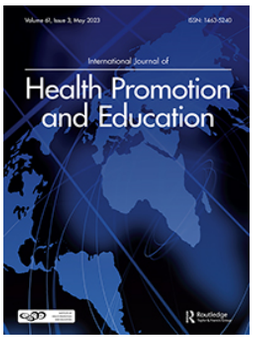

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Factors associated with clustering of health-related behaviors amongst emerging adults in Taiwan

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ABSTRACT

The objective of this study is to investigate factors associated with health-related behavior clusters amongst emerging adults in Taiwan. We employed data from the 2009 National Health Interview Survey in Taiwan and restricted the study sample to respondents aged 18–25 (n = 2,636). We analyzed the factors associated with three health-related behavior clusters, labeled 'smoking-drinking', 'unbalanced diet' and 'health consciousness' identified in a previous study. We performed multinomial logistic regression by controlling demographic, socioeconomics, disease knowledge, and medical history. Compared with the 'health-consciousness' cluster, the 'smoking-drinking' cluster was mostly comprised of men who were married, non-students, residents of low-income regions, and those earning a high income; by contrast, the 'unbalanced diet' cluster was mostly comprised of women in their late teens, residing in more affluent areas, and whose incomes ranged up to NT$20,000. Our study identified sociodemographic factors that are associated with unhealthy clusters, thus providing relevant evidence for designing tailor-made health promotion programs.

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KEYWORDS
Emerging adulthood; clustering; health-related behaviors; multinomial logit model; National Health Interview Survey

Introduction

Emerging adulthood is one of the most crucial phases in life when a person develops from being an adolescent into an adult. This is a concept introduced by the American psychologist Jeffrey Arnett, who defined emerging adulthood as a period that encompasses late adolescence and early adulthood, which comprised of young people who are aged between 18 and 25, but have not yet attained full adult status (Arnett 2000; Sussman and Arnett 2014). Previous studies have shown that poor diet, physical inactivity, tobacco use, and alcohol abuse are the four primary behavioral risk factors among emerging adult (Goldstein et al. 2015). In addition, numerous studies have shown that unhealthy behaviors may simultaneously involve the same person (Burke et al. 1997; F.-L. Chen and Yen 2001; Héroux et al. 2012; Laaksonen, Prattala, and Karisto 2001; Lazzeri et al.

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2016; Lew-Ting and Chiang 1996; Poortinga 2007; Schuit et al. 2002; Yeh and Shih 2014; Yen et al. 1995). The co-existence of behaviors that have an occurence rate higher than a singular behavior is called a clustering phenomenon (Jantine et al. 2002).

The clustering features of unhealthy behaviors have important implications for research and future interventions focused on whether changing one behavior affects the prevalence of another (Héroux et al. 2012). Studies specifically focusing on the clustering of behaviors may offer evidence and support for public health interventions targeting not only a primary behavior of concern but also behaviors which may be clustered together and impact health more broadly. With increased attention to health consciousness, thus there has also been increased focus on the co-occurrence of multiple behaviors, and the study of health-related behaviors has been transformed from a singular-behavior exploration to a multiple-behavior analysis (Lew-Ting and Chiang 1996). Although there have been many studies analyzing the clustering and co-occurrence of multiple risk behaviors, most focused on the general population, some on young adults, or at risk populations such as adolescents, pregnant women, workers, men who have same-sex relations, armed forces, sex workers, or prisoners (Idowu, Fatusi, and Olajide 2018; Meader et al. 2016; Ssewanyana et al. 2020; Fujii, Kuwabara, and Kinjo et al. 2021).

So far, few studies have focused on emerging adulthood and the patterns of multiple risk behaviors in this sensitive age period. Nelson and Padilla-Walker (2013) identified different typologies of emerging adult college students based on differences in beliefs, attributes and behaviors. Potard, Lancelot, and Courtois (2019) used a cluster analytic approach to analyze the relationship between sexual risk-safety behaviors and physical self-concept. However, more research is needed to investigate factors associated with multiple risk behaviors (Meader et al. 2016; Price and Coles 2019). However, to the best of our knowledge, little research has been done to investigate factors associated with cluster types. This study utilized a national database and a multinomial logit model to fill this gap. The results from our study could help to inform targeted health promotion initiatives that adopt a more holistic approach than focus on singular one health behaviour for emerging adults.

Methods

Study sample

This study used the 2009 National Health Interview Survey (NHIS), which is a nationally representative sample in Taiwan. The survey was conducted by the Health Promotion Administration using multi-stage sampling methods and the subjects were drawn from all 164 townships. In total, 30,528 participants were approached (National Health Research Institutes, Health Promotion Administration, Ministry of Health and Welfare, & Food and Drug Administration, Ministry of Health and Welfare 2009). Informed consent was obtained from all research participants and face-to-face interviews were conducted using computer-assisted data entry. The overall response rate was 84% with data collected from 25,636 participants of across all the age groups. The survey collected sociodemographic information, health status, knowledge of disease prevention, health-care utilization, health behaviors, health literacy, and SF-36, which is a quality of

life measure. This data set is managed by the National Health Research Institutes in Taiwan. There were 3,005 participants aged 18–25 years, which was defined as emerging adulthood from the NHIS. After excluding cases with missing values for research variables, our final study sample for the analysis comprised 2,636 participants.

Measures

Dependent variable

The dependent variable is the type of health-related behavior cluster and included: 1) 'smoking-drinking'; 2) 'unbalanced diets'; 3) and 'health consciousness. This variable was identified by our published work using two-step cluster analysis' (Yeh and Shih 2014). There are 25 health-related behaviors used in the cluster analysis to categorize the health behavior cluster variables. The first step of two-step cluster analysis is to construct a Cluster Features (CF) tree. The 25 health-related variables included (1) traffic safety; (2) cigarettes; (3) alcohol; (4) betel nut; (5) exercise frequency (the number of exercise times) within 2 weeks; (6) sedentary behavior; (7) hand washing habit; (8) weight control; (9) meal pattern (frequency of eating breakfast); (10) staple foods; (11) whole grains; (12) vegetables; (13) fruits; (14) dairy products; (15) meats, fish, eggs, and legumes; (16) sugary drinks and/or sweet soups; (17) tea; (18) coffee; (19) dietary supplements; (20) lunch, afternoon tea; (21) dinner; (22) late night snacks; (23) regular meal pattern; (24) frequency of eating out; and (25) frequency of consuming deep-fried food. In the second step, the leaf nodes of the CF tree are grouped using an agglomerative clustering algorithm. Our previous work used Schwarz's Bayesian Criterion (BIC) as the clustering criterion to determine which number of clusters is the best. The results showed that BIC performed well when the cluster types increased from 2 to 3 (Yeh and Shih 2014).

Independent variable

We included independent variables that were found to be statistically associated with health behaviors in previous studies as well as some variables that might be considered important based upon other Taiwanese studies in a multinomial logit model. The independent variables included the following sociodemographic variables: age, average annual disposable income per household (categorized into quartiles), gender, residential arrangement, family type, marital status, religious belief, work type, knowledge of disease (i.e. kidney disease, hypertension and diabetes, and health conditions). A composite score representing knowledge of disease was calculated by summing the number of correct responses for kidney health (10 questions), and hypertension and diabetes (8 questions). The health condition variable was calculated by counting the number of diseases diagnosed by a physician in the following list (n = 17), and categorized dichotomously as 'no disease' or 'at least one disease': hypertension, diabetes, hyperlipidaemia, stroke, asthma, kidney disorders, heart diseases, gout, gastric or intestine ulcer, lung diseases, osteoporosis, arthritis, cancers, disorders of the uterus and ovary (Female), disorder of prostate (Male), liver or gallbladder diseases, and mental illness. The scores regarding the knowledge of disease were used as a continuous variable, and the rest were used as categorical variables.

Statistical methods

We explored the association between three clusters and various sociodemographic characteristics. When conducting a bivariate analysis, a Chi-squared test was used for the categorical variables, and ANOVA was used for the continuous variables. In addition, we used the multinomial logit model to explore the factors associated with the clusters of health-related behaviors. The reason for using this model was that the dependent variable was comprised of three types of health behavior clusters. This model was used to predict the probability of being in a particular category membership based on multiple independent variables. In our study, the category membership was the cluster type. This model uses Maximum Likelihood Estimation to evaluate the probability of categorical membership. We used SAS 9.3 for data processing and bivariate analysis, and Stata 12 for multinomial logit model analysis.

Results

Table 1 shows the descriptive statistics of our study sample. Those classified with 'health-consciousness' – the largest group (40%) – did not have a betel nut chewing behavior, and had the lowest smoking rate (only 1%) and the highest number of exercise times within 2 weeks (mean: 5.49). Approximately 87% of this cluster had a regular meal time, and more than 99% had at least 4 days of breakfast, and included high consumption of vegetables and fruits. 'Unbalanced diet' – the second largest cluster – accounted for 36% of the sample. Lastly, approximately 24% of the emerging adults were classified in the 'smoking-drinking' cluster (Yeh and Shih 2014).

Across the full study sample, approximately 51% were men, and 63% lived in high household disposable income areas. Most of the emerging adults lived with their parents and were from Taiwanese families, with 95% of them unmarried and 55% indicating no religious belief. Most of the emerging adults earned money for living expenses – ~36% had a monthly income below NT$10,000, and nearly 50% had a monthly income of between NT$10,000–40,000. The majority of the study sample (~82%) were healthy (no conditions indicated).

Table 2 shows the distribution of the sample characteristics across three clusters. It also shows their bivariate associations based on either the Chi-square test or ANOVA. With the exception of the family type, religious belief, and having diseases that were not associated with the type of clusters, all other variables were statistically associated with clustering types.

To determine which factors were associated with health-related behavior cluster, we applied a multinomial logit model. As shown in Table 3, when compared to the participants aged between 18 and 19, those aged between 20 and 21 exhibited a higher likelihood of being classified into the cluster of 'smoking-drinking' than the 'health consciousness' cluster (Relative Risk Ratio (RRR) = 1.44 95% CI: 1.04, 2.00). Men were more likely to be classified into the 'smoking-drinking' cluster when compared to women (RRR = 4.59 95% CI: 3.60, 5.86). The results also indicated that those who lived in areas with the highest level of household disposable income were less likely to be classified into the 'smoking-drinking' cluster when compared to those who lived in areas with the lowest household disposable income. Regarding family types, the Taiwanese-Chinese

Table 1. Basic characteristics of research subjects.

Characteristics	n	%
Type of cluster		
Cluster 1: smoking-drinking	629	23.86
Cluster 2: unbalanced diet	941	35.70
Cluster 3: health consciousness	1,066	40.44
Age		
18–19	673	25.53
20–21	673	25.53
22–23	604	22.91
24–25	686	26.02
Gender		
Female	1,293	49.05
Male	1,343	50.95
Residential area by household disposable income		
High	924	35.05
Second-highest	739	28.03
Second-lowest	564	21.40
Low	409	15.52
Living arrangement		
Live alone	244	9.26
Live with parents	1,977	75.00
Live with other relatives	206	7.81
Others	209	7.93
Family Type		
Taiwanese-Taiwanese	1,839	69.76
Taiwanese-Hakka	244	9.26
Hakka-Hakka	212	8.04
Taiwanese-Chinese	150	5.69
Others	191	7.25
Marital Status		
Unmarried	2,501	94.88
Married or others	135	5.12
Religious belief		
Eastern religion and folk religion	1,079	40.93
Others	110	4.17
None	1,447	54.89
Employment		
Student	914	34.67
Non-students worker	1,356	51.44
Others	366	13.88
Personal income		
No income	257	9.75
Income under NT$10,000	940	35.66
Income between NT$10,000–20,000	598	22.69
Income between NT$20,000–40,000	721	27.35
Income over NT$40,000	120	4.55
Ever had a disease before		
None	2,154	81.71
At least one	482	18.29
Disease knowledge	**Mean**	**SD**
Kidney health	3.16	2.57
Hypertension and diabetes	3.05	2.22

(RRR = 1.71 95% CI: 1.08, 2.70), and 'others' (RRR = 1.83 95% CI: 1.18, 2.85), were more likely to be classified into the 'smoking-drinking' cluster than the archetypal Taiwanese families. Compared with the unmarried participants, those who were married or in other marital statuses (RRR = 2.84 95% CI: 1.66, 4.87), demonstrated a higher likelihood of being classified into the 'smoking-drinking cluster'. Compared to students, non-student workers (RRR = 2.50 95% CI: 1.78, 3.51) and others (RRR = 3.80 95% CI: 2.62, 5.49) had a higher likelihood of being categorized into the 'smoking-drinking' cluster than to be in

Table 2. Bivariate association between clustering type and characteristics of study sample.

Characteristics/Types of cluster	Cluster of smoking and drinking (n = 629)		Cluster of unbalanced diets (n = 941)		Cluster of health-conscious cluster (n = 1066)		
	n	%	n	%	n	%	*P*- value
Age							<0.001***
18–19	110	16.34	271	40.27	292	43.39	
20–21	170	25.26	260	38.63	243	36.11	
22–23	144	23.84	213	35.26	247	40.89	
24–25	205	29.88	197	28.72	284	41.40	
Gender							<0.001***
Male	144	11.14	587	45.40	562	43.46	
Female	485	36.11	354	26.36	504	37.53	
Residential area by household disposable income							<0.001***
High	212	22.94	361	39.07	351	37.99	
Secondary highest	171	23.14	267	36.13	301	40.73	
Secondary lowest	111	19.68	197	34.93	256	45.39	
Low	135	33.01	116	28.36	158	38.63	
Living arrangement							0.019**
Live alone	52	21.31	94	38.52	98	40.16	
Live with parents	464	23.47	688	34.80	825	41.73	
Live with other relatives	63	30.58	84	40.78	59	28.64	
Others	50	23.92	75	35.89	84	40.19	
Family type							0.041**
Taiwanese-Taiwanese	413	22.46	672	36.54	754	41.00	
Taiwanese-Hakka	60	24.59	83	34.02	101	41.39	
Hakka-Hakka	54	25.47	65	30.66	93	43.87	
Taiwanese-Chinese	42	28.00	48	32.00	60	40.00	
Others	60	31.41	73	38.22	58	30.37	
Marital status							<0.001***
Unmarried	570	22.79	896	35.83	1035	41.38	
Married or others	59	43.70	45	33.33	31	22.96	
Religious belief							0.173
Eastern religion and folk religion	284	26.32	367	34.01	428	39.67	
Religion from foreign countries and others	25	22.73	40	36.36	45	40.91	
None	320	22.11	534	36.90	593	40.98	
Employment							<0.001***
Student	99	10.83	384	42.01	431	47.16	
Non-students workers	409	30.16	434	32.01	513	37.83	
Others	121	33.06	123	33.61	122	33.33	
Personal income							<0.001***
No income	31	12.06	90	35.02	136	52.92	
Income under NT$10,000	148	15.74	380	40.43	412	43.83	
Income between NT$10,000–20,000	153	25.59	243	40.64	202	33.78	
Income between NT$20,000–40,000	253	35.09	202	28.02	266	36.89	
Income over NT$40,000	44	36.67	26	21.67	50	41.67	
Ever had a disease before							0.041
None	500	23.21	759	35.24	895	41.55	
At least one	129	26.76	182	37.76	171	35.48	
Disease knowledge	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	
Kidney health	2.68	2.45	3.27	2.66	3.36	2.52	0.08
Hypertension and Diabetes	2.66	2.17	3.12	2.27	3.22	2.18	0.41

Note: *: $p < 0.01$; **:$p < 0.05$; ***: $p < 0.001$
Note: All *p*-values are obtained based on Chi-square test except for the disease knowledge (ANOVA test).

the 'health-consciousness' cluster. Participants who earned a monthly disposable income of NT$20,000–40,000 had a higher likelihood of being categorized into the 'smoking-drinking' cluster than the 'health-conscious' cluster (RRR = 3.39 95% CI: 2.01, 5.74),

Table 3. Results of multinomial logit analysis to examine factors associated with health cluster type.

	Cluster of smoking and drinking vs. health-conscious cluster (reference group)					Cluster of unbalanced diets vs. health-conscious cluster (reference group)				
	RRR	95% CI		P>|z|		RRR	95% CI		P>|z|	
Age (reference group: aged 18–19)											
20–21	1.44	1.04	2.00	0.03	*	1.07	0.84	1.37	0.59	
22–23	0.85	0.60	1.21	0.38		0.82	0.63	1.08	0.15	
24–25	0.80	0.56	1.13	0.20		0.67	0.50	0.90	0.01	**
Gender (reference group: female)										
Male	4.59	3.60	5.86	<0.001	***	0.68	0.57	0.82	<0.001	***
Residential area by household disposable income (reference group: low)										
High	0.72	0.52	0.99	0.04	*	1.48	1.10	1.97	0.01	**
Second-highest	0.70	0.50	0.98	0.04	*	1.26	0.93	1.69	0.14	
Second-lowest	0.49	0.35	0.71	<0.001	***	1.12	0.82	1.54	0.47	
Living arrangement (reference group: live alone)										
Live with parents	0.95	0.65	1.41	0.81		0.84	0.62	1.15	0.28	
Live with other relatives	1.32	0.75	2.33	0.33		1.29	0.79	2.10	0.31	
Others	1.25	0.73	2.13	0.41		0.82	0.53	1.26	0.36	
Family type (reference group: Taiwanese–Taiwanese)										
Taiwanese–Hakka	1.32	0.90	1.94	0.15		0.87	0.63	1.19	0.38	
Hakka–Hakka	1.19	0.80	1.78	0.39		0.80	0.56	1.13	0.20	
Taiwanese–Chinese	1.71	1.08	2.70	0.02	*	0.81	0.54	1.21	0.30	
Others	1.83	1.18	2.85	0.01	**	1.28	0.87	1.88	0.21	
Marital status (reference group: unmarried)										
Married or others	2.84	1.66	4.87	<0.001	***	1.36	0.78	2.35	0.27	
Religious belief (reference group: eastern religion and folk religion)										
Religion from foreign countries and others	0.78	0.43	1.39	0.39		0.87	0.54	1.39	0.55	
nonreligious belief	0.83	0.67	1.05	0.12		1.00	0.83	1.21	0.98	
Employment (reference group: student)										
Non-students worker	2.50	1.78	3.51	<0.001	***	0.93	0.72	1.20	0.57	
Others	3.80	2.62	5.49	<0.001	***	1.29	0.95	1.77	0.10	
Personal income (reference group: no income)										
Income under NT$10,000	1.43	0.90	2.29	0.13		1.42	1.04	1.93	0.03	
Income between NT$10,000–20,000	2.71	1.63	4.51	<0.001	***	1.95	1.36	2.79	<0.001	***
Income between NT$20,000–40,000	3.39	2.01	5.74	<0.001	***	1.36	0.92	2.03	0.13	
Income over NT$40,000	2.65	1.36	5.16	<0.001	**	1.00	0.55	1.83	0.99	
Ever had a disease before (reference group: none)										
At least one	1.44	1.09	1.90	0.01	*	1.25	0.99	1.58	0.06	
Disease knowledge										
Kidney health	0.96	0.90	1.04	0.33		1.02	0.96	1.08	0.62	
Hypertension and diabetes	0.95	0.87	1.03	0.20		0.97	0.91	1.04	0.39	
cons	0.08	0.04	0.17	<0.001	***	0.76	0.45	1.29	0.31	

Note: RRR: Relative Risk Ratio; 95% CI: 95% Confidence interval; *P*>|z|: *P*-value

followed by those who earned NT$10,000–20,000 (RRR = 2.71 95% CI: 1.63, 4.51), and those who earned over NT$40,000 (RRR = 2.65 95% CI: 1.36, 5.16). However, those who earned under NT$10,000 did not show higher propensity to be classified into the 'smoking-drinking' cluster. Regarding the health status measure (i.e. whether a person indicated diagnosis of any of the conditions), participants who had been diagnosed with at least one condition/disease were more likely to be classified into the cluster of 'smoking-drinking' (RRR = 1.44 95% CI: 1.09, 1.90) than those who had not been diagnosed with any previous diseases. The variables regarding living arrangement, religious belief, and knowledge of disease did not show any statistically significant association with being classified into the 'smoking-drinking' cluster or the 'health-consciousness' cluster.

As presented in Table 3, when compared to those aged between 18 and 19, those who were between 24 and 25 were less likely to be categorized into the cluster of 'unbalanced diet' (RRR = 0.67; 95% CI: 0.50, 0.90) than to be categorized into a 'health-consciousness' cluster. Our results also indicated that those who lived in areas with the highest level of household disposable income were more likely to be classified into the 'unbalanced diet' cluster compared to those who lived in the low disposable income per household areas (RRR = 1.48 95% CI: 1.10, 1.97). Men were less likely than women to be classified into the 'unbalanced diet' cluster (RRR = 0.68; 95% CI: 0.57, 0.82); and those who earned NT $10,000–20,000 (RRR = 1.95 95% CI: 1.36, 2.79) demonstrated a higher likelihood of being classified into this cluster when compared to those who earned no discernible income. In addition, living arrangement, family type, marital status, religious belief, knowledge of disease, and health status did not show any statistically significant association with the likelihood of being classified as 'unbalanced diet' versus 'health consciousness'.

Discussion

Instead of investigating factors (i.e. demographics; knowledge of disease; health conditions – described in the Measures section) associated with single and specific health behaviors such as smoking, our study aimed to analyze factors associated with various types of health-related behavior cluster. This approach not only considers the nature of the concurrence of unhealthy behaviors, but also helps the health promotion planners to design multi-component programs in order to enhance the effectiveness of their programs. For example, a program aiming to help smokers to quit is usually focused on changing the smokers' behaviors; however, smokers might also have other unhealthy behaviors such as drinking and/or other addictive behaviors.

Previous studies have reported that the primary health-risk behaviors of college students include being physical inactivity, having low fruit and vegetable intake, and sleep deprivation (Kwan et al. 2013; Lee, Hwang, and Yen 2008; Wang, Xing, and Wu 2013). However, these studies have focused mostly on specific universities or on first-year students and were not nationally representative. These studies did not focus on individuals emerging into adulthood for conducting cluster analysis or relevant studies on health-related behaviors. The health behavior clusters that appeared in Taiwanese emerging adults included 'smoking-drinking', 'unbalanced diet' and 'health-consciousness'. Those who were aged between 20 and 21, male, those who lived in areas with low

household disposable income, being raised from Taiwanese-Chinese families, or other family types, those whose marital status was married or 'others', those who were non-student workers or others, earned more than NT$10,000, and had suffered from a chronic illness were more likely to be classified into the cluster of 'smoking-drinking' when compared with the 'health consciousness' cluster. Furthermore, those who were aged between 24 and 25, male, were less likely to be in the 'unbalanced diet' cluster than to be in the 'health consciousness' cluster. Those who lived in areas with the highest household disposable income, earned less than NT$10,000, or earned NT$10,000–20,000 were more likely of being classified into the cluster of 'unbalanced diet' rather than to be in the 'health consciousness' cluster.

Our results indicated that even within emerging adults, the propensity to be in the 'smoking-drinking' cluster was not similar. It seemed that those who were aged between 20 and 21 might be at an important turning point for emerging adults to be exposed to smoking and drinking behaviors, and stressors may be driven by one's environment. College life, for example, provides independence and is considered a major turning point in an emerging adult's life (Dawson et al. 2007; Poortinga 2007). Therefore, when facing pressures from school work, relationships or other reasons, students might smoke or drink alcohol as a way of coping with these problems. Therefore, when conducting health promoting school projects, schools should involve their staff in the health center, student affairs office, or the counseling center, and adopt a more holistic approach to understand the background information of students in order to provide a more comprehensive health service for students.

For emerging adults who have entered the workface, our study also suggests that those who worked were more likely to be in the smoking and drinking cluster than to be in the health-conscious cluster. This implies that a workplace health promotion program should first conduct a needs assessment to understand the root causes of smoking behaviors for young employees, and perhaps consider the unique role of raising health consciousness within this group rather than solely focusing on quitting unhealthy behaviors. Although our study found that emerging adults with higher incomes had a higher likelihood of being in the 'smoking-drinking' cluster, when compared to those without any income, the relative risk ratio indicated that when the income level was higher than NT$40,000, the propensity was not as high as those with an income between NT$20,000–39,999 or NT$10,000–19,999. This implied that the low socioeconomic group might be the major target for programming.

Our results indicated that older emerging adults (24–25 years old) did not pay as much attention to their dietary behaviors. A possible reason is that this may be an age when emerging adults have moved out of the family structure where their nutritional needs were cared for. Although those who lived in a more affluent area might have ample opportunity of gaining access to a better environment, such as restaurants promoting low-fat or low-sodium meals, or supermarkets to buy fresh vegetables or fruits, we found that those who lived in areas with the highest disposable household income were more likely to be classified into the 'unbalanced diet' cluster. The possible explanation might be that the emerging adults who lived in the more affluent areas, including urban areas, might lead a different life and work style when compared to those living in rural areas. We need to further study and investigate the associations between the living environment and the health behaviors clustering.

Our study has some limitations. First, previous studies have reported that health literacy, health status, and health behavior were correlated (Chang, Chen, and Chang 2009; Liu et al. 2014; Vozikis, Drivas, and Milioris 2014). However, because there was only one question about health literacy in the 2009 NHIS, and it was a selective question, over 80% of the respondents omitted or skipped the question, thus generating an excessive missing value. Therefore, we did not include this variable in our analysis. Second, since our study used secondary data, we were not able to adopt a theory to understand why people were classified into the different types of clustering, for example, knowledge, beliefs, attitudes, self-efficacy, or contextual factors. Therefore, we recommend that more research is needed to look at the unique cultural, lifestyle and developmental features of those within identified clusters. Third, demographic, lifestyle and health-related behaviors were all self-reported and might suffer from recall bias or not reflect real situations. Finally, the response rate from emerging adults was not available and it might affect the representative of our study sample if the non-response rate was high.

Conclusions

Emerging adulthood is a key period at the juncture of adolescence and adulthood, during which the health-related behaviors of the emerging adults determine their future health status and subsequent risks. Consequently, the health problems of the emerging adults should be addressed holistically, with attention to correlates and clusters in which these health behaviors occur. It is a critical turning point and the health problems of emerging adults are an important issue. By analyzing the factors associated with the types of health-related behavior clusters rather than with individual unhealthy behaviors, the significant factors have now provided us with relevant evidence for designing a tailor-made health promotion program. Health promotion practitioners should be encouraged to adopt a more holistic approach to understand the underlying factors associated with the overall picture of the lifestyle of one person, rather than use a simplified approach which targets only individual unhealthy behaviors, such that the effectiveness of the health promotion program can be enhanced. Understanding the unique aspects of emerging adults specific to their environment is critical to inform educational strategies and, ultimately, policy.

Moreover, because health-related behaviors revealed a clustering phenomenon, previous health promotion interventions that merely focused on a singular behavior should be amended. In addition to understanding the condition and distribution of each health-related behavior after relevant investigations, future studies must also explore as to whether specific clusters simultaneously possess two or more health-risk behaviors. During health promotion activities, relevant materials and activities can be integrated to conduct educational intervention programs, which can thereby enhance and improve the effectiveness of programs.

Currently, no nationwide investigation has focused on emerging adults and no relevant monitoring mechanism has been developed regarding the health-related behaviors and conditions of emerging adults in Taiwan. Therefore, because the current content of the NHIS cannot be used for conducting a complete analysis of health-related

behaviors amongst this specific group, we recommend that future studies conduct a theory-based health-related behavior national survey which would be appropriate for emerging adults, and to then conduct a long-term follow-up. Expanding the scope of data collection in this way will allow for more robust analysis of trends that are crucial for health planning and promotion. In addition to the socio-demographic factors, this study found to be associated with health-related behaviors, tailor-made programming and future study will also need to explore and address other possible inequalities in health-related behaviors, such as cultural bias and behavior, attitudes and beliefs, etc.

Ethical approval

The procedure was approved by the National Taiwan University Social and Behavioral Research Ethics Committee on 29 July 2014 (No: 201401ES031). Research subject records were anonymized and de-identified prior to analysis.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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