Original Article

Cooking methods and depressive symptoms are joint risk factors for fatigue among migrant Indonesian women working domestically in Taiwan

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Background and Objectives: Fatigue is a critical occupational health risk among migrant workers. Globally, more than half of migrant workers are women. However, the prevalence rate and risk factors for fatigue in domestically employed migrant women are unknown. **Methods and Study Design:** In total, 194 Indonesian women migrants aged 20–50 years who were working in Taipei were studied. Self-perceived acculturation, dietary acculturation, BMI and haemoglobin were evaluated. Fatigue and depressive symptoms were assessed using the Brief Fatigue Inventory and Beck Depression Inventory-II, respectively. **Results:** The prevalence of fatigue was 27.8%. Depressive symptoms (p<0.0001), cooking methods (p=0.027), and self-perceived feelings of sadness and weakness (p=0.003) were associated with fatigue. After adjustment for covariates, the ORs for depressive symptoms (OR: 5.40; 95% CI: 2.32–12.6), deep frying/stir frying (OR: 5.23; 95% CI: 1.27–21.5), and self-perceived feelings of sadness and weakness (OR: 3.41; 95% CI: 1.26–9.25) remained significant. An interactive analysis revealed that women without depressive symptoms who used deep frying/stir frying as a cooking method had a 3.5-fold (1–12.3) higher risk of fatigue than did those who used non-deep frying and stir frying as cooking methods (which served as the reference) for cooking. By contrast, women with depressive symptoms who used non-deep frying and stir frying had a 6.5-fold (2.8–15.3) higher risk of fatigue, and the risk increased sharply to 12.6-fold (1.26–125.8) if they used deep frying and stir frying for cooking. **Conclusions:** The risk of fatigue among migrant women working domestically is increased when they exhibit depressive symptoms and their cooking technique is frying.

Key Words: fatigue, cooking methods, deep frying/stir frying, depressive symptoms, domestic migrant women, Taiwan

INTRODUCTION

Globally, more than half of migrant workers are women,[1] and they represent 83% of the 52–100 million domestic workers worldwide.[2] Fatigue has been identified as a critical occupational health risk among migrant workers.[3,4] The prevalence of fatigue is estimated to be 11%–30.5% among non-migrant workers[5-7] and 14%–27% among workers in primary care.[8,9] Women are at a greater risk of fatigue than men.[10] Untreated fatigue may affect their quality of life[11] and negatively affect their work performance.[12,13]

Fatigue is "a subjective symptom of malaise and aversion to activity," either physically or mentally.[14] The causes of fatigue are diverse. Migration is a stressful process and can have a negative impact on mental health.[15] Studies have revealed that depression is a strong predictive marker of fatigue.[16,17] The prevalence of depression among migrant workers is estimated to be 25.1%–34%.[18-20] Depression may predispose individuals to fatigue,[17] and its impact on fatigue increases significantly with time.[16] Fatigue can also be affected by acculturation,[21] the process through which a migrant worker adopts the beliefs, habits, and behaviours of the host country.[22] Dietary acculturation, which is one of the most important aspects

of acculturation, is a process through which migrants adopt the dietary patterns and practices of the host country.[22] Cooking methods acculturation is one part of dietary acculturation.[23] Studies among immigrant revealed that dietary acculturation is linked to metabolic disorders such as obesity[24] and cooking methods may be its underlying reason.[25] Cooking methods such as steaming, boiling, poaching and stewing play a role on AGE formation which is identified affect mental health among type 2 diabetic.[26,27] In the other hand, obesity has been identified associated with sleep disruption[28] and anaemia;[29] these and other obesity-related medical conditions can cause fatigue.[30] One of the most common tasks that these women perform is cooking, which is increasingly being recognized as having health relevance.[31,32] Taken together, it is necessary to explore the role of acculturation in dietary

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practices related to cooking methods and depressive symptoms on fatigue. The aim of this study were to investigate (1) the prevalence of fatigue, (2) the impacts of anaemia (as measured by haemoglobin [Hb] level) and depression (as measured by depressive symptoms) on fatigue, and (3) the effects of dietary acculturation on fatigue among Indonesian female migrant workers (FMWs) living in Taiwan.

MATERIALS AND METHODS
Study design and participants
This cross-sectional study was undertaken from December 2014 to February 2015 in Taipei, Taiwan. In total, 235 Indonesian FMWs aged 20–50 years who were living in Taipei were recruited through convenience sampling. The response rate was 94%. The exclusion criteria were (1) a self-reported history of chronic disease (e.g. cancer, type 2 diabetes, hypertension, uterine fibroids, anaemia, and heart disease), fever, pregnancy, breast feeding, use of iron supplements, use of antidepressant or antihypertensive drugs, gastrointestinal disorders or severe bleeding (e.g. inflammatory bowel disease, gastric ulcers, menorrhagia, haemorrhoids, or haematuria), and parasitic infections (e.g. malaria and worm infection); (2) menopause; and (3) a Taiwanese resident visa. Further exclusion was applied to women with a history of mental or physical health conditions (fatigue or depression). Accordingly, the data of 194 women were obtained for analysis.

Data collection and biochemical measurements
Socio-demographic data such as age, monthly income, length of work permit, number of family members served, types of jobs performed, and educational levels were obtained. Body weight was measured using a digital weight scale from Mancorp Enterprises (Hong Kong, China) and was recorded to the nearest 0.5 kg in light clothing, with footwear removed and pockets emptied. Body height was self-reported. BMI was calculated as (weight in kg)/(height in m)^2. Overweight was defined as a BMI of 23–24.9 kg/m^2. Obesity was defined as a BMI of >25 kg/m^2.[27,33] Acculturation was measured by two parameters. Dietary acculturation and self-perceived acculturation were evaluated via a face to face interview by the investigator. Examples of dietary acculturation question were as follows: (1) What is the most common cooking method used in Taiwan?, (2) What is the most food you eat in Taiwan? and (3) Do you like Taiwanese food?. Example of self-perceived acculturation questions were as follows: (1) How have your feeling changed since living in Taiwan?, (2) How have your eating habits changed since living in Taiwan?, (3) Has your health status changed since living in Taiwan?. Physical distress (fatigue) was evaluated through an oral interviews conducted using the Brief Fatigue Inventory (BFI). The BFI was identified as a valid and reliable uni-dimensional instrument to assess fatigue severity and interference with life activities in the previous 24 h.[34] In the present sample, the Cronbach's alpha (0.89) met the standard criteria of acceptability. Mental distress (depressive symptoms) was also assessed using an Indonesian version of the Beck Depression Inventory (BDI)-II.[35,36] The BDI-II has been validated and is reliable for the general Indonesian population (Cronbach's alpha of 0.90). The BDI is one of the most widely used questionnaires for assessing depressive symptoms and their severity in general populations.[37,38]

Erythropoiesis status was determined using a Hemo-Cue® 201+ Hb photometer from HemoCue AB (Ängelholm, Sweden). This instrument is generally recommended for public health surveys to determine the prevalence of anaemia.[39] The HemoCue® system is based on the cyanmethemoglobin method and is stable and durable in field settings.[40] According to a 2001 WHO report,[40] anaemia severity in reproductive-aged women can be defined based on Hb levels: an Hb level of (1) ≥12 g/dL for no anaemia, (2) 11–11.9 g/dL for mild anaemia, (3) 8–10.9 g/dL for moderate anaemia, and (4) <8 g/dL for severe anaemia.

Ethics and confidentiality
In this study, all procedures involving human subjects were performed in accordance with ethical standards. This study was approved by the institutional review board of Taipei Medical University (201409045). Participants provided informed consent and patient anonymity was preserved.

Statistical analysis
Statistical analyses were performed using IBM SPSS, version 20.0. Categorical data are presented as numbers and percentages and were analysed using a chi-squared test. Continuous data are presented as the mean (standard deviation) or median (25th and 75th percentiles) and were analysed using a two-sample t test. The differences between two independent samples were analysed through the Mann–Whitney U-test for nonparametric data. Logistic regression models were used to estimate the ORs of the dependent variable (fatigue) and independent effects of known risk factors (e.g. anaemia and depressive symptoms), with a 95% CI. To further characterise the relationships between the risk factors and fatigue, a binary logistic model was employed. The Hosmer and Lemeshow goodness-of-fit test was used to assess the interactions between depressive symptoms and cooking methods with respect to fatigue. A p value of <0.05 was considered statistically significant.

RESULTS
Baseline characteristics
In total, the data of 194 FMWs, 99.4% (n=193) of whom were Muslim, were analysed. The mean age was 33.0±7.0 years, and the mean BMI was 23.6±3.4 kg/m^2. Fifty-four (27.8%) women were diagnosed with fatigue (Table 1). The prevalence of anaemia was 27.3% (unfatigued FMWs: 24.3% vs fatigued FMWs: 35.2%). The prevalence of depressive symptoms was 16.5% (unfatigued FMWs: 8.6% vs fatigued FMWs: 37.0%). Table 1 shows that depressive symptoms (p<0.0001), cooking methods (p=0.027), and feelings of sadness and weakness (p=0.003) were associated with fatigue. Compared with unfatigued women, fatigued women exhibited higher percentages of using deep frying/stir frying (14.8% vs 5.0%) and of feeling sad and weak (29.6% vs 10.0%) since moving to Taiwan (Table 1). No significant effects were

Table 1. Characteristics of the study participants, according to their fatigue status (n=194)

Variable[†]	Fatigued	Non-fatigued	*p* value[*]
Number (n, %)	54 (27.8)	140 (72.2)	
Socioeconomic and demographic factors			
Age (years)	32.1 (7.2)	33.3 (6.9)	0.283
Income (in 1000 New Taiwanese (NT) dollars)[‡]	16 (2.7)	16.3 (2.3)	0.144
Length of work permit (months)	53.9 (30.8)	52.8 (32.5)	0.788
Number of family member they serve	3.5 (1, 5)	3 (1, 4)	0.275
Type of job (%)			0.097
Caregiver	88.9	95.7	
Non-caregiver	11.1	4.3	
Education level (%)			
Elementary school	7.4	12.9	0.320
Junior high school	61.1	50.0	
≥Senior high school	31.5	37.1	
Religion (%)			1.000
Muslim	100. 0	99.3	
Non-Muslim	0.0	0.7	
Health status (%)			
Depressive symptoms			<0.0001
Absent	63.0	91.4	
Present	37.0	8.6	
Erythropoiesis			0.232
Normal	64.8	75.7	
Mild anaemia	22.2	12.9	
Moderate anaemia	13.0	11.4	
Body-mass index (kg/m^2)	3.89	3.13	0.520
Body weight change since living in Taiwan (%)			0.375
Decrease	18.5	25.0	
No change	20.4	25.0	
Increase	61.1	50.0	
Dietary acculturation (%)			
Most common cooking methods used in Taiwan			0.027
Steaming, scalding, and boiling	13.0	24.3	
Stewing, braising, and stir-frying	72.2	70.7	
Deep-frying and stir-frying	14.8	5.0	
Types of food consumed in Taiwan			0.490
Taiwanese foods	79.6	73.6	
Indonesian foods/western foods	20.4	26.4	
Preference for Taiwanese food			0.252
No/slight	48.1	37.9	
Yes	51.9	62.1	
Self-perceived acculturation (%)			
Self-perceived feelings in Taiwan			0.003
No change	27.8	37.9	
Feelings of sadness and weakness	29.6	10.0	
Feelings of happiness and energy	42.6	52.1	
Self-perceived eating habits in Taiwan			0.813
Worse	18.5	15.0	
No change	40.7	40.7	
Better	40.7	44.3	
Self-perceived cooking methods used in Taiwan			0.322
Less healthy/no change	35.2	44.3	
Healthier	64.8	55.7	
Self-perceived health status in Taiwan			0.128
No change	63.0	62.9	
Worse	14.8	6.4	
Better	22.2	30.7	

[†]Categorical data are presented as the number (%); continuous data are presented as the mean (standard deviation) or median (25th, 75th percentiles).
[‡]The average exchange rate in 2015 was US$1.00=NT$32.86.
[*]*p* values are based on a chi-squared test for categorical variables and a Mann-Whitney U-test for continuous variables.

identified with respect to socioeconomic demographic factors or erythropoiesis status.

Risk factors associated with fatigue symptoms
In the univariate analysis, depressive symptoms were strongly associated with fatigue (OR: 6.28; 95% CI: 2.79–14.1) compared with the absence of depressive symptoms (Table 2). Deep frying/stir frying and self-perceived feelings of sadness and weakness were also positively associated with fatigue (OR: 5.55; 95% CI:

Table 2. Logistic regression of the risk factors associated with fatigue

Variable	Univariate model			Multivariate model[†]		
	OR	95% CI	p value	OR	95% CI	p value
Health status						
Depressive symptoms						
Absent	Reference			Reference		
Present	6.28	2.79 14.1	<0.0001	5.40	2.32 12.6	<0.0001
Dietary acculturation						
Most common cooking methods used in Taiwan						
Steaming, scalding, and boiling	Reference			Reference		
Stewing, braising, and stir frying	1.91	0.78 4.68	0.155	1.86	0.71 4.88	0.209
Deep frying and stir frying	5.55	1.51 20.4	0.010	5.23	1.27 21.5	0.022
Self-perceived acculturation						
Self-perceived feelings in Taiwan						
No change	Reference			Reference		
Feelings of sadness and weakness	4.04	1.61 10.1	0.003	3.41	1.26 9.25	0.016
Feelings of happiness and energy	1.11	0.53 2.33	0.776	1.19	0.54 2.63	0.672

OR: odds ratio; CI: confidence interval.
[†]The multivariate model was adjusted for depressive symptoms, cooking methods used in Taiwan, and self-perceived feelings in Taiwan.

1.51–20.4; and OR: 4.04; 95% CI: 1.61–10.1, respectively). After adjustment for covariates, the ORs for depression (OR: 5.40; 95% CI: 2.32–12.6), deep frying/stir frying (OR: 5.23; 95% CI: 1.27–21.5), and self-perceived feelings of sadness and weakness (OR: 3.41; 95% CI: 1.26–9.25) remained significant.

Interactive effects of cooking methods and depressive symptoms on fatigue

A categorical logistic regression model for the relationships of cooking methods and depressive symptoms with the risk of fatigue demonstrated that women without depressive symptoms who used deep frying and stir frying had a 3.5-fold (1-12.3) higher risk of developing fatigue than did those who used non-deep frying and stir frying as cooking methods (Figure 1). Compared with women without depressive symptoms who used non-deep frying and stir frying as cooking methods (which served as the reference), women with depressive symptoms who used non-deep frying and stir frying had a 6.5-fold (2.8 – 15.3) higher risk of fatigue, and the risk increased sharply to 12.6-fold (1.26 – 125.8) if they used deep frying and stir frying for cooking (Figure 1).

DISCUSSION
To the best of our knowledge, this is the first study to investigate the association between acculturation and fatigue among FMWs in Taiwan. We demonstrated that depressive symptoms and cooking methods (deep frying/stir frying) were independently associated with fatigue, whereas anaemia was less likely to affect fatigue among reproductive-aged FMWs. In addition, a strong interactive relationship of depressive symptoms and deep frying/stir frying with fatigue was observed. Currently, little is known about the mechanisms of such interactions.

The hypothesised mechanisms by which depression and deep frying/stir frying are associated with fatigue include exogenous advanced glycation end products (AGEs), their receptors (RAGEs), and dietary fat. Chinese cooking techniques vary widely, but the most commonly used methods are deep frying/stir frying, braising, stewing, scalding, and steaming. Deep frying/stir frying is defined as a dry-heat cooking method in which food is cooked in preheated fat or oil at 195°C.[41] AGEs are products of the Maillard reaction occurring during dry-heat processing. Luevano-Contreras et al (2012) demonstrated that changes in cooking methods to steaming, boiling,
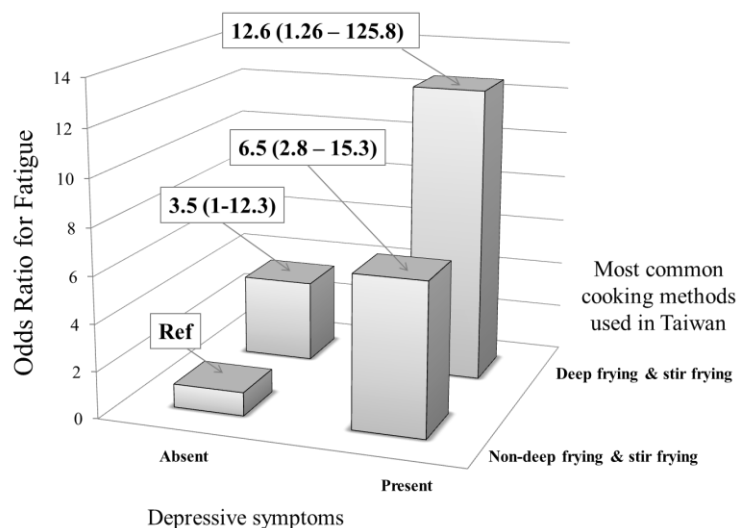

Figure 1. Odds ratio and 95% confidence intervals for cooking methods and depressive symptoms on fatigue.

poaching, and stewing decreased AGE formation by 44% as well as tumour necrosis factor-α levels. Exogenous AGEs derived from cooking and foods can be absorbed in the small intestine at an estimated 10% absorption rate.[26] The ligation of AGEs with surface RAGEs activates pro-inflammatory and oxidative stress responses.[25] Inflammatory mediators can act on the central nervous system and cause mental distress (e.g. chronic fatigue and depression).[42] An animal study revealed that the activation of RAGE signalling in brain glial cells results in long-term depression,[43] whereas a human study demonstrated that an endogenous secretory RAGE serves as a protective factor against depression among patients with type 2 diabetes.[27] Taken together, these data suggest that certain cooking techniques, particularly dry-heat methods, can have detrimental effects on mental health.[44] Further studies should evaluate whether changes in cooking practices in relation to AGE contents can improve the mental and physical health of FMWs.

Another possible mechanism underlying the risks of fatigue and depressive symptoms from deep frying/stir frying is dietary fat. Deep frying, a commonly used cooking method, may change the nutritional contents of food (in terms of water loss and fat uptake).[44] Frying modifies both the foods and the frying medium because oils deteriorate during frying, especially when reused, through the processes of oxidation and hydrogenation, leading to a loss of unsaturated fats and an increase in trans fats.[45] The increased consumption of fried foods is associated with various metabolic disorders such as cardiovascular disease, overweight, and obesity. Human studies have also reported that the consumption of fried foods is associated with depressive symptoms and a negative quality of life in the domains of sleep, energy, social functioning, and physical status.[46-48] Dietary fats are hypothesised to interact with body fat to increase tiredness while simultaneously decreasing sleep.[49] N-3 PUFAs, which serve as precursors for potent anti-inflammatory lipids, ameliorate depression-like behaviours in aged prediabetic rats.[50]

FMWs are more likely to develop fatigue than their male counterparts. Our study demonstrated that the prevalence of fatigue among Indonesian FMWs was 27.8%. Because limited data are available on the prevalence of fatigue among migrant workers, we cannot compare our results with findings in the literature. However, the prevalence of fatigue in our study was comparable to that in nonmigrant workers, which ranges from 11% to 30.5%.[5-7] The prevalence of depressive symptoms was 16.5% in our study population. This rate is much lower than the previous rates observed in Korean (25.2% in men and 34% in women)[19,20] and Arab (25.1% in men)[18] migrant workers. Our study also confirmed a previous finding of depression as a strong risk factor for fatigue. A 4-year follow-up study among workers reported that depression has a strong impact on the course of fatigue.[51] Individuals with chronic fatigue had increased levels of depression prior to the onset of their fatigue symptoms.[17] Our study also indicated that self-perceived feelings were a reliable predictor of fatigue. Feelings of sadness and weakness are symptoms that are closely related to both depression and fatigue.[14,52] Lu used longitudinal data from Indonesia to investigate the effect of rural-to-urban labour migration

on depression and reported that FMWs tended to internalize the stress experienced in migration and display depressive symptoms, whereas their male counterparts tended to externalize various stressors.[53] Our study highlights the need for social support for FMWs in order to mitigate the negative impacts of migration on mental health.

Our study demonstrated that Indonesian FMWs are well-acculturated with the Taiwanese environment rather than being enculturated. Enculturation is a process through which migrants retain the habits and behaviours of their country of origin.[54] Both fatigued and unfatigued participants followed Taiwanese dietary patterns. Our study identified that more than half of the Indonesian FMWs (fatigued: 52% vs unfatigued) preferred Taiwanese foods and more than 40% perceived that they had healthier eating habits than before. This finding is consistent with most studies in the United States and Europe that have assessed dietary acculturation among migrants, which have reported that they tend to acculturate with the host country environment.[24]

There are several limitations to our study. The design was cross-sectional and the sample size was small. In addition, we did not assess whether fatigue was physical or mental; hence, causality could not be established. The lack of serum AGE and soluble RAGE data also made it impossible to distinguish the relationship between the type of cooking method (e.g. boiling vs deep frying/stir frying) and mental distress (fatigue and depressive symptoms). The small number of FMWs who reported using deep frying/stir frying as the principal cooking method is another limitation. More than 10 techniques are commonly used in everyday Chinese cooking. These can be categorised into dry-heat (e.g. stir frying, deep frying, baking, roasting, and smoking) and wet-heat (e.g. boiling, scalding, stewing, braising, and stewing) methods. Furthermore, either a single cooking method (e.g. stir frying and steaming) or a combination of wet and dry cooking methods (e.g. braising, stewing, or simmering, followed by deep frying/stir frying) can be used. This may account for the low rate of using deep frying/stir frying as the principle cooking method among Indonesian FMWs. Nonetheless, our study also suggests that Indonesian FMWs have adopted Taiwanese cooking methods. Major cooking methods differ between Taiwan and Indonesia: stir frying/pan frying, stewing/braising, and scalding/steaming are the most frequently used cooking methods for Taiwanese cuisine, whereas Indonesians tend to use deep frying, roasting, and grilling. A strength of our study was the exclusion of participants who had self-reported mental distress (fatigue and depressive symptoms).

Conclusions
Education on healthy cooking techniques and additional social support must be provided to FMWs to assist them in dealing with an unfamiliar environment and prevent mental distress (fatigue and depressive symptoms).

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