Body mass index conditions and eating attitudes in young nurses: a pilot psycho-immune-endocrine investigation

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ABSTRACT

Purpose. To investigate a cohort of young Italian nurses to identify whether the body mass index (BMI) and eating flexibility differed and were associated according to the basic characteristics of sex, smoking behavior, or shift activity, the levels of neutrophils, lymphocytes, or platelets in blood, and the psychological conditions of anxiety, depression, stress, or insomnia. Materials and Methods. The data include sex, BMI, smoking behavior, shift activity, neutrophil, lymphocyte, and platelet levels, eating flexibility [measured using the eating disorder flexibility index (EDFLIX) and the subdimensions EDFLIX-GF for general flexibility, EDFLIX-FoEx for food and exercise flexibility, and EDFLIX-WeSh for weight and shape flexibility], and mental health [assessed using the depression, anxiety, and stress scale (DASS-21) and the insomnia severity index (ISI)]. Results. Differences in BMI with shift work (P=0.042) and anxiety with total EDFLIX (P<0.001), EDFLIX-GF (P<0.001), and EDFLIX-WeSh (P=0.044) scores were significant. Having depression was associated with significant differences in total EDFLIX (P<0.001), EDFLIX-GF (P=0.005), and EDFLIX-WeSh (P<0.001) scores. Nurses with moderate stress reported high total EDFLIX (P<0.001), EDGLIX-FoEx (P<0.001), and EDFLIX-WeSh (P=0.013) scores. Nurses with mild stress reported high EDFLIX-GF scores (P<0.001). Nurses without insomnia symptoms reported significantly high EDFLIX-FoEx scores (P<0.001). Associations between lymphocyte levels and EDFLIX-FoEx (β=-0.264; P=0.003), stress and EDFLIX-total (β=-0.436; P<0.001), EDFLIX-GF (β=-0.466; P<0.001) and EDFLIX-WeSh (P=0.022), and also between insomnia and EDFLIX-FoEx (β=-0.245; P<0.001) were significant. Conclusions. Nurses, from the beginning of their careers, should be monitored and encouraged to avoid adverse health practices that negatively influence their quality of life.

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Introduction

Globally, nurses are the most numerous group of healthcare workers and their health conditions have achieved more attention nowadays.[1,2] Nurses deal with increasing healthcare requirements from an older population and an increasing worry of non-communicable diseases, so it is necessary for healthy behavior to face adequately up to this charge.[2]

Nursing is a high-risk profession,[3] due to the daily exposition to several biological, chemical, environmental, physical, and psychosocial hazards at work.[4]

Nurses' activity is frequently dubious and very

time-sensible, adapting their eating behaviors to their work requests, causing an unsuitable dietary assumption and modifying eating habits.[5-7] Time restriction and urgent responsibilities are the most common causes to get fast and unhealthy foods.[5] Starting in 2003, the World Health Organization evidenced how scarce eating quality has negative consequences both on the economic and health conditions. Additionally, an unhealthy diet is associated with obesity, diabetes, cardiovascular diseases, osteoporosis, dental diseases, and cancer, too.[8]

Several studies suggest that a heavy workload may cause less flexible eating behaviors among nurses by consuming inadequate quantity and quality of food. Many nurses eat irregularly and frequently switch on high-fat and sweetened foods and avoid the daily suggested amount of fruits and vegetables.[9] Poor eating habits positively relate to cardiometabolic health risks, higher body fat composition, and worse psychological conditions, such as anxiety, depression, stress, and insomnia.[10] Furthermore, psychological distress,[3] specifically anxiety, depression, stress, and insomnia, may encourage the consumption of sweet and fatty foods and snacks between principal meals, causing high energy intake.[11-13] Shift work, especially night shifts, may contribute to psychological disorders, poor dietary choices, and scarce quality of rest.[14-16] Increasing appetite and irregular meal consumption influence the body mass index (BMI).[10,11,17] Several studies have investigated the eating behaviors of nurses.[11,18-21] However, little research has highlighted the tendency to overeat and its related contributing factors, which remain the most crucial key determinants in the etiopathogenesis of eating disorders among nurses, especially among young nurses. Moreover, no study has considered the eating flexibility of nurses and its effect on BMI. Cognitive flexibility is an essential dimension of mental health,[22-24] because cognitive and attitudinal flexibility are key to executive function, enabling the adaptation of thoughts and actions.[25] Another unhealthy behavior that is very frequent among nurses is the smoking one and the exposure to smoking, which increases the risk to nurses' health, exposing them to a high risk of immune system deterioration.[26,27] In this regard, the literature review of Nakata *et al.*[4] describes the prevalence of smoking behaviors among nurses in the United States and identifies their principal causes: high work stress, poor work environment, shift work, and peer influence. Cigarette smoking has been ubiquitous among American nurses for the latest 50 years. In 1959, the American Cancer Society conducted a national survey (n=9,498) and reported that 36% of the enrolled nurses smoked, a higher prevalence than that among other healthcare professionals.[28-32] Smoking may contribute to an increase of 30% in white blood cell counts by inducing systemic inflammation,[33] a potential predictor of cardiovascular and cancer disease mortality,[34,35] as demonstrated by several correlational studies. Smoking specifically induces the increase of helper T ($CD4^+$) cells, and simultaneously reduces their functioning.[36-38] Memory T cells induce B cell multiplication and differentiation and immunoglobulin production to defend the body from bacterial and viral infections. Smoking may induce excessive T cell memory proliferation and accelerate cellular aging and telomere shortening in circulating lymphocytes.[39]

Shift work, particularly night shift work, is common in nursing, especially in young nurses, as age is significantly higher in day workers.[40] Night shift nurses have high risks of chronic disease, cardiovascular disease, diabetes, metabolic syndrome, and cancer.[41] Specific conditions, such as rest-activity pattern alteration and obesity, are more prevalent among night shift nurses than among their day shift counterparts; circadian rhythm adaptation is a plausible mechanism.[42,43] This unusual circadian rhythm may adversely influence the digestion process and negatively affect nutrient assimilation, enzyme function, and metabolism.[44] Therefore, night shift nurses have high cardiometabolic risks and high risks of high triglyceride levels, low high-density lipoprotein-cholesterol levels, diabetes, high blood pressure, breast cancer, heart disease, and atherosclerosis.[45-54] Some possible causes of increased weight among night shift nurses are decreased energy expenditure, food selection behaviors (toward more sweet and fatty foods), and snacking habits;[55-59] increased weight leads to an amplified proinflammatory condition.[60] Shift work is linked to headaches, irritation after a night shift, non-communicable diseases, such as: diabetes, cardiovascular disease disorders,[9,61-65] and unhealthy eating assumptions,[5,62,66-67] type 2 diabetes, coronary heart disease, cardiovascular disease and gastrointestinal disorders and obesity.[68,69] Unhealthy diets induce an increase in BMI scores and a decrease in rest quality,[8] with a consequential negative impact on emotional and uncontrolled eating, due to dysregulations in hormones linked to appetite and body weight including insulin, leptin, ghrelin, growth hormone and thyroxin.[70-72] Moreover, both tumor necrosis factor-α and interleukin (IL)-1β induce rest.[73-77] IL-6 and soluble IL-6 receptors top during the REM sleep phase, while other cytokines increase during slow-wave sleep.[76,77] Sleep disorders have been also associated with elevated c-reactive protein and IL-6 concentrations,[78] which seem to be strongly associated with inflammation-related conditions, such as colorectal cancer and coronary heart disease.[79-82] Nurses' job tension has been associated with stress which influences the hormone cortisol and impacts obesity.[63,65] Literature suggests how job stress positively impacts on abdominal adiposity, weight gain and obesity, as negative emotional coping approach, such as stress and anxiety.[5,61,65,66,83]

The COVID-19 outbreak has also affected psycho-

logical health among nurses,[84] changes are characterized by psychological distress, fear, anxiety, depression, stress, insomnia, suicidal thoughts, and suicide.[85-93] The COVID-19 pandemic has provoked uncertainty, particularly among healthcare professionals directly involved in the care of patients with COVID-19, because of the severity of COVID-19 symptoms, the prevalence of death among healthcare professionals, the receiving of inadequate support, isolation, heavy workloads, and insecure attachment, which cause high levels of stress, anxiety, depression, insomnia, burnout, addiction, and post-traumatic stress disorder.[94-97]

Therefore, working as a nurse may contribute to the development of a latent chronic inflammation condition. The literature indicates that blood composition varies during inflammation. For example, increased platelet counts and platelet activation are associated with chronic inflammation.[98,99] Obesity causes chronic inflammation,[99,100] thus obese patients may exhibit abnormal platelet counts and platelet activation.

Compared with individuals with normal white blood cell counts, those with leukocytosis have higher BMIs in a direct positive association. Therefore, obesity is a possible cause of reactive leukocytosis.[101] Inflammation in patients with severe obesity is caused by the activation of different factors involved in the innate immune response because of increased plasma levels of acute phase proteins, endothelial cell activation markers, complement factors, and cytokines derived from activated macrophages. Available data suggest that in this phase, neutrophils are activated less in patients with morbid obesity.[102] This contradicts explicit evidence that the innate immune system is activated during morbid obesity.[103]

All the above-mentioned key factors impacting reduced eating flexibility and increased BMI in the nursing profession are summarized in Figure 1.

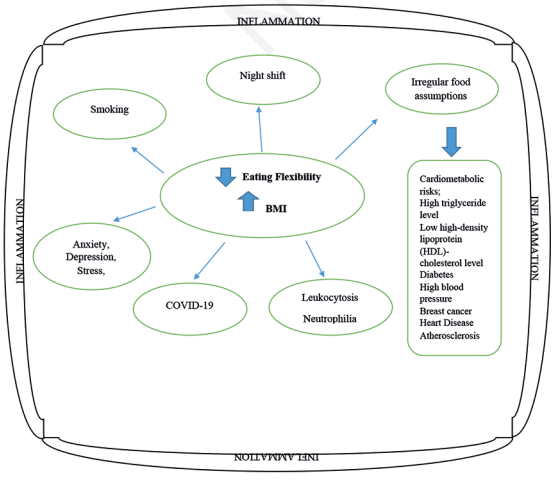

Figure 1. Eating flexibility and body mass index conditions and their related impacting factors in the nursing profession.

Purpose

By considering the aforementioned aspects, the present study aimed to investigate a cohort of young Italian nurses to identify whether BMI and eating flexibility differed according to: i) the basic characteristics of sex, smoking behavior, or shift activity; ii) the levels of neutrophils, lymphocytes, or platelets in blood; iii) the psychological conditions of anxiety, depression, stress, or insomnia.

Additionally, the present study aimed to identify any associations between BMI and eating flexibility with the abovementioned variables.

Materials and Methods

Study

An online cohort observational study was conducted during May 2022 where nurses were recruited through nursing pages on Facebook and Instagram.

Participants

Italian nurses directly employed during the COVID-19 outbreak in the public or private Italian health system were eligible for the present study. Only nurses aged less than 30 years with less than 5 years of work experience were included. On the other hand, nurses, who did not answer the questionnaires completely or were inactive during the outbreak of COVID-19 for several reasons, were excluded from the study.

Measures

The first part of the questionnaire administered collected data on the following characteristics: i) sex: female or male; ii) shift work per day: only during the morning, both during the morning and the afternoon or during the night shift; iii) BMI; this was calculated using the information on weight (kg) and height (m) provided by participants. BMI was classified in the literature as indicating underweight (<18.49), normal weight (18.50-24.99), overweight (25-29.99), or obesity (>30);[104] iv) smoking habit: yes or no; v) levels of neutrophils, lymphocytes, and platelets in the blood; measurements from the most recent blood count that was on earlier than 6 months before the study were used for screening purpose. The sample was divided into low (lower than the normal range indicated in own report), normal (within the normal range indicated in own report) and high (greater than the normal range indicated in own report) subgroups.

The Eating disorder flexibility index (EDFLIX) questionnaire was administered to assess eating flex-

ibility among participants.[105] Behavioral flexibility is the ability to adapt behavior according to internal or external stimuli by shifting one's attention between several things; it involves, for example, self-control, reversal learning, and set-shifting.[106-108] The EDFLIX questionnaire has 36 items. Each item is responded to using a Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). The EDFLIX exhaustively evaluates eating flexibility in terms of both specific and general cognitive-behavioral flexibility. This assessment tool can also be used to recognize treatment struggles, to additional existing pre-and post-treatment evaluations, or be adopted as a screening instrument in potential "at-risk" individuals.[105] It has three subsections: general flexibility (EDFLIX-GF), food and exercise flexibility (EDFLIX-FoEx), and weight and shape flexibility (EDFLIX-WeSh). Higher scores indicate higher eating flexibility.

The EDFLIX has strong psychometric qualities with high internal consistency and construct validity. It provides accurate measurements for individuals with and without eating disorders (EDs). Individuals with versus without EDs do not differ in general flexibility, but they differ in terms of ED-specific flexibility measures, partially indicating the existence of transdiagnostic differences in EDs and supporting the usefulness of the EDFLIX for classification.

In the last part of the questionnaire, the 21-item depression, anxiety, and stress scale (DASS-21) was administered;[109] it comprised a set of three self-report scales designed to assess negative emotional conditions related to depression, anxiety, and stress, respectively. Each of the three DASS-21 scales included seven items, measured on various subscales. The depression scale measured dysphoria, hopelessness, devaluation of life, self-deprecation, lack of interest or involvement, anhedonia, and inertia. The anxiety scale measures autonomic arousal, skeletal muscle effects, situational anxiety, and subjective anxiety. The stress scale measured levels of chronic nonspecific arousal by assessing having difficulty relaxing, experiencing nervous arousal, becoming easily upset or agitated, irritable or overreactive, and impatient. Participants were asked to rate each item using a Likert scale indicating how often the situation described in the item had occurred in their lives, from 0 (the situation has never occurred) to 3 (the situation very frequently occurs). Stress was assessed by summing items 1, 6, 8, 11, 12, 14, and 18 and doubling the total score. Anxiety was assessed by summing items 2, 4, 7, 9, 15, 19, and 20 and doubling the total score.[109] Depression was assessed by summing items 3, 5, 10, 13, 16, 17, and 21 and doubling the total score.[110] All three conditions assessed were classified at five levels: normal, mild, moderate, severe, and extremely severe.[111]

Insomnia was also investigated using the Insomnia severity index (ISI).[112,113] The ISI contained a total of seven items assessing: severity of sleep-onset, sleep maintenance, early morning awakening difficulties, satisfaction with current sleep pattern, interference with daily functioning, notability of strike due to sleep disorders, and level of distress provoked by the insomnia. The seven items were assessed using a Likert scale from 0, as "not at all" to 4, as "extremely". A total score was obtained, ranging from 0 to 28, indicating one of four levels of insomnia: from no insomnia to severe insomnia by referring to the last 2 weeks.[112,113] Evidence suggested that the ISI was a sensitive, reliable, and valid tool (α=0.76-0.78) to assess changes in perceived sleep difficulties with treatment.

Data analysis

All data was collected in a data sheet and then, processed thanks to the statistical package for the social sciences, version 20. All data collected, including psychological conditions, such as anxiety, depression, stress, and insomnia conditions were reported as categorical variables and thus, explained as frequencies and percentages. On the other hand, the EDFLIX score, being a continuous variable, was presented as means ± standard deviations. Then, to assess any differences between participants' characteristics, blood cell levels, and psychological conditions according to BMI levels, chi-square tests were performed. To assess any differences between participants' characteristics, blood cell levels, and psychological conditions according to the eating flexibility attitude, thanks to the EDFLIX score and its related subdimensions, ANOVA tests were assessed, too. The psychometric properties of the measurement scales (Cronbach alpha - α) were assessed. Specifically, α-EDFLIX=0.776, α-HADS=0.874 and α-ISI=0.724. Finally, linear regressions were performed between BMI and EDFLIX scores and sex, shift work, smoke habits, blood cell levels, and psychological conditions in order to highlight any significant associations that existed. The variance inflation factor (VIF) was also assessed in order to measure the severity of multicollinearity in the regression analysis performed. All the P-values<0.05 have been considered as statistically significant.

Results

A total of 148 young nurses were enrolled online. All recruited participants' ages were less than 30 years and have been employed for less than 5 years, as nurses. Of these, 114 (77%) were female and 34 (23%) were male. Eight nurses (5.4%) were employed only during the morning shift, 21 (14.2%) both for the morning and the afternoon shift and, 119 (80.4%) of participants worked also during the night shift. Most of the nurses recruited were normal weight (87; 58.8%), 39 (26.4%)

were overweight, 8 (5.4%) were underweight and 14 (9.5%) were obese. 60.1% (n=89) of nurses did not smoke. As shown in Table 1, a significant difference was assessed between BMI conditions and shift work (P=0.042), as more nurses who are employed during the night shift are overweight (23%) or obese (7.4%). No further significant difference was reported between BMI conditions and sex (P=0.810) and smoking habits (P=0.947). As regards differences in BMI conditions and blood cell levels, no significant correlations were assessed both with neutrophils (P=0.701) and lymphocytes (P=0.260). As regards platelet levels, all participants declared they had normal platelet levels and therefore, no further analysis was performed. Anxiety, depression, stress, and insomnia conditions according to BMI values showed no significant differences.

As shown in Table 2, no significant differences were reported between the EDFLIX total score and its subdimensions according to sex, shifting, and smoking habit. Additionally, significant differences were assessed between eating flexibility and neutrophil and lymphocyte levels, specifically between: EDFLIX-FoEx and lymphocyte levels (P<0.001), as those who reported low lymphocyte levels (4.1%) registered high

Table 1. Body mass index levels according to selected participants' characteristics and their psychological conditions (n=148).

BMI levels/Sampling (n; %)	Underweight (8; 5.4%)	Normal weight (87; 58.8%) n (%)	Over weight (39; 26.4%) n (%)	Obese (14; 9.5%) n (%)	chi square test (x^2)	P-value
Sex						
Female (114; 77%)	7 (4.7)	68 (45.9)	29 (19.6)	10 (6.8)	0.796	0.810
Male (34; 23%)	1 (0.7)	19 (12.8)	10 (6.8)	4 (2.7)		
Shift/day						
One (8; 5.4%)	1 (0.7)	6 (4.1)	0 (0)	1 (0.7)	0.051	0.042*
Two (21; 14.2%)	4 (2.7)	10 (6.8)	5 (3.4)	2 (1.4)		
Three (119; 80.4%)	3 (2)	71 (48)	34 (23)	11 (7.4)		
Smoking habit						
Yes (59; 39.9%)	3 (2)	34 (23)	17 (11.5)	5 (3.4)	0.947	0.947
No (89; 60.1%)	5 (3.4)	53 (35.8)	22 (14.9)	9 (6.1)		
Neutrophil levels						
Low (45; 30.4%)	1 (0.7)	27 (18.2)	12 (8.1)	5 (3.4)	0.653	0.701
Normal(103; 69.6%)	7 (4.7)	60 (40.5)	27 (18.2)	9 (6.1)		
Lymphocyte levels						
Low (6; 4.1%)	0 (0)	4 (2.7)	0 (0)	2 (1.4)	0.248	0.260
Normal (114; 77%)	5 (3.4)	68 (45.9)	31 (20.9)	10 (6.8)		
High (28; 18.9%)	3 (2)	15 (10.1)	8 (5.4)	2 (1.4)		
Anxiety						
Normal (54; 36.5%)	0 (0)	32 (21.6)	19 (12.8)	3 (2)	0.035	0.089
Mild (11; 7.4%)	0 (0)	7 (4.7)	4 (2.7)	0 (0)		
Moderate (27;18.2%)	4 (2.7)	15 (10.1)	6 (4.1)	2 (1.4)		
Severe (10; 6.8%)	0 (0)	6 (4.1)	3 (2)	1 (0.7)		
Extremely severe (46; 31.1%)	4 (2.7)	27 (18.2)	7 (4.7)	8 (5.4)		
Depression						
Normal (7; 4.7%)	0 (0)	3 (2)	3(2)	1 (0.7)	0.442	0.414
Mild (42; 28.4%)	2 (1.4)	25 (16.9)	13 (8.8)	2 (1.4)		
Moderate (28; 18.9%)	1 (0.7)	18 (12.2)	8 (5.4)	1 (0.7)		
Severe (36; 24.3%)	1 (0.7)	22 (14.9)	6 (4.1)	7 (4.7)		
Extremely severe (35; 23.6%)	4 (2.7)	19 (12.8)	9 (6.1)	3 (2)		
Stress						
Normal (37; 25%)	2 (1.4)	19 (12.8)	14 (9.5)	2 (1.4)	0.803	0.811
Mild (24; 16.2%)	1 (0.7)	14 (9.5)	8 (5.4)	1 (0.7)		
Moderate (37; 25%)	2 (1.4)	24 (16.2)	6 (4.1)	5(3.4)		
Severe (31; 20.9%)	2 (1.4)	19 (12.8)	7 (4.7)	3 (2)		
Extremely severe(19; 12.8%)	1 (0.7)	11 (7.4)	4 (2.7)	3 (2)		
Insomnia						
Absence (52; 35.1%)	4 (2.7)	29 (16.9)	14 (9.5)	5 (3.4)	0.553	0.559
Subthreshold (59; 39.9%)	2 (1.4)	32 (21.6)	18 (12.2)	7 (4.7)		
Moderate (36; 24.3%)	2 (1.4)	26 (17.6)	6 (4.1)	2 (1.4)		
Severe (1; 0.7%)	0 (0)	0 (0)	1 (0.7)	0 (0)		

BMI, body mass index. *P<0.05 is statistically significant.

EDFLIX-FoEx values (62.33±9.60) than the normal (52.17±7.31) and the high group (50.57±5.03), respectively. By considering psychological conditions and eating flexibility in young nurses (Table 2), significant differences were reported between anxiety levels and EDFLIX-total score (P<0.001), as nurses reporting moderate anxiety levels register significantly high levels both in EDFLIX-total score (151.41±20.65) and in the EDFLIX-GF (71.52±10.28). As regards the EDFLIX-WeSh sub-dimension, a significantly higher level (P=0.044) was reported among nurses with severe anxiety (27.00±8.01). Additionally, significant differences were reported in depression and EDFLIX-total (P<0.001), EDFLIX-GF (P=0.005), and EDFLIX-WeSh (P<0.001) scores as nurses reporting a normal depression condition recorded higher levels in EDFLIX-total scores than the others. As regards the stress condition, the trend seemed to be irregular, as nurses reporting moderate stress levels also recorded higher scores in EDFLIX-total (P<0.001), EDGLIX-FoEx

Table 2. Eating behaviors according to selected participants' characteristics (n=148).

EDFLIX/ Sampling (n; %)	EDFLIX-Total mean±s.d.	F	P-value	EDFLIX-GF mean±s.d.	F	P-value	EDFLIX-FoEx mean±s.d.	F	P-value	EDFLIX-WeSh mean±s.d.	F	P-value
Sex												
Female (114; 77%)	138.39±19.24	0.243	0.623	63.96±11.97	10.623	0.406	51.91±7.49	1.280	0.260	22.51±7.32	2.381	0.125
Male (34; 23%)	140.26±20.41			62.00±12.4			53.53±6.64			24.74±7.61		
Shift/day												
One (8; 5.4%)	129.75±11.94	0.989	0.375	55.75±15.40	1.874	0.157	50.25±5.12	0.382	0.683	23.75±6.27	0.044	0.957
Two (21; 14.2%)	140.81±18.67			65.05±11.62			52.90±7.42			22.86±6.12		
Three (119; 80.4%)	139.07±19.95			63.76±11.82			52.31±7.45			23.00±774		
Smoking habit												
Yes (59; 39.9%)	138.22±18.07	0.092	0.762	63.68±12.63	0.018	0.893	52.76±6.38	0.418	0.519	21.78±7.21	2.777	0.098
No (89; 60.1%)	139.21±20.42			63.40±11.74			51.97±7.90			23.84±7.48		
Neutrophil levels												
Low (45; 30.4%)	138.15±16.80	0.074	0.785	62.15±13.24	0.818	0.367	52.38±6.16	0.011	0.918	23.62±6.05	0.424	0.516
Normal(103; 69.6%)	139.11±20.58			64.11±11.53			52.24±7.80			22.76±7.95		
Lymphocyte levels												
Low (6; 4.1%)	156.17±10.48	2.554	0.081	71.17±7.11	1.371	0.257	62.33±9.60	0.001*	6.953	22.67±5.16	2.585	0.079
Normal (114; 77%)	137.94±19.78			63.42±12.37			52.17±7.31			22.34±7.74		
High (28; 18.9%)	138.68±18.27			62.25±11.30			50.57±5.03			25.86±5.82		
Anxiety												
Normal (54; 36.5%)	138.09±20.15	5.498	>0.001*	64.63±13.60	6.639	>0.001*	50.91±7.08	1.060	0.378	22.48±6.84	2.511	0.044*
Mild (11; 7.4%)	138.55±9.99			31.27±11.19			53.18±11.24			24.09±4.85		
Moderate (27;18.2%)	151.41±20.65			71.52±10.28			54.37±5.08			25.51±9.04		
Severe (10; 6.8%)	144.70±19.79			64.50±15.59			53.20±4.51			27.00±8.01		
Extremely severe (46; 31.1%)	131.06±15.71			57.83±6.73			52.17±7.99			21.06±6.89		
Depression												
Normal (7; 4.7%)	155.43±13.44	5.465	>0.001*	68.00±6.24	3.837	0.005*	52.86±6.01	1.455	0.219	34.57±3.78	7.658	>0.001*
Mild (42; 28.4%)	129.57±20.00			58.59±12.77			50.67±7.98			20.31±8.77		
Moderate (28; 18.9%)	146.64±15.38			69.07±11.16			52.28±4.44			25.28±6.00		
Severe (36; 24.3%)	138.36±20.02			64.58±10.10			51.08±9.68			21.97±5.27		
Extremely severe (35; 23.6%)	140.80±17.47			62.97±12.68			54.60±5.22			23.23±6.58		
Stress												
Normal (37; 25%)	144.24±14.96	7.510	>0.001*	67.89±11.95	9.289	>0.001*	53.05±5.58	6.969	>0.001*	23.30±6.18	3.281	0.013*
Mild (24; 16.2%)	143.79±21.80			70.21±11.51			48.19±9.42			24.67±5.78		
Moderate (37; 25%)	145.19±22.51			63.16±11.54			56.57±8.23			25.46±8.11		
Severe (31; 20.9%)	129.61±14.96			60.26±10.49			49.13±3.45			20.23±7.53		
Extremely severe (19; 12.8%)	124.58±10.70			52.52±6.19			51.84±5.93			20.21±8.14		
Insomnia												
Absence (52; 35.1%)	143.98±18.96	2.290	0.081	65.71±11.55	1.742	0.161	55.41±7.52	5.417	0.001*	22.86±6.73	0.734	0.533
Subthreshold (59; 39.9%)	136.50±20.87			13.06±1.70			50.93±6.71			23.98±7.59		
Moderate (36; 24.3%)	134.72±16.49			63.03±10.62			50.03±6.72			21.67±1.35		
Severe(1; 0.7%)	154.00±0.00			80.00±0.00			51.00±0.00			23.00±0.00		

EDFLIX, eating disorder flexibility index; EDFLIX-GF, general flexibility; EDFLIX-FoEx, food and exercise flexibility; EDFLIX WeSh, weight and shape flexibility; s.d., standard deviation; F, ANOVA test. *P<0.05 is statistically significant.

(P<0.001), EDFLIX-WeSh (P=0.013), while nurses recording mild stress levels reported higher EDFLIX-GF scores (P<0.001). Finally, nurses without any insomnia symptoms also reported significantly higher levels in the EDFLIX-FoEx values (P<0.001).

As reported in Table 3, significant associations were recorded between lymphocyte levels and EDFLIX-FoEx (β=-0.264; P=0.003), between stress and EDFLIX-total (β=-0.436; P<0.001), EDFLIX-GF (β=-0.466; P<0.001), EDFLIX-WeSh (P=0.022), and also between insomnia and EDFLIX-FoEx (β=-0.245; P<0.001). In all the linear regressions performed, the VIF was assessed as less than 2, therefore, all the variables considered were not influenced by multicollinearity among themselves.

Discussion

The present study investigated whether BMI and eating flexibility differed with respect to the basic characteristics of sex, smoking behavior, and shift activity; the levels of neutrophils, lymphocytes, and platelets in the blood; and the psychological disorders of anxiety, depression, stress, and insomnia. Additionally, the present study also explored any associations between BMI and eating flexibility with the abovementioned variables, too.

No difference in BMI was associated with sex or smoking behavior, but more nurses who worked night shifts were overweight (23%) or obese (7.4%; P=0.042). This was consistent with several studies that

Table 3. Associations between eating behaviors and body mass index levels according to selected participants' characteristics and their psychological conditions (n=148).

EDFLIX/Sampling – VIF	EDFLIX-Total	EDFLIX-GF	EDFLIX-FoEx	EDFLIX-WeSh	BMI
Sex – VIF: 1.140					
β	0.016	-0.117	0.133	0.101	0.058
t	0.189	-1.419	1.517	1.228	0.654
p-value	0.850	0.158	0.132	0.222	0.514
Shift/day – VIF: 1.146					
β	0.057	0.122	-0.057	0.009	0.121
t	0.689	1.496	-0.660	0.109	1.386
P-value	0.492	0.137	0.510	0.913	0.168
Smoking habit – VIF: 1.100					
β	-0.023	-0.017	-0.081	0.048	-0.024
t	-0.275	-0.210	-0.941	0.587	-0.271
P-value	0.784	0.834	0.348	0.558	0.787
Neutrophil levels – VIF: 1.133					
β	0.015	0.090	-0.065	-0.042	-0.006
t	0.178	1.078	-0.736	-0.525	-0.065
P-value	0.859	0.283	0.463	0.601	0.948
Lymphocyte levels – VIF: 1.096					
β	-0.098	-0.086	-0.264	-0.042	-0.059
t	-1.146	-1.028	-2.986	-0.505	-0.662
P-value	0.254	0.306	0.003*	0.615	0.509
Anxiety – VIF: 1.868					
β	0.150	0.085	0.153	0.105	-0.030
t	1.505	0.871	1.457	0.997	-0.275
P-value	0.135	0.385	0.147	0.320	0.784
Depression – VIF: 1.146					
β	0.023	0.010	0.129	-0.084	-0.026
t	0.289	0.132	1.554	-1.012	-0.310
P-value	0.773	0.895	0.122	0.313	0.757
Stress – VIF: 1.931					
β	-0.436	-0.466	-0.143	-0.245	0.012
t	-4.344	-4.764	-1.351	-2.314	0.115
P-value	>0.001*	>0.001*	0.179	0.022*	0.908
Insomnia – VIF: 1.452					
β	-0.051	0.157	-0.389	-0.005	-0.101
t	-0.541	1.773	-4.266	-0.048	-0.999
P-value	0.589	0.078	>0.001*	0.962	0.320

EDFLIX, eating disorder flexibility index; EDFLIX-GF, general flexibility; EDFLIX-FoEx, food and exercise flexibility; EDFLIX-WeSh, weight and shape flexibility; s.d., standard deviation; VIF, variance inflation factor; β; t; *P<0.05 is statistically significant.

also highlighted the cortisol circadian rhythm contribution to weight gain as well as unhealthy food choices and thereby caloric intake during the night shift.[114-117]

Eating flexibility differed significantly, specifically in the EDFLIX-FoEx subdimension, in relation to lymphocyte levels (P<0.001); those with low lymphocyte levels had higher EDFLIX-FoEx values (62.33±9.60) than did those with normal (52.17±7.31) or high lymphocyte levels (50.57±5.03). These significant differences were also confirmed by the negative significant associations between the EDFLIX-FoEx subdimension and lymphocyte levels (β=-0.264; P=0.003), too. These specific findings are consistent with results in the literature that routine physical activity improves resistance to infections, especially respiratory infectious diseases, and protects against malignancy,[118-120] because of the continuous stimulation of the immune system in regular physical activity. This positive effect may depend on the association between exercise and immune-system-related changes involving adrenaline (epinephrine), noradrenaline (norepinephrine), growth hormone, and cortisol, which are produced during physical activity.[121,122] The concentrations of these hormones increase during exercise and cause lymphocytes and neutrophils to return to normal values. Anxiety level and total EDFLIX score are significantly associated. Nurses with moderate anxiety levels exhibited significantly higher (P<0.001) total EDFLIX (151.41±20.65) and EDFLIX-GF (71.52±10.28) scores than nurses with normal anxiety levels. EDFLIX-WeSh score was significantly higher (P=0.044) among nurses with severe anxiety (27.00±8.01) than those with normal anxiety levels. The present findings are consistent with the concept of nutritional psychiatry introduced in the literature, which demonstrates that nutritional interventions, including diet counseling and education, may improve mental health.[123,124] Regarding anxiety disorders, there is little evidence that dietary factors influence anxiety symptoms or disorders and *vice versa*. However, anxiety highly influences psychological distress, disability, and quality of life, especially influencing irregular eating habits.[125-129] Moreover, depression is associated with total EDFLIX (P<0.001), EDFLIX-GF (P=0.005), and EDFLIX-WeSh (P<0.001) scores; nurses reporting normal depression levels recorded higher total EDFLIX scores than those with high depression levels.

Thus, eating behaviors may be associated with depression risk. Healthy diets that are rich in fruits and vegetables, whole grains, fish, olive oil, low-fat dairy products, and antioxidants and low in animal products are associated with a low risk of depression.[130]

The association between stress and eating flexibility appears irregular. Nurses with moderate stress levels reported higher total EDFLIX (P<0.001), EDGLIX-FoEx (P<0.001), and EDFLIX-WeSh scores (P=0.013); whereas nurses recording mild stress levels reported higher EDFLIX-GF scores (P<0.001). Additionally, associations are negative and statistically significant between total EDFLIX (β=-0.436; P<0.001), EDFLIX-GF scores (β=-0.466; P<0.001), and EDFLIX-WeSh (β=-0.245; P=0.022).

The considerable emotional distress involved in facing the COVID-19 outbreak should be considered. The literature agrees that most of the general population and healthcare professionals, especially nurses, who are at the frontline in the care of patients with COVID-19, experience high stress and anxiety levels caused by experiencing fear and panic.[131,132]

Stress is a key factor affecting healthy lifestyles and contributes to physiological effects such as elevated blood pressure, ulcers, migraine, perspiration, and fast breathing.[133]

Eating behaviors have also been associated with stress; some food types improve stress reactions or make individuals more susceptible to stress. Women tend to consume more calories and fatty meals, mostly when snacking, under stress, and in shifting circumstances.[134]

Nurses without insomnia symptoms reported significantly higher EDFLIX-FoEx scores (P<0.001). Individual lifestyles changed substantially during the COVID-19 pandemic, which caused an increase in sedentary and smoking behaviors.[135] Irregular resting behavior and high BMI are associated with elevated proinflammatory cytokine production, which also affects sleep-wake rhythm.[136,137]

No significant linear relationships between eating flexibility and the basic characteristics of young nurses directly employed in the care of patients with COVID-19 were identified, except for the inverse relationship between lymphocyte levels and EDFLIX-FoEx score (P=0.007). Low physical activity adversely influences both BMI and appetite.[138] Additionally, overweight or obesity is associated with a higher production of proinflammatory cytokines because of the modulation of the inflammation and oxidative stress processes.[139-141] Several studies have demonstrated the importance of a Mediterranean diet, which has an optimal combination of macronutrients and micronutrients that protect against immune-mediated inflammatory response.[142] High BMI has been associated with latent chronic inflammation because of the secretion of adipokine exerting immunomodulatory effects involved in several metabolic disorders,[143] such as insulin resistance and type 2 diabetes mellitus, dyslipidemia, and hypertension.

Anxiety levels and EDFLIX-FoEx score were significantly, linearly, and positively associated (P=0.017); in addition, stress was negatively related with total EDFLIX (P<0.001), EDFLIX-GF (P<0.001), and EDFLIX-WeSh (P=0.027) scores and insomnia was

negatively related with EDFLIX-FoEx score (P<0.001). Stress seems to be the most crucial emotional factor influencing eating flexibility, especially in women. However, in the present study, no significant difference or association related to sex was identified. Eating flexibility was negatively influenced by depression, stress, or insomnia. This reduced eating flexibility may have influenced BMI and weight variables and may cause emotional eating, as indicated in some studies. Most studies have focused on participants with overweight or obesity, and research on patients with underweight is lacking. This study is novel because the participants were all young nurses, and most studies have focused on nurses with more work experience because nursing is considered to be difficult and associated with low-grade inflammation.

Limitations

The present study presents some limitations. First of all, the sample is very small, given that only 148 young nurses do not represent all of the youngest Italian nursing population. However, the observational study design does not allow us to completely evaluate differences between all the large numbers and typology of variables considered, specifically: sex, shift, smoking habit, neutrophils, lymphocytes, platelets, anxiety, depression, stress, insomnia conditions with the BMI values and eating flexibility attitude in all its sub-dimensions. All participants were enrolled online and this approach may influence both the statistical significance of the sample and the answers given, mostly about their blood values. Additionally, very few immunological biomarkers in blood samples were considered, as only neutrophils, lymphocytes, and platelets blood levels, by classifying their reported data as low, normal, and high concentration. Additionally, the cross-sectional neutrophils, lymphocytes, and platelet readings could be affected by multiple confounding factors, such as infection, and other medical conditions (thrombocytopenia). Therefore, future prospective research considering a representative sample of the youngest Italian nursing population will be helpful to deeper investigating this topic.

Conclusions

The present study proposed associations between nursing activity among young nurses and their personal, professional, and psychological conditions. Analysis of young nurses may indicate which basic characteristics and psychological conditions are associated with their well-being.

The present data indicates that from the beginning of their careers, nurses should be monitored and encouraged to avoid latent conditions, which together may negatively affect their quality of life. The findings from this observational study have reported sufficient information to have a vision of the nurses' conditions associated with their work and to begin improving a healthier workplace for all nurses, especially to start from younger ones in order to prevent latent chronic inflammatory conditions. This study explains how complex the nurses' condition at work is, their improper alimentation, and on the other hand evidence where it could act to transform the workplace into a better environment, with a strategy both educational and political/organizational. Anyway, they have suggested other longitudinal studies with reproducible methodologies in order to achieve stronger results, maybe to achieve representative samples among young nurses.

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