ORIGINAL ARTICLE

Lifestyle Risk Factors Associated with Fatigue in Graduate Students

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Background/Purpose: Fatigue is not only common in clinical patients but is also prevalent in the healthy population. This study aimed to estimate the prevalence rate of fatigue and identify significant risk factors among graduate students.
Methods: Health check-ups were carried out on graduate students who were newly admitted to the National Taiwan University in this cross-sectional study. A total of 1806 attendees (response rate, 84%) agreed to participate in the fatigue survey, which used the Checklist Individual Strength questionnaire (CIS-20). The modified Baecke's questionnaire was used to quantify the intensity of physical activity.
Results: The prevalence rates of fatigue were 45.8% for males and 48.9% for females. Regular meal (odds ratio [OR], 0.69) and exercise habits (OR, 0.68), insomnia (OR, 2.23), greater amount of sleeping time (OR, 0.7), identity (doctorate *vs.* master students; OR, 0.61), and chronic disease history (OR, 1.61) were statistically significant predictors for fatigue. Intensity of physical activity was a protective factor (ORs, 0.72, 0.50 and 0.36 in the 2nd, 3rd and top quartiles *vs.* 1st quartile; $p < 0.001$).
Conclusion: A high prevalence rate of fatigue among the graduate students was demonstrated. The risk factors among young adults are not only related to current chronic disease and insomnia but are also attributed to the lack of physical activity. [*J Formos Med Assoc* 2007;106(7):565–572]

Key Words: fatigue, graduate student, lifestyle, physical activity, young adult

The prevalence rate of fatigue ranges from 7% to 45%,[1] and variations are due to the different characteristics of study populations. Fatigue is the predominant physical symptom in patients with chronic diseases, such as arthritis and cancers. The complaints from patients are attributable to biological factors or psychiatric distress, such as depression and anxiety.[2] In patients with physical illnesses, such as cancer, or chronic disease and depression, fatigue can be explained by care- and cure-related factors.[2]

However, patients with fatigue as their chief complaint in a primary care unit might have different causes that biologic factors cannot explain. The pathogeneses for fatigue are categorized into four main areas:[3] physical illnesses, demographic factors, lifestyle factors, and social factors. Among young adults, lifestyle and social factors play an important role. Poor physical activity may also be associated with fatigue.[4]

There are scanty reports on the prevalence of fatigue and its associated risk factors among working and young adult populations. Bultmann et al reported that fatigue prevailed among the working population, and lifestyle habits and psychologic distress contributed to the fatigue symptoms.[4] In one university, the prevalence of fatigue was as high as one-quarter of total new entrant students.[5] Risk factors in association with fatigue in graduate students are poorly understood, and fatigue-related

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risk factors, such as demographics, social and lifestyle factors, and physical illness are not reported among the young adult population.

This study aimed to estimate the prevalence rate of fatigue among graduate students in one university. Four dimensions of fatigue-related risk factors, including demographic factors, social factors, lifestyle factors, and physical illness, were investigated to identify significant predictors for fatigue.

Methods

Study subjects

Our survey targeted young adults, graduate students, in one university. According to the Labor Safety and Sanitary Regulations, new entry graduate students (including those in master's and doctorate programs) are required to undergo a health check-up. In September of 2004, 2688 students were admitted into the university graduate programs and they completed the health check-up program in October.

Data collection

The questionnaire package, including the basic information sheet, the Checklist Individual Strength–20 (CIS-20) questionnaire,[6] and the modified Baecke's physical activity questionnaire, were distributed to the students a week prior to the date of the health check-up. Students returned the questionnaire on the examination date and assistants gave instructions for those who had failed to complete the questionnaires properly and checked the data. Blood samples were collected in a fasting status and were sent to the central laboratory of National Taiwan University Hospital, which is affiliated to the National Taiwan University, for clinical measurements.

Measurement of variables

The CIS-20 questionnaire was used to detect fatigue severity. The items were divided into four dimensions, including eight questions for subjective fatigue (SF), four for reduced motivation (RM), three for reduced activity (RA), and five for reduced concentration (RC). Each question had seven levels, classified from a score of 1 to 7. Fatigue severities were presented as high scores. CIS-20 had good reliability and validity, and the Chinese version of the CIS-20 questionnaire was likewise validated and proven to be reliable.[7] We defined a CIS-20 score of more than 76 as the cut-off point for fatigue as in the Maastricht Study.[8]

The physical activity questionnaire was adapted from Baecke's physical activity questionnaire, although we excluded the work index in our study.[9] The sport index included the types of sports engaged in and the duration and frequency of the exercise. Three levels of intensity of the sport index were specified,[8] and we estimated the total calorie by enumerating the items. The leisure-time index, on the other hand, included normal daily activities and lifestyle other than work and exercise. The total activity score was the summation of the sport and leisure-time indices. We also defined insomnia status as sleeplessness of more than once per week, and specified the sleeping hours by 7 hours, with regular exercise and meals as lifestyle variables.

In addition to demographic features (age and gender), information regarding lifestyle factors was also collected on sleep duration, frequency of insomnia, the regularity of three meals per day, and smoking and drinking habits. The identification for students was classified into Doctorate or Master's status.

Information on previous hospitalization, hepatitis events, and medication history was obtained from the questionnaire. We performed the biochemical tests, including liver function, renal function, hemoglobin, and levels of glucose, uric acid, cholesterol, and triglyceride in the blood. Hepatitis history was defined by self-report of hepatitis B or hepatitis C. Abnormal liver function was defined as alanine aminotransferase (ALT) > 41 IU/L for males and ALT > 31 IU/L for females. Fasting blood glucose > 115 mg/dL was also considered abnormal. The criteria for defining abnormalities included serum creatinine ≥ 1.3 mg/dL for renal function, uric acid ≥ 7.6 mg/dL, cholesterol > 220 mg/dL, triglyceride > 200 mg/dL, hemoglobin < 12.3 g/dL for males and < 11.3 g/dL for females in association with anemia.

We defined the systemic diseases as follows: tuberculosis, asthma, hypertension, heart disease, stroke, renal disease, hyperlipidemia, diabetes, thyroid disease, gout/hyperuricemia, peptic ulcer disease, arthritis, epilepsy, poliomyelitis, hemophilia, systemic lupus erythematosus, anemia, psychiatric disease, or malignancies.

Statistical analysis

Continuous variables were presented as mean ± standard deviation and the categorical data were presented by contingency tables. We specified the characteristics of fatigue and related risk factors by gender. The χ^2 test was used to detect differences between genders and if the expected numbers were less than 5, Fisher's exact test was used. We defined fatigue status as a total score of more than 76 in the CIS-20,[8] and estimated the prevalence of fatigue in the study population.

Logistic regression model was used to estimate the parameters of various risk factors for fatigue. After the univariate model, we selected the best subsets of risk factors for binary outcome by stepwise selection criteria, with entry and stay significance levels of 0.2. We specified the quartiles of physical activity intensity as independent variables and test for the trend was used to evaluate the possible dose-response relationship between fatigue severity and physical activity intensity. All statistical analyses were performed using SAS version 9.1 (SAS Institute Inc., Cary, NC, USA) and a p value less than 0.05 was considered statistically significant.

Results

A total of 2144 students completed the health check-up program and 1806 signed the informed consent forms and were recruited into this study (response rate, 84%). The reasons for absence included withdrawal of admittance ($n = 400$) and failure to show up ($n = 124$). Distributions of age, gender, and identity of students were similar between respondents and non-respondents.

The characteristics of the study population, specified by gender, are listed in Table 1. Females were younger than males. Men had more doctorate students, more sleeping hours, more regular exercise habits, more irregular meals, more frequent drinking and smoking habits, and higher physical activity levels than women.

The overall prevalence rates of fatigue were 45.8% in males and 48.9% in females (Table 2). Master's identity had higher fatigue rates than doctorate identity. Subjects with hepatitis or systemic diseases also had high prevalent fatigue rates, more than 50%. Sleeping hours < 7 hours was associated with high fatigue rates (52.6% in men, 54.2% in women). The prevalence rates were higher in the insomnia group, and regular exercise and meal habits had lower fatigue rates than their counterparts. The fatigue rates were 28.9% in males in the top quartile of physical activity level and 60.2% in the bottom quartile. In women, the corresponding prevalence rates among the top and bottom quartiles were 34.9% and 60.2%, respectively (Table 2). There were no differences in fatigue score among biochemical variables.

Table 3 shows the simple and adjusted odds ratios (OR) and respective 95% confidence intervals (CI) of various risk factors to predict fatigue status. Doctorate identity had less than a one-third likelihood of fatigue, compared with master's identity. Those with systemic diseases or hepatitis history were strongly related to fatigue status, which had many associated risk factors, such as frequent insomnia, fewer sleeping hours, irregular meals, smoking and drinking habits, and irregular exercise habits.

Finally, physical activity intensity was inversely related to fatigue status, and the top physical activity quartile could reduce the significant likelihood of fatigue among the study population (adjusted OR, 0.36; 95% CI, 0.26–0.50). There were significant dose-response relationships between physical activity intensity and fatigue rates (adjusted ORs, 0.72, 0.50 and 0.36 in the 2nd, 3rd and top quartiles *vs.* 1st quartile, $p < 0.001$, test for trend).

Table 1. Characteristics of subjects by gender in the study population ($N = 1806$)

	Male, *n* (%)	Female, *n* (%)	*p*
Age (yr)			0.001
20–23	696 (52.1)	287 (61.1)	
≥23	640 (47.9)	183 (38.9)	
Identity			0.019
Master's	1118 (84.3)	416 (88.7)	
Doctorate	209 (15.7)	53 (11.3)	
History of systemic disease			0.060
No	1028 (76.9)	378 (80.4)	
Hepatitis[a]	117 (8.8)	23 (4.9)	
Sys dz[b]	172 (12.9)	61 (6.1)	
Hepatitis and sys dz[c]	19 (1.4)	8 (1.7)	
Sleep (hr)			<0.001
<7	363 (27.3)	177 (37.7)	
≥7	969 (72.7)	293 (62.3)	
Insomnia (≥once per wk)			0.694
No	863 (67.2)	307 (68.2)	
Yes	421 (32.8)	143 (31.8)	
Regular exercise			<0.001
No	782 (59.6)	358 (76.5)	
Yes	530 (40.4)	110 (23.5)	
Regular meals			0.002
No	469 (35.2)	128 (27.3)	
Yes	864 (64.8)	341 (72.7)	
Smoking habits			<0.001*
Smoker[d]	73 (5.5)	2 (0.4)	
Quit smoking	32 (2.4)	1 (0.2)	
Never smoked	1227 (92.1)	467 (99.4)	
Drinking habits			<0.001*
Drinker[e]	208 (15.6)	22 (4.7)	
Quit drinking	27 (2.0)	2 (0.3)	
Never drinked	1097 (82.4)	442 (94.9)	
Physical activity[f]			<0.001
Q1	362 (27.2)	191 (40.7)	
Q2	300 (22.5)	113 (24.0)	
Q3	359 (26.9)	100 (21.3)	
Q4	312 (23.4)	66 (14.0)	

**Fisher's exact test. [a]Hepatitis: positive hepatitis B antigen or anti-hepatitis C antibody; [b]Sys dz (other systemic disease), including any of these illnesses: tuberculosis, asthma, hypertension, heart disease, stroke, renal disease, hyperlipidemia, diabetes, thyroid disease, gout/hyperuricemia, peptic ulcer disease, arthritis, epilepsy, poliomyelitis, hemophilia, systemic lupus erythematosus, anemia, psychiatric disease, malignancy; [c]Hepatitis and sys dz: simultaneously having hepatitis and other systemic disease; [d]Smoker: individual who did not classify whether or not they have quit smoking were grouped into the smoking group; [e]Drinker: individual who did not classify whether or not they have quit drinking were grouped into the drinking group; [f]Physical activity: Q1 is ≤ the first quartile, Q2 is the first quartile to median, Q3 is the median to the third quartile, Q4 is > the third quartile.*

Table 2. Prevalence of fatigue in the study population

	Male ($n = 1336$) % (n)	Female ($n = 470$) % (n)	Total ($N = 1806$) % (n)
CIS-20			
> 76	45.8 (612)	48.9 (230)	46.6 (842)
≤ 76	54.2 (724)	51.1 (240)	53.4 (964)
Identity			
Master's	47.1 (527)	50.7 (211)	48.1 (738)
Doctorate	38.8 (81)	35.9 (19)	38.2 (100)
History of systemic diseases			
No	43.8 (450)	48.7 (184)	45.1 (634)
Hepatitis	47.9 (56)	52.2 (12)	48.6 (68)
Sys dz	56.4 (97)	49.2 (30)	54.5 (127)
Hepatitis and sys dz	47.4 (9)	50.0 (4)	48.2 (13)
Sleep (hr)			
< 7	52.6 (191)	54.2 (96)	53.2 (287)
≥ 7	43.1 (418)	45.7 (134)	43.7 (552)
Insomnia (≥ once per wk)			
No	37.9 (327)	43.3 (133)	39.3 (460)
Yes	60.6 (255)	59.4 (85)	60.3 (340)
Regular exercise			
No	53.2 (416)	52.5 (188)	53.0 (604)
Yes	34.3 (182)	42.0 (42)	35.0 (224)
Regular meals			
No	58.9 (276)	54.7 (70)	58.0 (346)
Yes	38.8 (335)	46.6 (159)	41.0 (494)
Physical activity			
Q1	60.2 (218)	60.2 (115)	60.2 (333)
Q2	50.0 (150)	47.8 (54)	49.4 (204)
Q3	42.3 (152)	38.0 (38)	41.4 (190)
Q4	28.9 (90)	34.9 (23)	29.9 (113)

CIS-20 = Checklist Individual Strength–20; Sys dz = other systemic disease, including any of these illnesses: tuberculosis, asthma, hypertension, heart disease, stroke, renal disease, hyperlipidemia, diabetes, thyroid disease, gout/hyperuricemia, peptic ulcer disease, arthritis, epilepsy, poliomyelitis, hemophilia, systemic lupus erythematosus, anemia, psychiatric disease, malignancy; Q1 is ≤ the first quartile; Q2 is the first quartile to median; Q3 is the median to the third quartile; Q4 is > the third quartile.

Discussion

This study clearly demonstrated the high prevalence rates of fatigue among young adults, composed by new entry graduate students in one university. We also defined several significant risk factors associated with fatigue. Physical activity intensity was demonstrated to be an independent protective factor.

The high prevalence of fatigue may cause some concern if graduate students, particularly those of master's identity, are overloaded with study work and stress, which lead to fatigue or distress. We found a high prevalence of poor lifestyle habits, including insomnia and irregular exercise and meals. Moreover, a lower prevalence of fatigue was found in young adults with a sufficient amount of sleep, regular meals/exercise,

Table 3. Odds ratios and respective 95% confidence intervals of various risk factors for fatigue status in logistic regression models

	n (%)	OR*	95% CI	OR†	95% CI‡
Gender					
Male	1336 (74.0)	1.00		1.00	
Female	470 (26.0)	1.13	0.92–1.40	0.99	0.78–1.25
Identity					
Master's	1534 (85.4)	1.00		1.00	
Doctorate	262 (14.6)	0.67	0.51–0.87	0.61	0.45–0.82
Systemic disease					
No	1406 (77.9)	1.00		1.00	
Hepatitis	140 (7.8)	1.15	0.81–1.63	1.11	0.76–1.64
Sys dz	233 (12.9)	1.46	1.10–1.93	1.61	1.19–2.19
Hepatitis and sys dz	27 (1.5)	1.13	0.53–2.42	0.81	0.34–1.91
Insomnia (≥ 1 per wk)					
No	1170 (67.5)	1.00		1.00	
Yes	564 (32.5)	2.34	1.91–2.88	2.23	1.79–2.76
Sleep (hr)					
< 7	540 (30.0)	1.00		1.00	
≥ 7	1262 (70.0)	0.69	0.56–0.84	0.70	0.56–0.87
Regular meals					
No	1205 (66.9)	1.00		1.00	
Yes	597 (33.1)	0.50	0.41–0.62	0.69	0.51–0.80
Smoking					
Never	1694 (94.0)	1.00		1.00	
Quit smoking	33 (1.8)	2.37	1.14–4.91	1.91	0.83–4.42
Smoker	75 (4.2)	1.51	0.95–2.40	1.21	0.70–2.11
Drinking					
Never	1539 (85.6)	1.00		1.00	
Quit drinking	29 (1.6)	2.22	1.03–4.81	1.86	0.75–4.62
Drinker	230 (12.8)	1.07	0.81–1.42	1.00	0.72–1.38
Regular exercise					
No	1140 (64.0)	1.00		1.00	
Yes	640 (36.0)	0.48	0.39–0.58	0.68	0.54–0.87
Physical activity					
Q1	553 (30.7)	1.00		1.00	
Q2	413 (22.9)§	0.64	0.50–0.83	0.72	0.54–0.95
Q3	459 (25.5)	0.47	0.36–0.60	0.50	0.38–0.66
Q4	378 (21.0)	0.28	0.21–0.37	0.36	0.26–0.50

**OR = simple odds ratio in univariate logistic regression model; †OR = adjusted odds ratio for multiple logistic regression model adjusting for gender, identity status, histories of systemic disease, insomnia, regular meals, smoking, drinking, regular exercise and physical activities; ‡c = 0.7 for multiple logistic regression model; §trend test, $p < 0.0$. Sys dz = other systemic disease, including any of these illnesses: tuberculosis, asthma, hypertension, heart disease, stroke, renal disease, hyperlipidemia, diabetes, thyroid disease, gout/hyperuricemia, peptic ulcer disease, arthritis, epilepsy, poliomyelitis, hemophilia, systemic lupus erythematosus, anemia, psychiatric disease, malignancy; Q1 is ≤ the first quartile; Q2 is the first quartile to median; Q3 is the median to the third quartile; Q4 is > the third quartile.*

and high physical activity levels. These findings might suggest that a high prevalence rate of fatigue may be mainly due to lack of regular lifestyle habits such as regular meals or exercise, sufficient amount of sleep and physical activity among graduate students.

Another possibility is that irregular lifestyle habits or lack of physical activity may lead to insomnia, and that in turn results in fatigue. By using a log-linear model to assess the association between these lifestyle factors, we found that regular meals of three times per day ($p < 0.0001$) were significantly associated with insomnia and that there was a lack of significant association for physical activity. This finding implied that those who have insomnia and irregular meals share common factors, such as stressful life events. The lack of association between physical activity and insomnia may also suggest that the link (or relationship) between physical activity and fatigue is independent of insomnia in causing the symptom of fatigue.

Our study reported higher rates than previous population studies (21.7% for males and 22.5% for females),[4] but less than an Arabian population.[10] Different ethnic populations have varied cultural viewpoints on fatigue and economic development levels also have impacts on fatigue prevalence. Fatigue is viewed as having a high relation with psychologic or life stresses, rather than as an illness in Western countries. Westerners might not pay as much attention to the symptoms related to fatigue during physical check-up. In contrast, Asians have an ingrained belief that fatigue is an illness due to the accumulation of too much work.[11] The distress association with fatigue would thus be more likely to be presented in routine health check-up programs.

Wang et al's study defined a cut-off point of 80 for males and 85 for females.[7] However, the present research has chosen 76 as the cut-off point for the following reason: although Wang et al's subjects are citizens, they were also from a patient population, while Bultmann et al's Masstricht cohort's subjects were from the normal working population.[8] The subjects of the present study go to graduate school, which is closer to a working population, and if we use 80 for males and 85 for females as the cut-off points, the false-negative rate might increase.

Although the relevant covariates presented in our study differed between males and females, no substantial gender difference in susceptibility to fatigue was observed after adjusting the related factors. Previous studies reported that females were more likely to show fatigue than males.[12–16] The difference might be due to a relatively young and homogeneous characteristic in our study population.

This study showed that individuals with high physical activity level had less fatigue. Also, regular exercise and three meals a day are protective factors for fatigue. Our empirical results have significant clinical implications for the management of patients with fatigue as their chief complaint. According to past studies, one-fifth to one-third of fatigue cases will eventually develop into persistent fatigue,[17] and cases of persistent fatigue were found to have an increasing risk of developing depression and chronic fatigue syndrome in future years.[18,19] Therefore, physicians should pay more attention to patients who complain of fatigue.

In addition to routine physical examinations, lifestyle information along with systematic disease or insomnia may become auxiliary criteria in exploring the reasons for fatigue. However, lifestyle information is often neglected in clinical practice. If everything is normal after biochemical tests, the patient would often not consider that it is his/her lifestyle that is causing fatigue. The individual would continue to seek further medical consultation in vain. It is at this point that our education ought to be able to offer not only teaching students the techniques of sport during physical education classes, but also to convey the message of establishing regular exercise habits.

In the original Baecke's physical activity questionnaire, there are three indicators: work, sport, and leisure time indices. As our target population comprised graduate students, the work indicator was not appropriate for our study.

This study had some limitations. Since the present study is a cross-sectional study, causal relationships between some clinical correlates and fatigue may be difficult to disentangle. For instance, whether insomnia is a cause of fatigue or a consequence of fatigue cannot be clarified. Only an association was proven in this study. In addition, some studies have reported that emotional status such as depressed mood and anxiety are associated with fatigue. This dimension was not considered in our study. However, it would have required more time to make such evaluations. Therefore, ongoing research should perhaps be conducted to assess the effects of depressed mood and anxiety on fatigue using a structural equation model.

In conclusion, a high prevalence rate of fatigue, as measured by the CIS-20 among graduate students, was found. The risk for fatigue was not only related to insomnia but also to irregular lifestyle habits and physical inactivity. Physicians should take care to consider lifestyle evaluation when evaluating young adults with fatigue complaints.

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