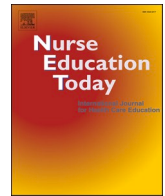




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## Research article

# The association of self-control, self-efficacy, and demographic characteristics with home-based E-learning behavior in nursing and midwifery undergraduates: A cross-sectional study under the COVID-19 epidemic

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## ABSTRACT

**Background:** During the coronavirus disease 2019 (COVID-19) pandemic, nursing and midwifery undergraduate students' time spent in home isolation and being engaged in home-based e-learning was extended. Limited research has been conducted on home-based e-learning behavior during home isolation, and the relationships between individual factors, such as self-control, self-efficacy, and other demographic characteristics, and home-based e-learning behavior are unclear.

**Objectives:** This study aimed to explore the associations between self-control, self-efficacy, and demographic information with home-based e-learning behavior among nursing and midwifery undergraduates during the COVID-19 pandemic.

**Design and methods:** A cross-sectional study was employed, and an online survey was conducted with 3733 nursing and midwifery undergraduates across seven provinces and cities in mainland China. Data were collected using the Brief Self-control Scale, General Self-efficacy Scale, Undergraduate Home-based E-learning Behavior Questionnaire, and Demographic Information Questionnaire. A multiple linear regression analysis using the stepwise method was conducted to identify predictors of home-based e-learning behavior.

**Results:** Undergraduates achieved an overall mean score of 26.02 (SD = 4.20) for home-based e-learning behavior and an overall mean score of 42.54 (SD = 6.22) and 27.59 (SD = 3.89) for self-control and self-efficacy, respectively. Better self-control ( $\beta = 0.250, P < 0.001$ ), higher self-efficacy ( $\beta = 0.169, P < 0.001$ ), universities being located in non-Hainan provinces ( $\beta = 0.249, P < 0.001$ ), being a sophomore or freshman ( $\beta = -0.255, P < 0.001$ ), and good perceived health status ( $\beta = -0.044, P = 0.003$ ) were identified as the predictors of better home-based e-learning behavior among nursing and midwifery undergraduates.

**Conclusion:** Self-control, self-efficacy, and demographic characteristics including the province of the university, grade level, and personal perceived health status were associated with home-based e-learning behavior. Universities should help nursing and midwifery undergraduates improve self-control and enhance self-efficacy while taking measures to decrease the impact caused by demographic characteristic differences.

## 1. Introduction

Coronavirus disease 2019 (COVID-19) is a global pandemic posing a severe threat to public health. According to the World Health Organization, the number of confirmed cases and deaths worldwide due to

COVID-19, as of March 17, 2022, exceeded 476 million and 6.1 million, respectively (World Health Organization, 2022). National blockade and social distancing among citizens caused by the COVID-19 pandemic had a significant impact on education, work, social activities, and economic functioning. Regarding education, schools at all levels were forced to

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close during the pandemic (The World Bank, 2022). As of May 30, 2021, schools were still reportedly closed in 23 countries, which affected >2.02 million students including nursing and midwifery undergraduates. By February 28, 2022, COVID-19 continued to affect 2.8 % of the total number of students enrolled worldwide, resulting in school closures in six countries (UNESCO, 2022).

Due to the widespread of COVID-19 in China in the early spring of 2020, as in many other countries (Sahu, 2020; Burki, 2020), the Chinese Ministry of Education extended home isolation and enforced the closure of schools and universities (Ministry of Education of People's Republic of China, 2020). In response to the government's request for continued learning and teaching, undergraduate students studied at home with the aid of the Internet (Ministry of Education of People's Republic of China, 2020). It was unprecedented for such a large number of undergraduates to shift from traditional classroom learning to home-based e-learning for such a large number of undergraduates. Therefore, e-learning or home-based e-learning (HBEL) has gained significant attention. E-learning is usually defined as a learning format supported by modern information technologies, enabling students to learn from anywhere (Rodrigues et al., 2019). HBEL is an e-learning format wherein learning occurs at home via the internet, which allows for physical separation between students and teachers, and students accessing learning materials and activities without being at school (Hu et al., 2022). A descriptive qualitative study indicated the effectiveness of HBEL (Hu et al., 2022).

However, there were some disadvantages of e-learning alone at home affecting academic performance and causing problems such as lack of concentration and discipline, the inability to resist temptation, social isolation, and stress (Wang et al., 2021a; Bao, 2020; Goh and Sandars, 2020; Rose, 2020). Thus, HBEL behavior is critical to ensure learning quality for nursing and midwifery undergraduates who study at home by themselves. In addition, compared to students who are in primary school and middle school, undergraduates have developed relatively independent personalities. They often receive e-learning alone at home without parental supervision. Therefore, individual characteristics such as self-control and self-efficacy may be important factors for nursing and midwifery undergraduates to engage in HBEL behavior. This is because individuals with higher self-control and self-efficacy might have more self-discipline, a better ability to resist temptations, and more confidence in overcoming difficulties during online learning. However, there is a lack of research on the relationships between self-control, self-efficacy, and demographic characteristics, and HBEL behavior. Therefore, the purpose of this study was to examine associations between self-control, self-efficacy, and demographic characteristics, and HBEL behavior in nursing and midwifery undergraduates, to provide empirical evidence for the development of targeted interventions.

## 2. Literature review

Individual factors such as self-control, self-efficacy, and demographic characteristics might play important roles in shaping HBEL behaviors. Although the current generation of undergraduates is referred to as "digital natives," it remains difficult for them to resist temptations on the Internet without supervision at home. A qualitative study found that undergraduates expressed difficulty in concentrating on their HBEL due to the lack of a good learning environment at home, or other distractions such as televisions or mobile phones (Hu et al., 2022). One study reported that undergraduate students spent over seven hours per day on their phones (Roberts et al., 2014). Students also reportedly multitasked while being online; for instance, while doing homework, many students watched television (45 %), listened to music (80 %), exchanged text messages (62 %), and browsed through social media (51 %) (Rideout and Robb, 2019). Therefore, self-control might be an influencing factor for HBEL behavior. Self-control refers to an individual's ability to control thoughts, feelings, desires, and actions in the face of momentary more tempting alternatives (Oaten and Cheng,

2005; Duckworth et al., 2019), and it requires the individual to overcome or change internal responses to interrupt and avoid performing desired behaviors (Tangney et al., 2004). Studies have shown that self-control predicts academic performance, psychological adjustment, intimate relationships, and diets (Tangney et al., 2004; Allemand et al., 2019; Jin et al., 2019). Furthermore, some studies found that effective self-control was associated with low levels of Internet addiction (Mei et al., 2016; Enyuan and Huiyu, 2017). However, no studies have examined the relationship between self-control and HBEL behavior in undergraduates during the COVID-19 pandemic.

Moreover, self-efficacy may have a potential influence on HBEL behavior. In the Social Cognitive Theory, self-efficacy was defined as an individual's perception or beliefs about their ability to adapt to environmental challenges, and it was recognized as a central predictor of individual behavior (Bandura, 1977; Bandura and Adams, 1977). Abrupt changes in the learning format and environment during the pandemic from face-to-face learning at school to e-learning at home entailed significant challenges for undergraduates. Students with high self-efficacy might have more confidence in adapting to the ensuing challenges. A cross-sectional study in Ethiopia identified low levels of self-efficacy among undergraduate students who were re-entering campus during the COVID-19 pandemic (Tadese and Mihretie, 2021). Moreover, self-efficacy influences study processes and learning performances both directly and indirectly (Hayat et al., 2020; Grøtan et al., 2019; Wang et al., 2021b; Kumar et al., 2021). A systemic review suggested that self-efficacy was closely related to self-directed learning (Wong et al., 2021). However, the relationship between self-efficacy and HBEL behavior needs to be determined. In addition, the demographic characteristics (e.g., province of university, grade level, and others) of undergraduates may also have an impact on HBEL behavior (Jiang et al., 2020; Wang et al., 2020).

In summary, nursing and midwifery undergraduates were quarantined at home and received HBEL during the COVID-19 pandemic, making it difficult for them to ensure the quality of learning, it is consequently necessary to focus on the HBEL behavior of undergraduate students. However, research on the HBEL behavior of nursing and midwifery undergraduate students and its influencing factors is scarce. Therefore, this study aimed to explore the associations between self-control, self-efficacy, and demographic characteristics with home-based e-learning behavior among nursing and midwifery undergraduates.

## 3. Methods

### 3.1. Study design and participants

A cross-sectional study was conducted in 2020 across colleges/universities in Mainland China. Convenience sampling was performed to collect the data from universities distributed across nine provinces and cities including Hainan, Anhui, Beijing, Shandong, Hunan, Hubei, Shanxi, Zhejiang, and Guangdong. Full-time undergraduate students from colleges and universities who were willing to participate in the survey were included and undergraduates with no access to the Internet were excluded. This article presented secondary data analyses based on the cross-sectional study and study procedures detailed in a previous study (Jiang et al., 2020). The report of this study was guided by the STROBE checklist for an observational study.

### 3.2. Indicators and measurement

#### 3.2.1. Self-control

Self-control was measured using the Brief Self-control Scale. The 13-item Brief Self-control Scale was developed by Tangney et al. (2004) (Tangney et al., 2004), and was translated and adjusted by (Yi, 2013). The scale included two subscales of self-discipline and impulse control. The score for each item was derived after adopting a five-point Likert

scale. For example, the choices for the item “I am good at resisting temptation” ranged from “not at all” to “very much,” and the scores were assigned between 1 and 5 points; the total score ranged from 13 to 65 points. A higher score indicates better self-control. The two subscales of self-discipline and impulse control were composed of five and eight items, respectively. Their total score ranged from 5 to 25, and 8 to 40, respectively. The Cronbach's  $\alpha$  coefficient and test-retest reliability for the scale were 0.82 and 0.80, respectively (Yi, 2013). The Cronbach's  $\alpha$  coefficient of the scale in this study was 0.77.

### 3.2.2. Self-efficacy

Self-efficacy was evaluated using the General Self-efficacy Scale. The English version of the General Self-efficacy Scale was developed by Schwarzer et al. (1997) (Schwarzer et al., 1997), while the Chinese version was translated and adapted by Wang (Wang et al., 2001). The scale contains 10 items and the score of each item ranges from one to four points. For instance, the choices for item “I can always manage solving difficult problems if I try hard enough” ranged from “not at all true” to “exactly true,” and the scores were assigned between one to four points. The total score for the scale was within the range of 10–40 points. A higher score indicates higher self-efficacy. The Cronbach's  $\alpha$  coefficient and test-retest reliability were 0.87 and 0.83, respectively (Wang et al., 2001). The Cronbach's  $\alpha$  coefficient of the scale in this study was 0.90.

### 3.2.3. HBEL behavior

HBEL behavior was assessed using an undergraduate HBEL behavior questionnaire designed by Jiang et al. (Jiang et al., 2020). The design of the questionnaire was based on a literature review and online interviews with several students, and it was verified by experts. Some improvements and revisions were made after conducting a small-scale pilot survey. The questionnaire was used to assess the HBEL of undergraduates during isolation. It contained ten items divided across four dimensions, including online curriculum learning (e.g., the content, frequency, approach, and method of learning), learning time, concentration, and satisfaction of learning behavior. Two items of HBEL content and approach to learning were assessed by multiple choice questions. Scores ranged from zero to three and were assigned by adding one point for each additional learning component or approach. Further, two more items on the dimension of online curriculum learning, as well as the dimensions of learning time, concentration, and satisfaction of learning behavior were scored using a five-point Likert scale. For instance, if the satisfactory for HBEL behavior was extremely dissatisfied, dissatisfied, satisfied, or very satisfied, they were scored on a scale of one to four, respectively. The total score for HBEL ranged from 8 to 38; a higher score indicated better HBEL behavior. A total score of  $>29$ , 19 to  $\leq 29$ , and  $\leq 19$  indicated high, medium, and low levels of HBEL behavior, respectively. The four dimensions of online curriculum learning, learning time, concentration, and satisfaction of learning behavior were composed of five, two, one, and two items, respectively. Their total mean score ranged from 0.6 to 3.6, 1 to 4, 1 to 4, and 1 to 4, respectively. The Cronbach's  $\alpha$  coefficient and test-retest reliability of the questionnaire were 0.74 and 0.94, respectively.

### 3.2.4. Demographic information

Participants' demographic information was collected using a self-designed questionnaire. The questionnaire was created after conducting a literature review and refined after expert discussion and a small-scale preliminary survey. It covered eight main items, including age, gender, place of residence, the university's province, type of university, major, grade level, and the personal perceived health status of the undergraduate students.

### 3.3. Data collection

From March to April 2020, a nationwide online survey was

conducted with the assistance of “WenJuan Xin” software (<https://www.wjx.cn/>). The electronic questionnaires developed using this software were distributed to universities for researchers to communicate. Undergraduates independently completed the online questionnaire using their mobile phones and computers by anonymously self-reporting. The questionnaire could only be submitted once it was completed. Each Internet protocol address could only be submitted once. The researchers could access the data from the questionnaires on the “WenJuan Xin” platform.

### 3.4. Ethics considerations

The study was approved by the ethics committee of Hainan Medical University (hyll-2020-011) and was conducted in accordance with the principles of the Declaration of Helsinki. Since the study data were collected online using the “WenJuan Xin” software, the guidelines were displayed on the first page of the electronic questionnaire, that is, it stated the purpose, significance, and confidentiality principle of the study. Those who completed and submitted the questionnaire were considered to have provided their informed consent.

### 3.5. Data analysis

IBM SPSS version 25.0 was used for the data analysis. Descriptive statistics, such as frequency, proportion, mean, and standard deviation were used to present basic demographic information. Two independent *t*-tests, Pearson's correlation analysis, and multiple linear regression analysis using the stepwise method with *P*-in = 0.05 and *P*-out = 0.1 were conducted for statistical inference. A *P* value below 0.05 indicated that the difference was statistically significant for all analyses.

## 4. Results

### 4.1. Demographic characteristics of participants

A total of 5435 questionnaires were collected from undergraduate students in the nationwide cross-sectional study, with 5309 valid questionnaires identified after the exclusion of 126 questionnaires. The effective recovery rate was 97.7%. Of the 5309 undergraduate students, 3733 (70.31%) nursing and midwifery undergraduate students completed the questionnaire. The nursing and midwifery undergraduate students were from seven provinces and cities across China. Nursing and midwifery undergraduates aged 20 years or younger accounted for 59.79%. Of these, females accounted for 88.70%, with 2364 students (63.33%) living in rural areas, 1965 students (52.64%) were medical college/university students, and 2032 students (54.43%) were from universities in Hainan province. Of these, 2648 students (70.93%) were freshmen and sophomores, and 96.46% of the undergraduate students perceived themselves as being in good health (Table 1). The mean difference in HBEL behavior was found to be significant concerning age, university province, grade level, and perceived health status ( $P < 0.05$ ). The results are shown in Table 1.

### 4.2. Self-control, self-efficacy, and HBEL behavior

The overall scores for self-control, impulse control, and self-discipline were 42.54 (SD = 6.22), 26.42 (SD = 5.52), and 16.14 (SD = 2.28), respectively (Table 2). The overall score for self-efficacy was 27.59 (SD = 3.89, Table 2). The overall mean score of HBEL behavior for undergraduates was 26.02 (SD = 4.20, Table 2). The proportion of high, medium, and low levels of HBEL behavior for undergraduates was 20.89%, 72.41%, and 6.70%, respectively. The mean scores of the items for four dimensions including online curriculum learning, learning time, concentration, and satisfaction of learning behavior were 2.31 (SD = 0.52), 3.15 (SD = 0.64), 2.94 (SD = 0.94), and 2.61 (SD = 0.63), respectively.

**Table 1**  
Descriptive and univariate analysis of undergraduate HBEL behavior (N = 3,733).

Variables	n (pro, %)	Scores of HBEL behavior (mean ± SD)	t value	P value
Age, year			5.593	<0.001
≤20	2232 (59.79 %)	26.33 ± 4.18		
>20	1501 (40.21 %)	25.55 ± 4.20		
Gender			1.137	0.256
Female	3311 (88.70 %)	26.05 ± 4.14		
Male	422 (11.30 %)	25.80 ± 4.69		
Residence			-0.742	0.458
Rural area	2364 (63.33 %)	25.98 ± 4.20		
Cities and towns	1369 (36.67 %)	26.08 ± 4.21		
University province			-7.937	<0.001
Hainan province	2032 (54.43 %)	25.52 ± 4.27		
Non-Hainan province	1701 (45.57 %)	26.61 ± 4.05		
Type of university			-1.948	0.051
Medical	1965 (52.64 %)	25.89 ± 4.36		
Non-medical	1768 (47.36 %)	26.16 ± 4.01		
Grade level			11.644	<0.001
≤Sophomore	2648 (70.93 %)	26.52 ± 4.12		
≥Junior	1085 (29.07 %)	24.79 ± 4.14		
Health status			5.190	<0.001
≥well	3601 (96.46 %)	26.09 ± 4.17		
≤not very well	132 (3.54 %)	24.16 ± 4.71		

**Note:** HBEL: home-based e-learning; university province, the province where university is located; Health status, personal perceived health status; pro, proportion; SD, standard deviation.

4.3. Correlations between self-control, self-efficacy, and HBEL behavior

The results of Pearson's correlation analysis revealed a positive correlation between self-control, self-efficacy, and HBEL behavior ( $P < 0.05$ , Table 2). Subscales of self-control, namely, impulse control and self-discipline were also found to have significant positive correlations with self-control, self-efficacy, and HBEL behavior, respectively ( $P < 0.05$ , Table 2).

4.4. Linear regression analysis

A multiple linear regression analysis was conducted using undergraduate students' scores of HBEL behavior as a dependent variable and the variables with statistically significant differences ( $P < 0.05$ ) in the univariate analysis as independent variables. The methods of assigning independent variables are detailed as follows: Age: original variable;

**Table 2**  
Correlations between study variables (N = 3,733).

Variables	Mean ± SD	Min	Max	HBEL behavior	Self-efficacy	Self-control	Impulse control	Self-discipline
HBEL behavior	26.02 ± 4.20	11	38	1				
Self-efficacy	27.59 ± 3.89	10	40	0.238***	1			
Self-control	42.54 ± 6.22	24	65	0.296***	0.227***	1		
Impulse Control	26.40 ± 5.52	8	40	0.237***	0.052**	0.932***	1	
Self-discipline	16.14 ± 2.28	9	25	0.235***	0.495***	0.475***	0.123***	1

**Note:** HBEL: home-based e-learning; Min: minimum; Max: maximum. \*  $P < 0.05$ , \*\*  $P < 0.01$ , \*\*\*  $P < 0.001$ .

University Province: Hainan province = 1, non-Hainan province = 2; Grade level: ≤sophomore = 1, ≥junior = 2; Perceived health status: well and above = 1, not very well and below = 2. The results of the multiple linear regression analysis showed that self-control ( $\beta = 0.250$ ,  $P < 0.001$ ), self-efficacy ( $\beta = 0.169$ ,  $P < 0.001$ ), university province ( $\beta = 0.249$ ,  $P < 0.001$ ), grade level ( $\beta = -0.255$ ,  $P < 0.001$ ), and personal perceived health status ( $\beta = -0.044$ ,  $P = 0.003$ ) were independent influential factors for the HBEL behavior of nursing and midwifery undergraduate students ( $P < 0.05$ , Table 3).

5. Discussion

The nationwide cross-sectional study was conducted across seven provinces and cities in China; its results on nursing and midwifery undergraduate students' HBEL behavior revealed relationships between variables including self-control, self-efficacy, university province, grade level, and perceived health status associated with HBEL behavior. Thus, the findings would help guide targeted assistance for nursing and midwifery undergraduate students caught in self-imposed isolation during COVID-19.

The overall mean score of the HBEL behavior of the undergraduate students in this study indicated a moderate level. This suggests that the HBEL behavior of undergraduate students needs to be improved. Despite the lacking number of studies conducted on undergraduates' HBEL during the pandemic, it was found that high school students had more positive attitudes toward HBEL compared to students in middle and primary school (Wang et al., 2020). This may indicate that those with higher education are more receptive to HBEL. A qualitative study demonstrated that nursing undergraduates acknowledged their HBEL experiences positively (Hu et al., 2022). Therefore, although it is new for such a large number of nursing and midwifery undergraduates to study at home, the HBEL behavior of undergraduates was acceptable. Nevertheless, there remains room for improvement. The current study also found that the highest and lowest mean scores of each item pertaining to the four dimensions of HBEL were learning time, and online curriculum learning. This might imply that too many online learning courses should not be scheduled during home isolation, considering that undergraduate students might need to spend more time studying online due to technical issues with the Internet, network problems, and other distractions.

This study demonstrated that higher self-control was associated with

**Table 3**  
Multiple linear stepwise regression analysis on HBEL behavior (N = 3,733).

Variables	B value	Standard error	$\beta$ value	t value	P value
Constant	14.815	0.727		20.378	<0.001
University province	2.099	0.135	0.249	15.572	<0.001
Grade level	-2.356	0.148	-0.255	-15.921	<0.001
Health status	-1.002	0.336	-0.044	-2.978	0.003
Self-efficacy	0.182	0.016	0.169	11.168	<0.001
Self-control	0.169	0.010	0.250	16.449	<0.001

**Note:** 1) University province, the province where university is located; Health status, personal perceived health status; 2) R value = 0.445; R<sup>2</sup> value = 0.198, adjusted R<sup>2</sup> = 0.197, F = 183.731,  $P < 0.001$ .



better HBEL behavior among nursing and midwifery undergraduates, suggesting that self-control was a crucial factor in ensuring HBEL. HBEL requires nursing and midwifery undergraduates to study alone at home via the internet, leading to a lack of supervision from teachers and interaction with classmates. A previous study has revealed that students with higher self-control were more likely to perform better academically (Tangney et al., 2004), and undergraduate students with strong self-control were linked to a low level of Internet addiction (Mei et al., 2016; Enyuan and Huiyu, 2017). In addition, the overall total mean score of students' self-control indicated a moderate level. Therefore, to meet the challenge posed by COVID-19 and the rapid growth of the Internet, measures/interventions should be taken to promote self-control among nursing and midwifery undergraduate students. Duckworth et al. summarized some strategies that could facilitate self-control in e-learning (Duckworth et al., 2019). Strategies include telling students to eliminate possible temptations (e.g., blocking social media apps and muting phones) from their immediate sight before online classes begin, setting deadlines for assignments, and informing students to plan ahead, which are also applicable for nursing and midwifery undergraduate students.

The results also found that a high level of self-efficacy predicted good HBEL behavior. Furthermore, the findings in this study showed that undergraduate students' self-efficacy levels were moderate. Individuals with a higher level of self-efficacy are more self-confident and successfully conquer the difficulties of studying online while being quarantined at home. Therefore, the self-efficacy of undergraduate students needs to be strengthened in the landscape of the COVID-19 pandemic as well as in routine teaching. According to the Social Cognitive Theory (Bandura, 1997), an individual's self-efficacy can be enhanced using interventions that adequately incorporate four sources of information, namely performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal. A systematic review and meta-analysis, and other original studies (Jiang et al., 2019a; Jiang et al., 2021; Jiang et al., 2019b), have indicated that self-efficacy-focused education combining these four sources of information could also improve metabolic control, diabetes self-efficacy and other psychological indicators for patients with diabetes. Thus, it may be feasible to develop an intervention based on all four sources of information to assist in enhancing nursing and midwifery undergraduate students' self-efficacy. In addition, several strategies can be applied to the aforementioned four sources of information. For example, a study conducting a simulation with repetitive strategies could assist students in improving their self-efficacy, while also acquiring clinical knowledge and skills (Al Gharibi et al., 2021). In addition, other strategies may be used as viable options when designing and implementing interventions, including assisting students in setting progressive and realistic goals, assigning tasks based on difficulty (from easy to difficult), encouraging students, providing them with positive feedback, and sharing their experience, to help them to step-by-step build confidence.

In addition, this study demonstrated that university students' score of HBEL behavior in the Hainan province was inferior to that in non-Hainan provinces. This may be owing to the relative lagging economic and educational development in this province in China (He et al., 2021; Qi, 2020), which results in relatively outdated online platforms and a poor learning atmosphere in universities. Other provinces and regions with similar conditions may also have such problems. Therefore, investing in the construction of educational networks in undeveloped areas by the local or national government is necessary. Additionally, there is a need to strengthen the learning awareness and atmosphere among undergraduate nursing and midwifery students.

In this study, it was found that the outcome of HBEL behavior for junior and senior students was poorer than for sophomore and freshman students. This may be attributed to the different needs and concerns of students across different grade levels. Compared to sophomore and freshman students, junior and senior nursing and midwifery undergraduate students face challenges arising from practicum, continuing

education, and employment, which may hinder them from using HBEL. Therefore, it is necessary for universities to provide them with added online support and resources, such as online internship training and guidance and career fairs, among others. Thus, these juniors' and seniors' needs can be met while their concerns are allayed.

Additionally, perceived health status was indicated as another significant factor for HBEL behavior. This could be attributed to healthy undergraduates having more energy to focus on studying at home. In addition, most students may not have physical ailments or diseases, but may instead experience negative emotions such as anxiety and stress. An online survey of 89,588 college students in China during the COVID-19 pandemic demonstrated that 41.1 % of students experienced anxiety symptoms (Fu et al., 2021). Another online survey indicated that 82.3 % of medical students had moderate to high levels of stress while engaging in online learning during COVID-19 (Wang et al., 2021a). Students' health status may be affected by high levels of negative emotions, which also affect their learning at home. Thus, providing timely and targeted psychological interventions to all students during the pandemic, especially during the home isolation period, is critical.

### 5.1. Strengths and limitations

This study had several strengths, including the fact that the study was a nationwide survey with a large number of participants. To the best of our knowledge, this is the first study in China to focus on the HBEL behavior of nursing and midwifery undergraduate students during the COVID-19 pandemic. This study sheds light on the HBEL behavior of undergraduates and its influencing factors and acts as a reference point for other countries and regions with similar conditions. Simultaneously, the findings provided strong implications for future online learning concerning nursing and midwifery undergraduate students and can also be applied to other streams. Moreover, the findings of this study also provide empirical evidence supporting the relationship between the individual factors of self-control, self-efficacy, demographic characteristics, and HBEL behavior, as per the Social Cognitive Theory. However, this study has some limitations that must be addressed. This study is a cross-sectional study, meaning it did not reflect changes in the HBEL behavior during the pandemic. Therefore, a longitudinal study is needed to further explore this specific situation. In addition, because of the prevalence of COVID-19, data collection relied on access to online services and self-reporting, which implies that the results may be influenced by social desirability. Meanwhile, other factors such as family support and ongoing faculty support that may influence home-based e-learning behavior were not investigated in this study as this was an online survey, as well as other time constraints.

## 6. Conclusions

The HBEL behavior of undergraduates requires improvement. Self-control, self-efficacy, and some demographic variables including the province of university, grade level, and perceived health status are associated with home-based e-learning behavior. The study's results showed that universities should assist nursing and midwifery undergraduates in improving self-control and enhancing self-efficacy to resist temptations and conquer difficulties when receiving HBEL during the COVID-19 pandemic. Furthermore, strategies such as informing students to avoid distractions on the Internet, enabling them to make plans/goals ahead of time, setting deadlines, and assigning tasks on a gradual basis, can be adopted by universities. In addition, increasing educational network constructions, providing targeted online resources for different grade levels of undergraduates, and providing timely psychological interventions may also contribute to reducing the impact of differences in the university's province, grade level, and personal perceived health status.

## CRediT authorship contribution statement

XJ contributed to the design of the study, data collection and analysis. CZ and TW conceptualized and supervised the study. XJ, HZ, CZ, and TW prepared and revised the manuscript. All authors prepared the manuscript and approved the final version for submission. And all authors agree to be accountable for the content of the study.

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## Ethics approval

The study was approved by the ethics committee of Hainan Medical University (hyll-2020-011).

## Declaration of competing interest

The authors declared that there was no conflict of interest.

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