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*Original Article*

# Associations Between Food Insecurity and Tension-Type Headache in Steel Industry Employees

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## ABSTRACT

**Background and Objectives:** Food insecurity, defined as limited or uncertain access to adequate and nutritious foods, includes negative effects on physical and mental health. Tension-type headache, the most common form of primary headache, can significantly affect individuals' quality of life. The two factors are linked to socioeconomic status.

**Materials and Methods:** The aim of this study was to investigate the relationship between food insecurity and incidence of tension-type headaches in employees of Isfahan Steel Industry, Isfahan, Iran.

**Results:** Findings showed that employees with a bachelor's degree or lower, less than 7 h of sleep, consumption of less than the recommended quantity of the meat and legumes group (5.5 U/d) and lower food security were further likely to experience tension-type headaches ($P < 0.05$). Logistic regression analysis identified food insecurity as the strongest predictor of tension-type headaches.

**Conclusions:** Improving food security, increasing educational attainment and ensuring adequate sleep may help decrease the incidence of tension-type headaches. Additionally, maintaining balanced consumption of food groups, especially meats and legumes, could decrease the occurrence of tension-type headaches. Further prospective studies are necessary to investigate the causal relationships between food security and tension-type headaches.

**Keywords:** Food insecurity, Tension-type headache, Headache disorders, Sleep, Food, Socioeconomic factors

## Highlights

- Food type headaches among steel industry employees-insecurity was identified as the strongest predictor of tension
- Tension-type headaches were more prevalent among individuals with lower education levels and insufficient sleep (<7 hours).
- A lower intake of meat and legumes significantly increased the likelihood of experiencing tension-type headaches.
- Ensuring food security, enhancing education, and maintaining healthy sleep patterns may help reduce the prevalence of tension-type headaches.
- This study is the first in Iran to examine the association between food insecurity and tension-type headaches, highlighting its public health significance.

## Introduction

Food insecurity (FI) is defined as limited or uncertain access to sufficient and nutritious foods or a decrease in access to foods, leading to serious consequences, including overweight and obesity, deterioration of physical and mental health such as depression, anxiety and stress and increased risks of chronic diseases such as diabetes, hypertension, cardiovascular diseases (CVD), chronic kidney disease and others (1-7). The FI occurs when people lack the freedom to choose their foods, fear running out of foods or make significant changes in types of foods they consume (1).

The FI is a complex, multidimensional phenomenon including social, cultural and psychological aspects. Risk factors for food insecurity identified in numerous studies include income, socioeconomic status, race and ethnicity (1, 8). Based on a meta-analysis carried out in 2022, prevalence of FI in Iran was higher than the global average

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(9). The relationship between health and food insecurity may be bidirectional (8). Additionally, FI and tension-type headache (TTH) are linked to factors such as socioeconomic status, body weight and depression (10).

A study carried out by Safiri et al. showed that the prevalence of TTH in Iran increased from 1990 to 2019. By 2019, the age-standardized point prevalence rate of tension-type headaches in Iran was the highest in the MENA (Middle East and North Africa) region. Furthermore, the prevalence of TTH was particularly higher in men aged 35-39 and women aged 70-74. The annual incidence rate and YLDs (years lived with disability) due to TTH slightly increased during this time. This indicates that the burden of TTH in Iran is higher, compared to other MENA countries and the global average (11).

Technically, TTH is the most common type of headache, affecting approximately one in five people worldwide and it leads to further disability and workday lost than that migraines does. The exact cause of TTH is not fully understood; however, it is addressed as multifactorial, involving nutritional, muscular, genetic and environmental factors (12-14). The TTH, also known as muscle contraction headache, stress headache or psychogenic headache, is differentiated from other primary and secondary headaches using diagnostic criteria from HIS (International Headache Society) (13, 14). Moreover, TTH is typically bilateral with mild to moderate intensity and a pressing or tightening quality that it is non-pulsating. It is often accompanied by stiffness and pain in neck and shoulder muscles. The headache develops slowly and gradually increases in intensity. This type of headache is not associated with nausea, vomiting and photophobia and is not worsened by light physical activities (e.g. walking) (14-17).

Duration of TTH can vary from 30 min to 7 d and often begins during the day, gradually increasing in severity. This is reported that its intensity does not change much with various activities. However, individuals may experience worsening symptoms later in the evening (14, 17). The TTH is more common in women than in men and typically begins in adolescence with peak prevalence occurring between the ages of 20-50 years-old (14, 16).

Based on previous studies, FI has played a significant role in the occurrence and severity of migraine headaches (18-20). However, due to the lack of findings regarding the relationship between FI and TTH, this study aimed to investigate the association between food insecurity and incidence of TTH in employees of a steel industry, Isfahan, Iran.

## Materials and Methods

This cross-sectional study was carried out on 217 administrative employees of a subsidiary of Isfahan Steel Industry, Isfahan, Iran, using simple random sampling. Sample size was calculated using Cochran's formula, as the total population size was known. Inclusion criteria included aged 25-55 years-old and having at least one year of work experience at the company. Exclusion criteria included a history of migraines, being a production worker and completing less than 70% of the FFQ.

### Data collection

Data were collected through a general information questionnaire (including age, gender, education, sleep hours, marital status, household size and breakfast consumption), HFIAS was used to assess FI within various dimensions, including food quality and insufficient intake. A 147-item FFQ was used to assess energy consumption and food group intake over the past year. Reliability and validity of the HFIAS were verified by Salarikia et al. and those of the FFQ were established by Mirmiran et al., ensuring accuracy and consistency of the collected data (21, 22). Height and weight were measured and BMI was calculated. The TTH was diagnosed by a specialist physician using ICHD-3 criteria (23).

### Ethical considerations

This study was approved by the Ethics Committee of the Islamic Azad University, Science and Research Branch, Tehran, Iran, under the ethics code of IR.IAU.SRB.REC.1403.177. Participants were fully informed about the study objectives before completing the questionnaires. Written informed consent was collected from all participants.

### Data analysis method

Data were analyzed using SPSS software v.27. In this study, chi-square test was used to assess the relationship between qualitative variables and the incidence of TTH. Independent t-test was used to compare the means and standard deviations (SD) of quantitative data. Additionally, logistic regression modeling was used to assess independent effects of various variables on the incidence of TTH. A significance level of $P < 0.05$ was considered for all analyses.

## Results

This study included 217 participants, comprising 116 men and 101 women. Of them, 104 participants (51 men and 53 women) experienced TTH. A majority of participants had a bachelor's degree or lower, middle to lower income, less than 7 h of sleep, being married, more than three family members and consumed breakfast regularly. Nutritionally, most participants had energy intake of less than 2000 kcal. Consumption of bread and grains, meat and legumes and fruit was moderate to high (≥ 6, 5.5 and 2 servings per day, respectively), whereas dairy and vegetable consumption was less than the recommended levels (< 3 and 2.5 servings per day, respectively). Additionally, 99 participants had high food security.

### Characteristics of qualitative variables based on the presence or absence of tension-type headache

Table 1 presents the frequency distribution of TTH within qualitative variables linked to TTH using the chi-square test. In this study, a P-value of less than 0.05 was considered statistically significant. The chi-square test results indicated significant associations between the education level, sleep duration, meat and legume consumption and food security and the incidence of TTH. However, other variables such as gender, marital status, household size, breakfast consumption, energy intake and



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consumption of bread and grains, dairy, fruit and vegetables showed no significant associations.

The frequency of TTH was significantly lower in individuals with postgraduate education than those with lower educational levels. A significant inverse relationship was observed between the TTH frequency and sleeping hours and food security, indicating that the frequency of tension-type headaches was lower in individuals who slept 7 h or further, compared to those who slept less than 7 h. Individuals with higher food security experienced tension-type headaches less frequently than others. A significant difference was detected between meat and legume consumption and the incidence of TTH, with individuals consuming moderate to high quantities of meat and legumes experiencing significantly fewer frequency of TTH.

**Table 1.** Distribution of the absolute frequency and relative frequency of demographic data and food group data in participants based on the presence or absence of tension-type headache

| Variables | | With TTH | Without TTH | P-value |
|---|---|---|---|---|
| | | N(Percentage) | N(Percentage) | |
| Sex | Men | 51(44) | 65(56) | 0.211 |
| | Women | 53(52.5) | 48(47.5) | |
| Education | Less than a Bachelor's degree | 89(53) | 79(47) | 0.006 |
| | a Master's degree Higher than | 15(30.6) | 34(69.4) | |
| Household Income | Lower-middle income | 73(51.4) | 69(48.6) | 0.158 |
| | Upper-middle income | 31(41.3) | 44(58.7) | |
| Sleep Hours | Less than 7 hours | 68(54.4) | 57(45.6) | 0.026 |
| | 7 hours or more | 36(39.1) | 56(60.9) | |
| Marital Status | Single | 50(53.2) | 44(46.8) | 0.175 |
| | Married | 54(43.9) | 69(56.1) | |
| Household Size | 3 or fewer | 29(49.2) | 30(50.8) | 0.825 |
| | More than 3 | 75(47.5) | 83(52.5) | |
| Breakfast Consumption | Consumes | 82(47.1) | 92(52.9) | 0.635 |
| | Don't consume | 22(51.2) | 21(48.8) | |
| Energy Intake | Less than 2000 kcal | 62(53.4) | 54(46.6) | 0.081 |
| | 2000 kcal and more | 42(41.6) | 59(58.4) | |
| Grains group | Less than moderate | 7(63.6) | 4(36.4) | 0.284 |
| | Moderate or more | 97(47.1) | 109(52.9) | |
| Milk agrouairy group | Less than moderate | 60(54.1) | 51(45.9) | 0.064 |
| | Moderate or more | 44(41.5) | 62(58.4) | |
| Meat and legumes group | Less than moderate | 40(59.7) | 27(40.3) | 0.020 |
| | Moderate or more | 64(42.7) | 86(57.3) | |
| Fruit group | Less than moderate | 44(51.2) | 42(48.4) | 0.439 |
| | Moderate or more | 60(45.8) | 71(54.2) | |
| Vegetables group | Less than moderate | 77(51.3) | 73(48.7) | 0.133 |
| | Moderate or more | 27(40.3) | 40(59.7) | |
| Food security | High | 24(24.2) | 75(75.8) | <0.001 |
| | Medium | 39(60) | 26(40) | |
| | Low | 41(77.4) | 12(22.5) | |

Analyzed by chi-square



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**Anthropometric measures based on the presence or absence of tension-type headache**

The normality of quantitative data was assessed using Kolmogorov-Smirnov test. If P > 0.05, distribution of each variable was normal. Based on Table 2, no statistically significant difference was seen in the means of age, weight and body mass index (BMI) between the individuals with and without TTH. Therefore, these variables could not be addressed as risk factors for TTH. Nevertheless, individuals with TTH were slightly older, while their weight and BMI were marginally lower than those without TTH.

**Analysis of the effect of various variables on the incidence of tension-type headache**

Table 3 presents results of the logistic regression analysis to further investigate the effect of various variables on the incidence of TTH in participants. Results indicated significant inverse relationships between the education level, sleeping hours and consumption of meat and legume group with TTH. However, no significant associations were detected between other variables and TTH.

Education: Participants with a bachelor's degree or lower were three times more likely to experience TTH, compared to those with higher education. This association was statistically significant (P-value = 0.013), suggesting that lower educational achievement might include a positive effect on the incidence of TTH.

Sleeping hours: The odds ratio for sleep duration indicated that with an increase in sleep hours, the likelihood of TTH decreased. This decrease was statistically significant (P-value = 0.027), Individuals with less than 7 h of sleep were approximately twice as likely to experience tension-type headaches, compared to those who sleep 7 h or more, implying that sleeping hours included a significant effect on the incidence of TTH.

Meat and legume group: Participants with consumption less than the recommended consumption of meat and legumes group were approximately twice as likely as experiencing TTH, compared to those who consumed moderate to high quantities. This association was statistically significant (P-value = 0.029).

FI: The FI was significantly associated with a decreased likelihood of TTH. Participants with lower food security were much more likely to experience TTH, compared to those with higher food security. This result indicated that individuals with food security are significantly less prone to TTH (P-value < 0.001).

**Table 2.** The mean and standard deviation of quantitative variables based on the presence or absence of tension-type headache in participants.

| P-value | with TTH (N=104) | without TTH (N=113) | P-value |
|---|---|---|---|
| | Mean±SD* | Mean±SD* | |
| Age | 38/49 ± 9/84 | 36.88±9.15 | 0.270 |
| Weight | 70.58±14.98 | 74.38±17.97 | 0.094 |
| BMI | 24.29±3.49 | 34.81±3.47 | 0.276 |

Analyzed by independent t-test
*standard deviation

**Table 3.** Results of the logistic regression test between the quantitative and qualitative variables and the occurrence of tension-type headache in participants

| | OR* | 95% Cl** | p-value |
|---|---|---|---|
| Age | 0.764 | 0.5-1.032 | 0.079 |
| Sex | 0.499 | 0.163-1.523 | 0.222 |
| Education | 3.010 | 1.256-7.212 | 0.013 |
| Household income | 0.592 | 0.274-1.278 | 0.182 |
| Sleep hours | 1.855 | 1.074-3.205 | 0.027 |
| Marrital status | 2.439 | 0.940-6.331 | 0.067 |
| Household size | 1.986 | 0.776-5.082 | 0.152 |
| Weight | 1.846 | 0.316-10.772 | 0.496 |
| BMI | 0.857 | 0.264-2.591 | 0.785 |
| Breakfast consumption | 0.794 | 0.377-1.675 | 0.545 |
| Energy Intake | 1.527 | 0.868-2.687 | 0.142 |
| Grains group | 1.982 | 0.524-7.496 | 0.314 |
| Milk and diary group | 1.526 | 0.862-2.701 | 0.147 |
| Meat and Legumes group | 1.928 | 1.069-3.478 | 0.029 |
| Fruit group | 1.038 | 0.576-1.869 | 0.901 |
| Vegetables group | 1.401 | 0.750-2.619 | 0.290 |
| Food security | 0.152 | 0.083-0.277 | <0.001 |

Analyzed by logistic regression analysis
* Odds ratio
**95% Confidence interval



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## Discussion

### Association between tension-type headache and food security

Findings were linked to the hypothesis that significant relationships were between the incidence of TTH and food security in employees, showing an inverse association. Frequency of tension-type headaches was significantly higher in individuals with lower food security. Moreover, a significant association was observed between food insecurity and tension-type headaches in the chi-square test. Additionally, logistic regression analysis identified food security as the strongest predictor of tension-type headaches. As food security increased, incidence of tension-type headaches in employees significantly decreased. Previous studies have shown that individuals with food insecurity are more likely to experience headaches, particularly migraines (18-20).

### Association between the tension-type headache and affecting factors

In this study, a significant inverse relationship was seen between the education level and TTH with individuals holding a bachelor's degree or lower being more likely to suffer from TTH than others. Previous studies on the association between education and TTH have resulted in inconsistent results. Studies similar to the current one, reporting a significant inverse relationship between these two variables (24-33). For example, a study by Chu et al. verified an inverse relationship between the women's education levels and TTH (34). In contrast, a population-based study in USA detected that chronic TTH was associated with lower education levels in women; however, episodic TTH increased with higher education levels in the two genders (35). Overall, higher education levels are associated with less pain and disability, which may indicate better coping strategies for pain (34). However, other studies detected a significant direct relationship between the education and TTH with individuals with higher education levels experiencing further TTH, compared to those with lower educations. This might suggest that in societies, increased responsibilities associated with higher education can lead to increased stress and hence further headaches (36-41). In contrast, population-based and non-population-based studies did not find a significant relationship between the headache and education level (42-53). In population studies from Germany and Russia and a study on healthcare providers, individuals with lower education levels experienced further TTH; however, this relationship was not statistically significant (43, 45, 47). These results revealed complexity of the relationship between these factors and the multiple effects affecting it.

Naturally, a strong association is reported between sleep and primary headaches, including migraines, tension-type headaches and cluster headaches. Primary headaches not only cause sleep disturbances, insomnia and daytime sleepiness but also can trigger headaches. This bidirectional relationship includes significant economic and social burdens (54). Similarly, several studies have reported a significant direct association between insufficient sleep or shorter average sleep hours and the occurrence of TTH (33, 49, 54-60). In contrast, a study by Ayatollahi et al. on elementary school teachers in Shiraz, Iran, detected no association between abnormal sleep patterns and short sleep time (61), which could be due to the various study populations. Furthermore, a study by Sabah et al. detected that sleep times of less than 5 h and more than 8 h significantly exacerbated TTH with a significant association with TTH (62). Similarly, a study by Milde-Busch et al. detected no significant association between breakfast consumption and TTH (63). Similarly, Takeshima et al. detected no significant association between breakfast consumption and TTH (55). In contrast to the current study, a study by Mansouri et al. detected a significant inverse relationship between breakfast consumption and primary headaches (64).

Similar to the present findings, a study by Milde-Busch et al. detected no association between fruit and vegetable consumption and TTH (63). Similarly, Wober et al. reported no significant association between fruit and vegetable consumption, particularly citrus fruits, and TTH, suggesting that fruit and vegetables were not typically recognized as a significant trigger for TTH in these patients (65). Furthermore, a review by Holzhammer et al. detected insufficient evidence for an association between the consumption of dairy, meat, fruit and vegetables with TTH, although they did suggest that fruit and vegetable consumption could be a protective factor against headaches in general (66). In contrast, Takeshima et al. detected that daily consumption of green and yellow vegetables was significantly associated with decreased risk of TTH, while daily meat consumption did not show a significant association with the decrease of TTH risk (55). Mansouri et al. detected a significant inverse relationship between primary headaches and dairy consumption, fruit consumption in women and vegetable consumption in men (67, 68).

### Conclusion

Results of this study show significant associations between the education level, sleep duration, compensation of meat and legume group, food security and incidence of TTH in participants. Employees with a bachelor's degree or lower, less than 7 h of sleep, consumption of lower quantities than recommended meat and legume quantities and lower food security experienced a higher frequency of TTH. Due to the novelty of this topic, comprehensive studies assessing relationships between the consumption of all food groups and the occurrence of TTH are limited. Most existing studies have focused on the association between TTH and one or a few food groups or specific nutrients. Therefore, further studies are needed on the effectiveness of dietary interventions and food groups. Carrying out further prospective and interventional studies may enhance understanding of the prevention and treatment of TTH and help identify high-risk populations. Carrying out similar studies in other populations can help assess generalizability of the findings.

Due to its cross-sectional nature, this study cannot establish a causal relationship, highlighting the need of future longitudinal studies in this area. Moreover, results may not be generalizable to the entire population due to geographical differences, dietary habits and various access



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to various types of foods within regions. Additionally, factors such as stress and anxiety, which can affect the results, were not addressed in this study. As the first study in Iran to investigate the relationship between food insecurity and TTH, this study holds significant public health and economic relevance, given that the two factors can affect individuals' quality of life and work productivity. Relative homogeneity of the study population for occupation, economic status and social conditions helped control for the variables, making this a significant strength of the study.

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**Abbriviation**

FI: Food insecurity
TTH: Tension-type headache
FFQ: Food frequency questionnaire
HFIAS: Household food insecurity access scale
ICDH-3: International Classification of Headache Disorders, 3rd edition
BMI: Body mass index

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