for their long-term well-being. Furthermore, this study highlights the importance of reducing the sedentary time and increasing the physical activity of cancer survivors. Although no significant difference in sedentary time was observed between the middle-aged cancer survivors and non-cancer controls, targeted interventions are necessary to change the sedentary behaviors of middle-aged cancer survivors.

This study has some limitations. First, cancer stage was not considered, which may have influenced the findings, as individuals with advanced cancer often exhibit physical limitations affecting their activity levels. Therefore, future studies should assess cancer staging to provide more comprehensive insights. Second, self-reported nature of the survey may have introduced potential recall bias and subjective variability, particularly in dietary and physical activity assessments. Third, this cross-sectional study did not determine the associations between cancer survival and health-related behaviors, warranting further longitudinal studies. Nevertheless, this study provided valuable insights into the health-related behaviors of middle-aged cancer survivors, facilitating the development of tailored interventions to enhance their long-term survival.

In conclusion, although middle-aged cancer survivors exhibited health-promoting behaviors, including reduced alcohol consumption and smoking, high physical activity, and dietary adherence, some gaps persisted in their preventive care. This study highlights the importance of secondary cancer screening and reduced sedentary time for the enhanced survival of these individuals. Furthermore, targeted interventions are necessary to address the existing gaps and improve the long-term health outcomes of middle-aged cancer survivors.

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Comparative Study of Middle and High School Students on the Relationship between High-Caffeine Drinks and Mental Health

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ABSTRACT

Background: This study aim to compare between middle and high school students on the relationship of high-caffeine drinks and mental health.

Methods: This national cross-sectional secondary study used data from the 20th Korea Youth Risk Behavior Survey (2024). The respondents of this study were 54,653 middle and high school students. Descriptive statistics, chi-square analysis, and complex sample logistic regression analysis were performed using IBM SPSS Statistics 25.0.

Results: Respondents of 'much' perceived stress consumed 1.493 times ($P<0.001$) more high-caffeine drinks in middle school and 1.699 times ($P<0.001$) in high school than those of 'little.' Respondents of 'yes' sadness & despair consumed 1.189 times ($P<0.001$) more high-caffeine drinks in middle school and consumed 1.142 times ($P<0.001$) in high school than those of 'no.' Suicidal ideation and loneliness variables were statistically significant in middle school, but not in high school.

Conclusions: It was concluded that middle and high school students who were more stressed and experienced sadness & despair consumed more high-caffeine drinks. However, only middle school students who experienced suicidal ideation and loneliness consumed more high-caffeine drinks. Recognizing each characteristic of middle and high school students, tailored intervention program should be developed based on the community and school.

Keywords: Mental health, Caffeine, Middle school, High school

INTRODUCTION

Caffeine is a central nervous system stimulant and has been consumed worldwide for a long time as food supplements [1]. High-caffeine drinks contain large amounts of caffeine, taurine, etc., and are widely consumed by adolescents for reasons such as increased energy and concentration, awakening effects, and athletic performance [2]. The Ministry of Food and Drug Safety [3] recommends that adolescents consume no more than 2.5 mg

of caffeine per kg of body weight per day. There are concerns that adolescents' recommended daily caffeine intake may easily be exceeded when combined with multiple caffeinated drinks or foods. As it is known that high-caffeine drinks are effective in temporarily relieving fatigue, increasing physical activity, and relieving stress, their consumption is increasing, especially among adolescents [2,4]. According to the results of the Korea Youth Risk Behavior Survey (KYRBS) targeting middle and high school students in Korea, the consumption of high-caffeine

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drinks increased from 28.4% in 2022 to 31.5% in 2024 [5]. Despite of side effects such as heart palpitations and sleep disturbances, the consumption of high-caffeine drinks by adolescents is increasing every year [6]. Students in middle adolescence, including middle and high school students, is a developmental transition period from childhood to adult and they experienced physical and mental changes in this period. The social environment contains various factors that threaten mental health, such as stress and anxiety, so adolescents face many difficulties in adapting to changes in the social environment [7,8]. According to the results of the KYRBS, the rate of youth's perceived stress, depression, and loneliness experiences is expected to increase in 2024 compared to 2023 [6]. Mental health in middle and high school affects adulthood, so it is very important to manage it not only on an individual but also at a policy level. Adolescents are likely to consume excessive amounts of high-caffeine drinks for curiosity without recognizing the health issue [9]. Consumption of high-caffeine drinks by middle and high school students can be addictive and have negative mental health, more research is needed to develop policy development.

In prior studies on the mental health of adolescents and high-caffeine drinks, most of them were surveys or studies on influencing factors targeting adolescents [10-14]. Despite the differences in physical and mental development characteristics of middle and high school students, there have been no cases of studying them separately. Considering the results of KYRBS that show that the stress rate in middle school is higher than that in high school, it is necessary to establish policy measures tailored to each middle and high school student. This study aim to compare between middle and high school students on the relationship of high-caffeine drinks and mental health. And we expect that the results of this study may contribute to the development of policies for improving mental health coping skills of middle and high school students and strengthening customized support programs.

METHODS

Research design

This study is a secondary data analysis study to compare the relationship between high-caffeine drinks and mental health by separating middle and high school students in Korea. Data on the study respondents were obtained from the 20th KYRBS [5], which was administered in 2024 by the Korean Ministry of Education, Science and Technology, the Ministry of Health and Welfare, and the Korea Disease Control and Prevention Agency (KDCA).

Respondents

KYRBS is an ongoing national cross-sectional survey that assesses health-risk behaviors among middle and high school students monitor progress toward achieving national health objectives and health plan of South Korea. Respondents of this study were 54,653 respondents from 400 middle schools and 400 high schools. Written informed consent was obtained from each participant prior to the self-administered online survey. All the data used in this study were fully anonymized before access. The data collection period was from June 2024 to July 2024.

Measures

The data collected by the survey includes information on respondent's characteristics such as sex, school, academic performance, and household income. As health-related behaviors, high-intensity physical activity, high-caffeine drinks, walking days, cigarette smoke, and drinking experience, perceived health were included. The mental health variables were perceived stress, sadness & despair, suicidal ideation, and loneliness. As an outcome variable, we analyzed the relationship between high-caffeine drinks and mental health variables. Academic performance was asked, "How was your academic performance over the past 12 months?" and response were modified upper, middle, and lower. Household income was asked, "What is your family's financial situation?" and response were modified upper, middle, and lower. The variable of 'high-caffeine drinks' was asked, "During the past 7 days, how often did you get high-caffeine drinks?" and response were modified that 'yes' is if student drank high-caffeine drinks at least once and 'no' is if student did not drink it in last 7 days. In mental health variables, perceived stress was asked, "How much stress do you usually feel?" and responses were modified often, sometimes, or rarely. Sadness & despair was asked, "In the past 12 months, have you ever felt so sad or hopeless that you stopped doing your usual activities for a full 2 weeks?" and suicidal ideation was asked, "In the past 12 months, have you ever seriously considered suicide?" Loneliness was asked, "In the past 12 months, how often have you felt lonely?" and responses were modified often, sometimes, or rarely.

Data analysis

The KYRBS comprises complex data, which were analyzed based on complex sampling design and strata, cluster, weight, and finite population correction provided by the KDCA. The analysis was performed using IBM SPSS Statistics 25.0 at a significance level of 0.05. Descriptive statistics were used to characterize the study population. Differences high-caffeine drinks consumption by respondent's characteristics were analyzed using chi-square and the t-test. Lastly, logistic regression analysis using complex sample were performed to identify the relationship high-caffeine drinks and mental health. Logistic analysis was conducted in two steps. First, the analysis was conducted without adjusting the general characteristic variables, which is Model 1. Second, analysis was performed after adjusting general characteristic variables which is Model 2.

Ethical considerations

The KYRBS is a government-approved statistical survey conducted annually in Korea since 2005 (approval no. 117058). This study obtained data from the survey website (https://www.kdca.go.kr/yhs) according to the regulations of the KDCA.

RESULTS

General characteristics

The general characteristics of respondents are as follows Table 1. Male is 51.3% and female is 48.7% in middle school. Male is 51.6% and female is 48.4% in high school. In academic achievement, upper was the highest in middle school at 45.8% (13,009 persons), and lower was the highest in high school at 38.3% (8,246 persons). In household income, upper was the highest in middle school at 47.7% (13,451 persons), and middle was the highest in high school at 48.9% (12,598 persons). Looking at health-related behavior variables, the highest of middle school students engaged in high-intensity physical activity 3 or more times per week at 51.5% (15,170 persons), while the highest of high school students engaged in 1–2 times at 39.4% (10,099 persons). In case of walking days per week, the highest of middle school students engaged in high-intensity physical activity 3 or more times per week at 46.8% (13,741 persons), while the highest of high school students engaged in never at 34.9% (8,847 persons). In lifetime smoking experience, the most common answer was 'no' in middle (95.6%) and high school (88.8%). In lifetime drinking experience, the most common answer was 'no' in middle (78.8%) and high school (59.5%). In weekly con-

Table 1. General characteristics in respondents (N=54,653)

Variable	Category	Middle school (n=29,087)	High school (n=25,566)
Sex	Male	15,067 (51.3)	13,023 (51.6)
	Female	14,020 (48.7)	12,543 (48.4)
Academic performance	Upper	13,009 (45.8)	7,829 (30.4)
	Middle	7,831 (26.7)	8,013 (31.3)
	Lower	8,246 (27.5)	8,246 (38.3)
Household income	Upper	13,451 (47.7)	9,692 (38.6)
	Middle	12,833 (43.4)	12,598 (48.9)
	Lower	2,801 (8.9)	3,273 (12.5)
High-intensity physical activity (/wk)	Never	4,796 (16.9)	7,431 (29.2)
	1–2 times	9,121 (31.6)	10,099 (39.4)
	≥3 times	15,170 (51.5)	8,036 (31.4)
Walking days per week (≥ 60 min/day)	Never	7,520 (26.2)	8,847 (34.9)
	1–2 times	7,826 (27.0)	8,601 (33.5)
	≥3 times	13,741 (46.8)	8,118 (31.6)
Cigarettes smoking experience	No	27,766 (95.6)	22,676 (88.8)
	Yes	1,321 (4.4)	2,890 (11.2)
Drinking experience	No	22,751 (78.8)	15,247 (59.5)
	Yes	6,336 (21.2)	10,319 (40.0)
High-caffeine drink (last 7 days)	No	17,033 (58.6)	10,480 (40.2)
	Yes	12,054 (41.4)	15,086 (59.8)
Perceived health	Healthy	20,144 (69.4)	16,052 (62.8)
	Neutral	6,742 (23.2)	6,610 (25.9)
	Unhealthy	2,201 (7.5)	2,904 (11.3)
Perceived stress	Much	11,961 (41.3)	11,081 (43.4)
	Middle	12,235 (42.1)	10,728 (42.2)
	Little	4,891 (16.6)	8,648 (15.5)
Sadness & despair	No	20,950 (72.1)	18,538 (72.5)
	Yes	8,137 (27.9)	7,028 (27.5)
Suicidal ideation	No	25,098 (86.1)	22,604 (88.5)
	Yes	3,989 (13.9)	2,962 (11.5)
Loneliness	Much	5,324 (18.7)	4,837 (19.0)
	Middle	10,539 (36.1)	9,528 (37.5)
	Little	13,224 (45.2)	11,201 (43.5)

sumption of high-caffeine drinks, 'no' was the highest at 58.6% (17,033 persons) followed by 'yes' at 41.4% (12,054 persons) in middle school. On the other hand, 'yes' was the highest at 59.8% (15,086 persons) followed by 'no' at 40.2% (10,480 persons) in high school.

Regarding variables of mental health, perceived health was healthy accounted for the most in middle and high school. In terms of perceived stress, middle was the highest at 42.1% (12,235 persons) followed by much at 41.3%, little at 16.6% in middle school. On the other hand, much was the highest at 43.4% (11,081 persons) followed by middle at 42.2%, little at 15.5% in high school. In terms of sadness & despair, the most common answer was 'no' in middle (72.1%) and high school (72.5%). In terms of suicidal ideation, the most common answer

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was 'no' in middle (86.1%) and high school (88.5%). In terms of loneliness, little was the highest at 45.2% (13,224 persons) in middle school and 43.5% (11,201 persons) in high school.

Differences of high-caffeine drinks by general characteristics

Table 2 shows the differences in consumption of high-caffeine drinks by general characteristics. There were statistically significant differences in high-caffeine drinks consumption by sex (P=0.001), academic performance (P<0.001), household income (P<0.001), walking days (P<0.001), smoking and drinking experience (P<0.001), perceived health (P<0.001), perceived stress (P<0.001), sadness & despair (P<0.001), suicidal ideation (P<0.001), and loneliness (P<0.001). However, high-intensity physical activity was not statistically significant.

The specific results about consuming high-caffeine drinks are as follows. In middle school, respondents with 'yes' were male (42.8%, 6,446 persons) and female (40.0%, 5,608 persons), but in high school, respondents with 'yes' were male (60.3%, 7,768 persons) and female (59.2%, 7,318 persons). In the academic performance variable, in middle school, students with 'lower' (47.5%, 3,906 persons) consumed more high-caffeine drinks than middle and upper, while in high school, students with upper (62.8%, 4,821 persons) consumed more it than middle and lower. In the household income variable, in middle school, students with lower (48.5%, 1,355 persons) consumed more high-caffeine drinks than middle and upper, while in high school, students with upper (62.4%, 5,944 persons) consumed more it than middle and lower. In the walking variable, students with ≥3 times per week in middle (43.8%, 6,053 persons) and

Table 2. Differences of high-caffeine drinks by respondents's characteristics (N=54,653)

| Variable | Category | High-caffeine drinks (last 7 days), n (%) | | | | F or χ² (P) |
| | | Middle school | | High school | | |
		No	Yes	No	Yes	
Sex	Male	8,621 (57.2)	6,446 (42.8)	5,255 (39.7)	7,768 (60.3)	21.966 (0.001)
	Female	8,412 (60.0)	5,608 (40.0)	8,412 (40.8)	7,318 (59.2)	
Academic performance	Upper	8,095 (62.2)	4,914 (37.8)	3,008 (37.2)	4,821 (62.8)	50.817 (<0.001)
	Middle	4,598 (58.6)	3,233 (41.4)	3,215 (39.5)	4,798 (60.5)	
	Lower	4,340 (52.5)	3,906 (47.5)	4,256 (43.2)	5,466 (56.8)	
Household income	Upper	7,975 (59.0)	5,479 (41.0)	3,748 (37.6)	5,944 (62.4)	23.498 (<0.001)
	Middle	7,611 (59.6)	5,222 (40.4)	5,367 (42.1)	7,231 (57.9)	
	Lower	1,446 (51.5)	1,355 (48.5)	1,363 (41.0)	1,910 (59.0)	
High-intensity physical activity (/wk)	Never	2,946 (61.4)	1,850 (38.6)	3,230 (42.6)	4,201 (57.4)	3.025 (0.050)
	1–2 times	5,490 (60.2)	3,631 (39.8)	4,069 (39.4)	6,030 (60.6)	
	≥3 times	8,597 (56.6)	6,573 (43.4)	3,181 (39.1)	4,855 (60.9)	
Walking days per week (≥60 min/day)	Never	4,712 (62.1)	2,808 (37.9)	3,938 (43.5)	4,909 (56.5)	19.826 (<0.001)
	1–2 times	4,633 (59.2)	3,193 (40.8)	3,408 (38.9)	5,193 (61.1)	
	≥3 times	7,688 (56.2)	6,053 (43.8)	3,134 (38.0)	4,984 (62.0)	
Cigarettes smoking experience	No	16,602 (59.8)	11,164 (40.2)	9,676 (41.9)	13,000 (58.1)	820.428 (<0.001)
	Yes	431 (32.5)	890 (67.5)	804 (27.2)	2,086 (72.8)	
Drinking experience	No	14,277 (62.7)	8,474 (37.3)	6,947 (44.7)	8,300 (55.3)	1,523.609 (<0.001)
	Yes	2,756 (43.3)	3,580 (56.7)	3,533 (33.7)	6,787 (66.3)	
Perceived health	Healthy	12,195 (60.6)	7,949 (39.4)	6,722 (41.0)	9,330 (59.0)	78.918 (<0.001)
	Neutral	3,721 (55.1)	3,021 (44.9)	2,657 (39.7)	3,953 (60.3)	
	Unhealthy	1,117 (51.0)	1,084 (49.0)	1,101 (37.1)	1,803 (62.9)	
Perceived stress	Much	6,237 (52.4)	5,724 (47.6)	4,082 (35.8)	6,999 (64.2)	325.469 (<0.001)
	Middle	7,489 (61.0)	4,746 (39.0)	4,512 (41.5)	6,216 (58.5)	
	Little	3,307 (67.9)	1,584 (32.1)	1,886 (49.7)	1,871 (50.3)	
Sadness & despair	No	13,003 (61.9)	7,947 (38.1)	7,967 (42.3)	10,571 (57.7)	413.423 (<0.001)
	Yes	4,030 (49.9)	4,107 (50.1)	2,513 (34.8)	4,515 (65.2)	
Suicidal ideation	No	15,154 (60.4)	9,944 (39.6)	9,439 (41.0)	13,165 (59.0)	192.766 (<0.001)
	Yes	1,879 (47.6)	2,110 (52.4)	1,041 (34.5)	1,921 (65.5)	
Loneliness	Much	2,644 (49.8)	2,680 (50.2)	1,794 (36.1)	3,043 (63.9)	207.112 (<0.001)
	Middle	5,928 (56.3)	4,611 (43.7)	3,735 (38.5)	5,793 (61.5)	
	Little	8,461 (64.0)	4,763 (36.0)	4,951 (43.5)	6,250 (56.5)	

high school (62.0%, 4,984 persons) consumed more high-caffeine drinks than 1–2 times per week and never. In smoking variable, 67.5% of smoking experience in middle school and 72.8% of smoking experience in high school consumed high-caffeine drinks. In drinking variable, 56.7% of drinking experience in middle school and 66.3% of drinking experience in high school consumed high-caffeine drinks. In perceived health variable, respondents with unhealthy consumed the most high-caffeine drinks in middle (49.0%, 1,084 persons) and high school (62.9%, 1,803 persons).

In the mental health-related variables, the more stressed, the more sadness & despair, the more suicidal ideation, and the more loneliness, the more high-caffeine drinks they consumed. The specific results are as follows. In perceived stress variable, respondents with much consumed the most high-caffeine drinks in middle (47.6%, 5,724 persons) and high school (64.2%, 6,999 persons). In sadness & despair variable, respondents with 'yes' consumed the most high-caffeine drinks in middle (50.1%, 4,107 persons) and high school (65.2%, 4,515 persons). In suicidal ideation variable, respondents with 'yes' consumed the most high-caffeine drinks in middle (52.4%, 2,110 persons) and high school (65.5%, 1,921 persons). Lastly, in loneliness variable, respondents with much consumed the most high-caffeine

drinks in middle (50.2%, 2,680 persons) and high school (63.9%, 3,043 persons).

Logistics regression analysis of mental health and high-caffeine drinks

Complex sample logistic regression analysis were performed after non-adjusting control variables (model 1) and adjusting control variables (model 2) in Table 3. In middle school, there were statistically significant differences in perceived stress ($P<0.001$), sadness & despair ($P<0.001$), suicidal ideation ($P=0.07$), and loneliness ($P<0.001$) with high-caffeine drinks. But in high school, only perceived stress ($P<0.001$) and sadness & despair ($P<0.001$) were statistically significant. The specific results are as follows after adjusting control variables (model 2). In middle school, respondents of much perceived stress consumed 1.493 times ($P<0.001$) more high-caffeine drinks than those of little. Respondents of 'yes' sadness & despair consumed 1.189 times ($P<0.001$) more high-caffeine drinks than those of 'no.' Respondents of 'yes' suicidal ideation consumed 1.125 times ($P<0.05$) more high-caffeine drinks than those of 'no.' And respondents of 'yes' loneliness consumed 1.243 times more high-caffeine drinks than those of little. In high school, respondents of much perceived stress consumed 1.699 times ($P<0.001$)

Table 3. Logistic regression analyses of high-caffeine drinks and mental health

Variable	Category	High-caffeine drinks (last 7 days) (Ref. none)			
		Model 1[a]		Model 2[b]	
		Middle school, yes	High school, yes	Middle school, yes	High school, yes
Perceived stress (Ref. little)	Much	1.482 (1.359–1.616)***	1.598 (1.478–1.727)***	1.493 (1.366–1.632)***	1.699 (1.571–1.836)***
	Middle	1.242 (1.148–1.343)***	1.341 (1.253–1.4.4)***	1.257 (1.160–1.362)***	1.404 (1.311–1.503)***
Sadness & despair (Ref. no)	Yes	1.290 (1.218–1.367)***	1.197 (1.125–1.272)***	1.189 (1.121–1.262)***	1.142 (1.075–1.214)***
Suicidal ideation (Ref. no)	Yes	1.226 (1.132–1.328)***	1.066 (0.977–1.163)	1.125 (1.032–1.227)*	1.047 (0.956–1.147)
Loneliness (Ref. little)	Much	1.243 (1.145–1.350)***	1.028 (0.947–1.116)	1.243 (1.142–1.353)***	0.976 (0.897–1.062)
	Middle	1.179 (1.110–1.252)***	1.068 (0.896–1.056)	1.181 (1.111–1.256)***	1.041 (0.986–1.099)
Sex (Ref. female)				1.157 (1.094–1.223)***	0.981 (0.925–1.041)
Academic performance (Ref. lower)	Upeer			0.745 (0.701–0.790)***	1.326 (1.234–1.426)***
	Middle			0.882 (0.825–0.942)***	1.234 (1.156–1.317)***
Household income (Ref. lower)	Upeer			1.010 (0.920–0.1110)	1.191 (1.096–1.294)***
	Middle			0.901 (0.827–0.981)***	1.037 (0.956–1.124)
Walking days per week (≥60 min/day) (Ref. never)	1–2 times			1.142 (1.069–1.220)***	1.201 (1.131–1.276)***
	≥3 times			1.237 (1.159–1.320)***	1.241 (1.164–1.322)***
Cigarettes smoking experience (Ref. no)				1.919 (1.704–2.162)***	1.573 (1.443–1.716)***
Drinking experience (Ref. no)				1.798 (1.695–1.908)***	1.453 (1.369–1.542)***
Perceived health (Ref. unhelthy)	Healthy			0.900 (0.809–1.001)	0.950 (0.870–1.038)
	Neutral			1.013 (0.909–1128)	0.967 (0.981–1.062)

Values are presented as adjusted OR (95% CI). Logistic regression was done on the complex sample.
CI, confidence interval; OR, odds ratio; Ref., reference.
*$P<0.05$, ***$P<0.001$.
[a]Analyzed high-caffeine drinks and mental health with non-adjust variables. [b]Analyzed high-caffeine drinks and mental health after adjusting sex, academic performance, household income, walking days, cigarettes smoking and drinking, and perceived health variables.

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more high-caffeine drinks than those of little. Respondents of 'yes' sadness & despair consumed 1.142 times (*P*<0.001) more high-caffeine drinks than those of 'no.'

DISCUSSION

This study was conducted to compare the relationship between consumption of high-caffeine drinks and mental health in middle and high school students. Data were used from the 20th KYRBS (2024). Statistically significant variables associated with high-caffeine drinks were academic performance, household income, walking days, smoking and drinking experience, and mental health variables. Some findings are consistent with those of previous research. Students with lower academic performance had higher rated of consuming high-caffeine drinks [15] and my research results showed the same results in middle school, but different results in high school. People with relatively high household income tended to consume more high-caffeine drinks [15,16] and my research results showed the same results in middle school, but different results in high school. So, further studies are needed to segment respondents. According to this study, students with ≥3 times per week walking consumed more high-caffeine drinks than other, and the previous research showed similar results [17]. This appears to be due to the positive effect of caffeine intake on improving exercise performance. The more students smoked and drank, the more they consumed high-caffeine drinks. Also, previous researches showed significant differences between smoking, drinking, and experience consuming high-caffeine drinks [18]. High-caffeine drinks consumption was higher in the current smoking and current drinking groups [17].

In result of complex sample logistic regression analysis after adjusting the control variable, the more stressed, the more sad or hopeless students felt, and the more they consumed high-caffeine drinks in middle and high school. This findings are consistent with those of previous research, which found that students who answered 'yes' to high-caffeine drinks consumption experienced 2.46 times more sadness & despair than those who answered 'no' [19]. And the higher consumption of high-caffeine drinks, the more negative mental health problems such as stress, sadness, and depression [13,14]. According to the results of this study, in situations of high stress, middle school students consumed 1.493 times more high-caffeine drinks, and high school students consumed 1.699 times more. These results looks like that high school students consume more high-caf-

feine drinks in stressful situation to increase their academic concentration for preparing college entrance exams.

Interestingly, suicidal ideation and loneliness were significant variables associated with high-caffeine consumption in middle school students, but not in high school students in this study. But, in previous studies, adolescents with suicidal thoughts consumed 1.37 and 1.47 times more high-caffeine drinks than those without [13] and high school students who consumed high-caffeine drinks had a higher risk of suicidal thoughts than those who did not [20,21]. The fact that suicidal thoughts and loneliness variables were significant only for middle school students seems to be because middle school students are in early adolescence, when school adaptability is evaluated as lower than high school students. There is research that shows that suicidal thoughts occur when school adaptability is low [22]. In addition, middle school students are subject to greater psychological control from their parents than high school students, and previous research results have shown that those who receive greater psychological control from their parents are more likely to become addicted to social networking service, etc. [23]. High-caffeine drinks are also one of the addictive substances with caffeine, so it can be assumed in a similar context.

There is concern that students are unaware of the dangers of high-caffeine drinks and habitually consume them frequently when studying or when tired in order to achieve a short-term boost of energy during exam periods. Therefore, customized education on consumption habits is necessary for middle and high school students separately. Adolescents are emotionally less mature due to the nature of puberty. They can easily become mentally disturbed or engage in unhealthy behaviors to avoid problems, the consumption of caffeinated beverages as stimulants is one example. Adolescents are exposed to stress on academics, interpersonal relationships, and social expectations. The high-caffeine drinks market is expanding, and adolescents' consumption of high-caffeine drinks is expected to continue. In addition, stress, despair, depression, and suicidal thoughts are highly related to adolescents and it can be assumed that they inevitably consume high-caffeine drinks for relieving these problems. Therefore, management and emotional support from home, school, and society are very important and government-level intervention programs are needed to effectively carry out this. Recognizing each characteristic of middle and high school students, tailored intervention program should be developed based on the community and school.

The limitation of this study are as follows. First, it does not

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reflect long-term changes due to a cross-sectional study. So it is unable to establish direct causal relationships between high-caffeine drinks and mental health. Second, there is a limit to the selection and adjustment of variables in secondary data analysis. Despite its limitations, this study may contribute as a basic data for policy development by presenting specific variables related to various mental health issues and showing the differences in research results for middle and high school students. Adolescents are a valuable asset that will lead the future of the country. So we have to pay attention for their mental health issue they are experiencing. This study suggests that tailored preventive policies for mental health in middle and high school each based on school and community levels, and further comparative studies considering the characteristics of each school are needed.

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AUTHOR CONTRIBUTIONS

Dr. Haesun YUN had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Author reviewed this manuscript and agreed to individual contributions.

Conceptualization, Data curation: JP. Formal analysis: HY. Writing–original draft, Writing–review & editing: all authors.

CONFLICTS OF INTEREST

No existing or potential conflict of interest relevant to this article was reported.

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DATA AVAILABILITY

The data presented in this study are available upon reasonable request from the corresponding author.

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Plantar Fasciitis: A Continuous Challenge for Medical Professionals

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Dear Editor,

Plantar fasciitis (PF) is an unpleasant hurdle that medical professionals have to face on a daily basis and susceptible to a pathological condition known as PF, which represents one of the primary etiologies of heel pain. PF arises from a multifactorial pathogenesis, characterized by a biomechanical overload response to recurrent microtrauma [1]. This letter emphasizes the epidemiology, risk factors with systemic consequences of PF among healthcare workers, encouraging targeted interventions to mitigate this easily preventable occupational menace. This inflammatory condition arises due to repetitive stress upon the plantar fascia, due to excessive running, overuse, or standing for prolonged periods. It can cause unbearable pain and stand as a constant hurdle during work hours.

According to a Korean study which was done in 2020 by Lee et al. [2], a literature-based questionnaire was administered to 472 nurses at a university hospital in B city, with data collected from August 1 to August 15, 2020. The Foot Health Status Questionnaire assessed foot health conditions. Results indicated that PF (7.8%) and hallux valgus (7.0%) were the most prevalent foot disorders. Common pain relief methods included stretching, leg elevation, foot massage, and relaxation techniques. Nurses exhibited poorer foot health compared to older adults or the general population with chronic foot conditions. Younger age and a higher number of foot disorders correlated with increased pain severity and functional impairment [2].

Another cross-sectional retrospective observational design, analyzing patients diagnosed with PF in South Korea between January 2010 and December 2018. A total of 60,079 individuals who accessed healthcare at least once were included. Healthcare utilization, costs, treatment methods, and visit patterns were evaluated. Findings revealed that treated PF cases rose from 11,627 (3,571 patients) in 2010 to 38,515 (10,125 patients) by 2018. The 45- to 54-year age group represented the largest patient cohort, with a higher prevalence among women [3]. According to a nationwide study held in 2020 in Taiwan, physicians and nurses had a period prevalence of PF of 8.14% and 13.11%, respectively. The results also showed that prevalence was considerably higher in specialists such as orthopedic surgeons, and physical medicine and rehabilitation doctors, as specialists in these fields have to stand for long hours during their shifts [4].

In 2021, a study from India by Bhoir and GD [5] a simple random sample of 100 healthy nurses (70 females, 30 males) aged 20–50 years. The Windlass test was administered in both non-weight-bearing and weight-bearing positions. Pain reproduction during the test was considered a positive result, with participants indicating the pain location. Findings revealed that 21% of participants tested positive, comprising 17% females and 4% males. The study concluded that female nurses exhibit a higher predisposition to PF compared to their male counterparts [5].

As the pain extends beyond suffering, the disease follows a degenerative pattern which may result in thickening, fibrosis, and ultimately metaplasia, necrosis, and calcification of the

plantar fascia. Not only this disease hinders the quality of life, a study has shown that individuals with PF are more likely to suffer from diabetes, depression as well as sleep disorders. These findings pose as a multifaceted threat to workforce sustainability as well as healthcare delivery. Hence, PF not only disrupts the daily course of life, it also spawns dangerous long-term repercussions that can cause a nosedive in productivity, competency, and efficiency.

In a hospital setting, chronic pain and mobility limitations contribute to decreased productivity. Additionally, reduced physical capacity may compromise patient care, especially in circumstances requiring rapid response.PF can easily be resolved at an early stage by using stretching exercises, orthotic footwear, and night splints before it advances and requires corticosteroid injections, extracorporeal shockwave therapy, and surgical interventions such as fasciotomy.

This is utterly avoidable and can be tackled by raising awareness among healthcare staff regarding this issue, arranging seminars, and implementing better ergonomic policies.

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Dr. Muhammad Ajmal DINA had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Author reviewed this manuscript and agreed to individual contributions.

Writing–original draft: AA. Writing–review & editing: MAD and AJ.

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Acknowledgments

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Author Contributions

What authors have done for the study should be described in this section. To qualify for authorship, all contributors must meet at least one of the seven core contributions by CRediT (conceptualization, methodology, software, validation, formal analysis, investigation, data curation), as well as at least one of the writing contributions (original draft preparation, review, and editing).

   The submitting author is responsible for completing this information at submission, and it is expected that all authors will have reviewed, discussed, and agreed to their individual contributions ahead of this time.

<Example>

Dr. MYUNG had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy

of the data analysis. All authors reviewed this manuscript and agreed to individual contributions.

Conceptualization: SKM.
Data curation: SWO and YJC.
Formal analysis: YJC.
Methodology: SKM, SWO, and YJC.
Software: SKM and YJC.
Writing - original draft: YJC.
Writing - review & editing: SKM, SWO, and YJC.

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