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## ORIGINAL ARTICLE

# Exploring nursing student self-esteem change and its predictors: Cohort study and its methodological challenges

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### KEYWORDS

Nursing student;  
Self-concept;  
Longitudinal studies;  
Cohort Studies

### Abstract

**Objective:** Considering methodological difficulties and inconsistent results of previous studies on it, the objective was to describe the change in nursing student self-esteem over time and its predictors, using a sound theoretical framework and relevant tools to measure and analyse the data.

**Method:** Cohort study. Self-esteem and related factors were assessed in nursing students in a 4-year bachelor's program at the beginning of each academic year from 2017 to 2019 and at the end of the academic year in May 2020, using the revised version of Self-liking/Self-competence scale of Tafarodi and Swann. Univariate and multivariate analyses were performed via generalized linear mixed modelling.

**Results:** Self-esteem was moderate at the beginning of the program: 50.40 (9.10). It increased slightly over time: 51.15 (9.11) at T1; 51.64 (0.49) at T2; and 51.39 (10.79) at T3 ( $P = .002$ ). Baseline variables that predicted self-esteem change were gender, secondary school graduation level, state anxiety, intent to continue, and self-efficacy. Assessing and improving those last variables via a strong career plan could boost student achievement and increase retention during and after training.

**Conclusion:** Nursing student self-esteem can be assessed using a bidimensional model, with a two-factor scale like Tafarodi & Swann's self-liking/self-competence scale. Generalized linear mixed model is a useful way to correlate large sets of longitudinal data.

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## PALABRAS CLAVE

Estudiantes de enfermería;  
Autoconcepto;  
Estudios longitudinales;  
Estudios de cohortes

## Explorando el cambio de la autoestima de los estudiantes de enfermería y sus factores predictivos: estudio de cohortes y sus retos metodológicos

### Resumen

**Objetivo:** Teniendo en cuenta las dificultades metodológicas y los resultados inconsistentes de estudios previos, el objetivo fue describir el cambio de la autoestima de los estudiantes de enfermería a lo largo del tiempo y sus factores predictivos, utilizando un marco teórico sólido e instrumentos pertinentes para medir y analizar los datos.

**Método:** Estudio de cohortes. Se evaluaron la autoestima y los factores relacionados en los estudiantes de enfermería pertenecientes a un programa de licenciatura de 4 años al comienzo de cada año académico desde el año 2017 al año 2019, así como al final del año académico de mayo del año 2020, utilizando la versión revisada de la escala *Self-liking/Self-competence* de Tafarodi y Swann. Se realizaron análisis univariantes y multivariantes mediante modelos lineales mixtos generalizados.

**Resultados:** La autoestima fue moderada al inicio del programa: 50,40 (9,10), aumentando ligeramente con el tiempo: 51,15 (9,11) medición 1 (T1); 51,64 (0,49) en medición 2 (T2); y 51,39 (10,79) en la medición 3 (T3) ( $P = ,002$ ). Las variables de referencia que predijeron el cambio en la autoestima fueron el sexo, el nivel de estudios secundarios, el estado de ansiedad, la intención de continuar y la autoeficacia. Evaluar y mejorar estas últimas variables mediante un plan de carrera sólido podría impulsar el rendimiento de los estudiantes y aumentar la retención durante y después de la formación.

**Conclusiones:** La autoestima de los estudiantes de enfermería puede evaluarse utilizando un modelo bidimensional, con una escala de dos factores como la escala de autoafirmación/autocompetencia de Tafarodi y Swann. El uso de modelos lineales mixtos generalizados es una forma útil de correlacionar grandes conjuntos de datos longitudinales.

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## What is known

- Nursing student self-esteem has been studied without clear and coherent results. It is rigorous to use a relevant theoretical framework and a coherent assessment tool.

## What it contributes to

- Nursing student self-esteem can be assessed using a bidimensional model, via the Tafarodi & Swann's self-liking/self-competence scale. It is moderate at the beginning of the education, and stays quite stable. Are determinants: gender, secondary school graduation level, state anxiety, intent to continue, self-efficacy.

## Introduction

Nursing student self-esteem is considered as an important issue and has been studied often, with contradictory results.<sup>1</sup> Less often it is studied as a variable impacted by nurse training. These studies highlight the role of

self-esteem in the process of becoming a nurse – hence the importance of monitoring this variable during student training. Research findings regarding this last point are contradictory, with some showing nursing student self-esteem declining drastically,<sup>2</sup> others showing it increasing<sup>3</sup> or decreasing during the second year and then increasing again during the final year.<sup>4</sup>

Comparing studies is often difficult due to differing definitions of and/or approaches to self-esteem (or in some cases even the lack of any theoretical approach); to the use of different scales and different thresholds for the results and different data collection timetables; to different study populations with different levels of education, number of years needed, and programs; to the use of cross-sectional designs at different phases of education, etc. This makes it hard to draw any conclusion about the impact of nursing education on student self-esteem. In longitudinal studies, this difficulty is exacerbated by losses to follow-up due to attrition, as nursing students have a high dropout rate.<sup>5</sup>

These difficulties highlight the importance of a coherent approach using a sound theoretical framework. Self-esteem is described as the emotional reaction to the perceived self. It is conceptualized as one-dimensional, based on the sense of value or competence; two-dimensional, based on both those dimensions; or multi-dimensional, based on various domains such as the familial, academic, and physical aspects of our lives. The two-dimensional approach focuses on dimensions potentially impacted by higher education,

and enables us to address some of the contradictory results in self-esteem research by considering imbalances between the two dimensions, which can lead to defensive behaviours even in “high” self-esteem people.<sup>6</sup>

In nursing students, self-esteem is often, but not consistently, associated with gender,<sup>7</sup> social support,<sup>8</sup> self-efficacy,<sup>9</sup> and state anxiety.<sup>10</sup> Studies do not always explore the direction of these associations, which could be bidirectional, making difficult to know the predictors of self-esteem without a longitudinal study. In the population, it could theoretically<sup>6</sup> be associated with age, higher education experience and its results, having responsibilities like a job or children.

Self-esteem appears to be extremely important for the development of mental health and professional behaviour in nursing students. The effect of higher education on nursing student self-esteem, however, remains unclear, as well as the other associated variables. Using a strong theoretical model like Mruk’s<sup>6</sup> could help improve our understanding of the issue, thereby allowing intervention, if necessary, to produce competent, healthy nurses. The aims of the study were to describe changes in nursing student self-esteem and the predictors of those changes.

## Method

### Design

We conducted a longitudinal cohort study to investigate changes in, and covariates of, self-esteem during nursing education.

### Study population

Four high schools (out of the sixteen that offer a Bachelor’s in nursing in French-speaking Belgium) were selected to provide a diverse sample in terms of size, geographical location, and network. In that educational system, students do not belong to a specific study year, but take courses from several different years according to a personalized program. In order to follow all of the students in a specific cohort, they were enrolled in the study while attending classes from study years 1 and 2 (T0) and then followed for three years: while attending classes from study years 2 and 3 (T1), and then from study years 3 and 4 (T2 and T3). By doing follow-up on two study years at the same time and administering the questionnaires during class, we were able to maximize participation and limit losses to follow-up. The potential number of participants at inclusion was approximately 1,100. There were no exclusion criteria.

### Sample calculation

The power calculation was based on a comparison of self-esteem level measured at two different times. By varying the effect size from 0.05 to 1.5, we applied a two-tailed test for comparing the means from a paired sample using an uncertainty of 5% and a power of 80%. The calculation was done with G\*Power software, version 3.1.9.2. Given the stability of self-esteem, we presumed an effect size of 0.15 and

estimated a sample size of 351 participants with complete data to get 80% power.

### Data collection

The participants completed the questionnaire at the beginning of each year (T0, T1, and T2 in September/October 2017, 2018, and 2019, respectively) and at the end of the fourth study year (T3, in May 2020). Questionnaires were completed during class time, except for T3, where they were mailed to the students due to the COVID-19 lockdown. This meant that only students who had passed their classes, or failed at most one year, were followed. The number of potential participants at T3 – only those students who made it to their final year – was obviously smaller, especially given remote participation due to the lockdown.

### Study variables

The questionnaire was described in a previous study<sup>11</sup> and included the following sociodemographic questions: age (in years), gender (male/female), children (yes/no), previous and current job (yes/no), previous higher education (yes/no and the results), and explored the following variables:

- Self-esteem: The revised version of Self-liking/Self-competence scale (SLCS-r)<sup>12</sup> is a way to measure the two-dimensional conception of self-esteem. It consists of two 8-item subscales, with eight self-competence and eight self-liking indicators. Respondents indicated their degree of agreement (1 = *strongly disagree* to 5 = *strongly agree*) with global statements reflecting low and high self-competence and self-liking. The SLCS-r has been tested for convergent and discriminant validity.<sup>12</sup> It was translated using published recommendations,<sup>13</sup> viz.: (1) two independent translators translated the English version into French; (2) an expert committee compared and revised their translations to produce a preliminary French version; (3) that version was back-translated by a native English speaker; and (4) translators and experts compared the back translation to the original English version. The final French version was tested by 51 nursing students. No changes were made after testing.
- State Anxiety: The French version of the Spielberger State-Trait Anxiety Inventory, Form Y (STAI-Y©), form A, measures state anxiety. State anxiety is transient and linked to a specific stressful event. The participant reports how he or she feels at the present moment on a 20-item test that includes assertions scored on a four-point Likert scale (1 = *not at all* to 4 = *very much so*). Ten items have inverted scoring. Higher scores correspond to higher levels of anxiety.<sup>14</sup> The STAI-Y© scale has been tested previously. Spielberger<sup>14</sup> presents a summary of all of the validity studies done.
- Perceived social support: rated on a scale of 1 (*total lack of support*) to 5 (*very active support*).
- Intent to continue: rated on a scale of 1 (*firm intention to give up*) to 5 (*firm intention to continue*).
- Self-efficacy regarding completion of the nursing program, internships, and the nursing profession: rated on a scale of 1 (*not at all able*) to 5 (*very able*).

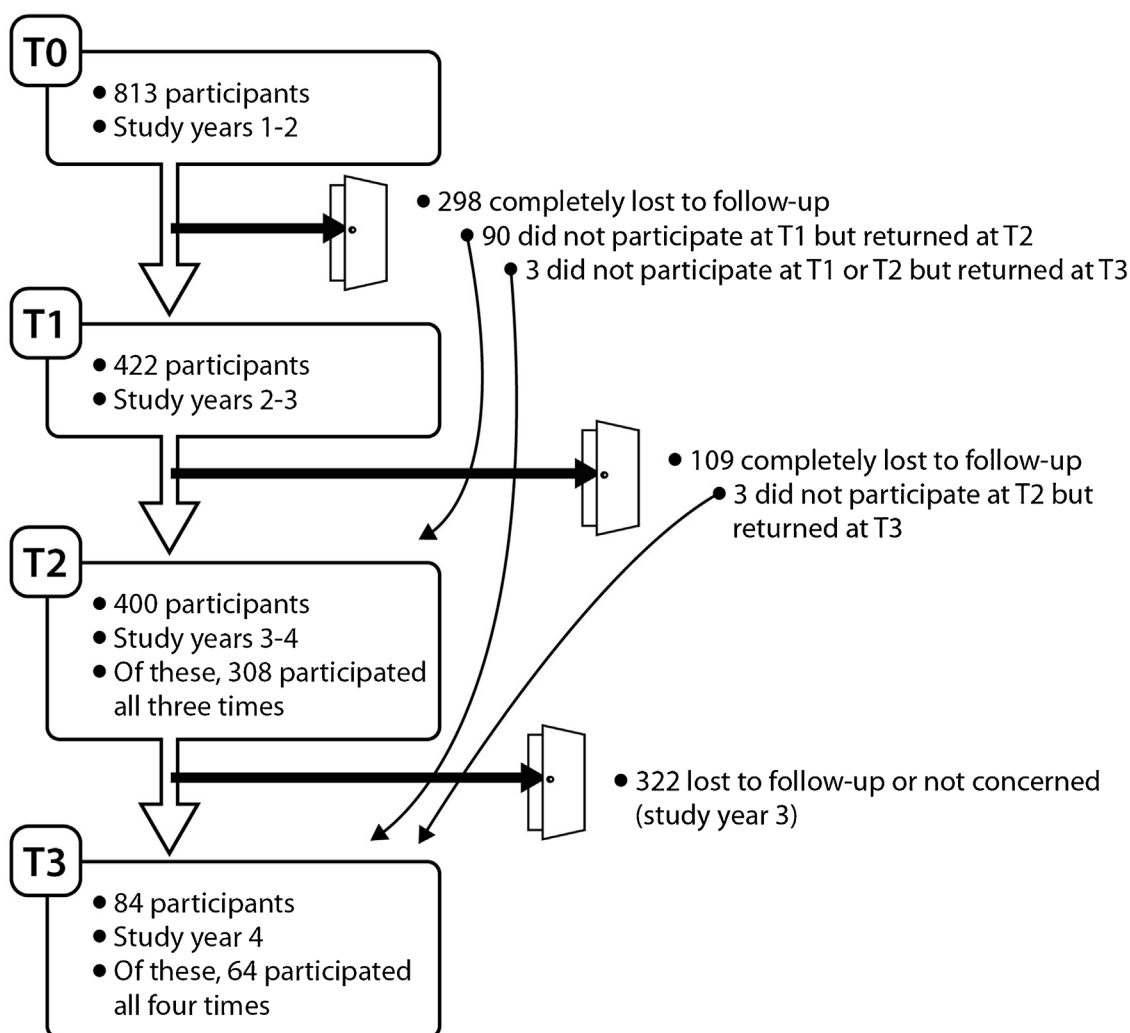


Figure 1 Study flowchart.

## Data analysis

Quantitative parameters are summarized using mean and standard deviation (SD) or median and interquartile range (P25–P75) for asymmetric distributions. The qualitative parameters are expressed as numbers (n) and frequencies (%). The distribution of quantitative parameters was investigated numerically by comparing the mean and median values and graphically by means of histograms and quantile-quantile plots. The Shapiro-Wilk normality test was also performed.

The change of self-esteem over time was analysed using generalized linear mixed modelling (GLMM). GLMM was also used to identify baseline covariates significantly associated with changes in self-esteem. Those statistically significant predictors were then included in a multivariate model.

The level of uncertainty was  $\alpha = 5\%$  ( $P < .05$ ). When needed for the tests, the normality and heteroscedasticity of the residuals were checked. Analyses always used all available data for the variables being considered.

Statistical analysis was performed using SAS® version 9.4, R version 4.1.1, and RStudio version 4.0.2 software.

## Ethical considerations

This study was approved by an ethics committee (CHU de Liège, ref. 2017/233). At each step, participants were given information about the study and about their rights as participants, and were asked to sign a consent form. The decision to participate or not had no impact on students' educational support or assessment. The data were not used to draw comparisons between identified institutions.

All the data were anonymized, meaning that all participants are referred to by code so they cannot be identified. Nominative data are stored in a secure location for the duration of the study. All nominative data will be destroyed once the research and publication process is over. Data protection and privacy comply with General Data Protection Regulation principles (UE2016/679).

**Table 1** Sample characteristics at T0.

Variable	Categories	n	Frequency (%)	Min	Q1	Median	Q3	Max
Age	Years	809		17.0	19.0	20.0	21.0	49.0
Gender		811						
	Male		122 (15.0)					
	Female		689 (85.0)					
Secondary Education Level		809						
	General		458 (56.6)					
	Transition		91 (11.2)					
	Qualification		183 (22.6)					
	Vocational		43 (5.3)					
	Other		34 (4.2)					
Previous job		813						
	No		724 (89.1)					
	Yes		89 (10.9)					
Previous student job		813						
	No		484 (59.5)					
	Yes		329 (40.5)					
Previous higher education		813						
	No		486 (59.8)					
	Yes		327 (40.2)					
Social support T0	1-5	812		1.0	4.0	4.0	5.0	5.0
Children T0		813						
	No		778 (95.7)					
	Yes		35 (4.3)					
Current job T0		813						
	No		578 (71.1)					
	Yes		235 (28.9)					
State anxiety T0	20–80	749		20.0	32.0	39.0	48.0	77.0
Intent to continue T0	1–5	812		1.0	4.0	5.0	5.0	5.0
Self-efficacy/program T0	1–5	638		1.0	3.0	4.0	4.0	5.0
Self-efficacy/internships T0	1–5	640		1.0	3.0	4.0	4.0	5.0
Self-efficacy/profession T0	1–5	639		1.0	4.0	4.0	5.0	5.0

STROBE guidelines<sup>15</sup> were used to conduct and report the study.

## Results

There were 813 participants at T0; 422 (51.01%) participated again at T1, 400 (49.20%) participated again at T2, and 84 (10.33%) participated again at T3, as shown in Fig. 1. In the T0 sample, 85% were female and the median age was 20 (19–21) years. Other variables are shown in Table 1.

In Belgium, there is no entrance examination or other way of restricting the access to higher education. The failure rate at the end of the first year is important, explaining the loss of participants between T0 and T1. At T3, we choose to follow only the participants which could graduate that year, excluding those of the other study year, and we had a restricted access to participants due to lockdown.

### Self-esteem changes

The reliability of the self-esteem scale was 0.84 as assessed via Cronbach’s alpha at T0. Fig. 2 reports the mean scores for self-esteem, and its dimensions, at each survey point.

Mean global self-esteem was 50.40 (9.10) at T0; 51.15 (9.11) at T1; 51.64 (0.49) at T2; and 51.39 (10.79) at T3. The change in global self-esteem was statistically significant ( $P = .002$ ). Global self-esteem was significantly higher at T2 than at T0 ( $P < .001$ ) and T1 ( $P = .020$ ); no other difference was observed. The decline at T3 was not statistically significant.

Change was also significant for self-competence ( $P < .001$ ), which was significantly higher at T2 than at T0 ( $P < .001$ ) and T1 ( $P = .002$ ), and also significantly higher at T3 than at T0 ( $P < .001$ ) and T1 ( $P = .001$ ).

Self-liking increased slightly from T0 to T2 and decreased by T3; these changes were not statistically significant ( $p = .155$ ).

### Baseline variables associated with self-esteem change over time

Univariate analysis showed that self-esteem change was positively associated with age ( $P = .002$ ); male gender ( $P < .001$ ); graduation from secondary school with a professional degree ( $P = .021$ ); having a child ( $P = .002$ ); social support ( $P < .001$ ); intent to continue ( $P = .024$ ); and self-efficacy regarding the program ( $P < .001$ ), the internships ( $P < .001$ ), and the pro-

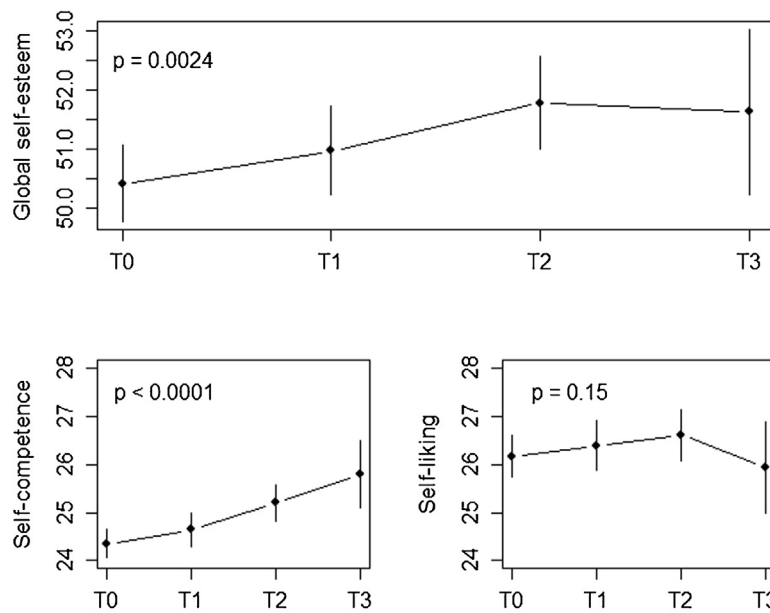


Figure 2 Mean scores for self-esteem and its dimensions in each measurement.

Table 2 Baseline predictors of global self-esteem change over time (GLMM).

	Modality	Univariate		Multivariate $P < .001^*$	
		Estimate (Standard Error)	P-value	Estimate (Standard Error)	P-value
Age	17–49	0.22 (0.07)	.002*	–0.01 (0.10)	.953
Gender	Female (vs. Male)	–5.04 (0.84)	<.001*	–2.06 (0.78)	.008*
Secondary school graduation level	General (ref)		.021*		.010*
	Transition	0.46 (0.98)	.639	0.70 (0.87)	.422
	Qualification	–0.08 (0.77)	.921	2.38 (0.75)	.002*
	Vocational	3.90 (1.41)	.006*	3.56 (1.56)	.023*
	Other	3.93 (1.55)	.011*	0.67 (1.54)	.666
Social support T0	1–5	1.42 (0.33)	<.001*	0.35 (0.31)	.253
State anxiety T0	20–80	–0.40 (0.02)	<.001*	–0.27 (0.03)	<.001*
Intent to continue T0	1–5	4.72 (2.05)	.024*	–1.49 (0.42)	<.001*
Self-efficacy/program T0	1–5	4.61 (0.38)	<.001*	2.43 (0.38)	<.001*
Self-efficacy/internships T0	1–5	3.63 (0.37)	<.001*	1.04 (0.39)	.009*
Self-efficacy/profession T0	1–5	3.50 (0.41)	<.001*	1.33 (0.38)	.001*
Previous job	Yes (vs. No)	–0.51 (0.97)	.596		
Previous student job	Yes (vs. No)	–1.03 (0.62)	.099		
Current student job T0	Yes (vs. No)	–0.43 (0.38)	.255		
Previous higher educ.	Yes (vs. No)	0.10 (0.62)	.875		
Child T0	Yes (vs. No)	4.54 (1.49)	.002*	2.49 (2.20)	.259

\* Statistically significant results ( $P < .05$ ).

fession ( $P < .001$ ). It was negatively associated with state anxiety ( $P < .001$ ). Regarding self-efficacy vis-à-vis the program and profession, the effect diminished over time. These results are reported in Table 2.

The same type of analysis for changes in the two dimensions of self-esteem showed that self-liking was positively associated with age ( $P = .003$ ); male gender ( $P < .001$ ); secondary school graduation level ( $P = .004$ ); having a child ( $P = .007$ ); social support ( $P < .001$ ); and self-efficacy for the program ( $P < .001$ ), internships ( $P = .001$ ), and the profes-

sion ( $P < .001$ ); and negatively associated with state anxiety ( $P < .001$ ). Self-competence was positively associated with male gender ( $P = .005$ ); having a child ( $P = .007$ ); social support ( $P = .003$ ); intent to continue ( $P = .005$ ); and self-efficacy with regard to the program, internships, and the profession ( $P < .001$ ,  $P < .001$ ,  $P = .002$  respectively); and negatively associated with state anxiety ( $P < .001$ ).

Those variables were incorporated into a multivariate model. Gender, secondary school graduation level, state anxiety at T0, intent to continue at T0, and self-efficacy

regarding completion of the program, internships, and being a good nurse at T0 were predictors of self-esteem change over time. The p-values are reported in Table 2. Results were similar for the two dimensions of self-esteem, except that gender was not associated with a change in self-competence.

## Discussion

A better understanding of changes in nursing student self-esteem and the factors that influence those changes could provide valuable information about how and when to intervene and about which factors are most effective in fostering self-esteem during nursing education – the ultimate goal being to improve student well-being and professionalization.

Regarding our first aim, which was to describe how nursing student self-esteem changes during nursing education, we found that mean global self-esteem was moderate at the beginning, and gradually improved by a small amount over the course of the program, with a small, non-statistically significant decline at the end of the program. There was a small, gradual improvement in self-competence over the entire educational process. The change in self-liking was less positive, and showed a decline at the end of the program; neither of these changes was statistically significant.

Regarding our second aim, which was to identify the baseline factors (T0) associated with changes in self-esteem over the entire nursing program, we found that gender, secondary school graduation level, state anxiety, intent to continue, and self-efficacy were associated with global self-esteem change over time.

Our sample reflected the characteristics of the French-speaking Belgian population in terms of gender and age (personal communication from *Académie de Recherche et d'Enseignement Supérieur* [ARES], April 2020), which are similar to those in other studies and other countries; 40% of our participants had started some other form of higher education, the majority (79.5%) of them failing. This varies between countries, depending on the entry requirements for higher education. Because dropping out of a higher education program can impact self-esteem,<sup>16</sup> this may explain, in part, the moderate self-esteem in our sample at T0.

We found moderate global self-esteem at the beginning of nursing education, with a slight improvement over the course of the program. That improvement was explained by continuous improvement in the self-competence dimension of self-esteem, which itself might be due to the fact that we followed students from their first year to their last, as they built upon their successes and gained a growing sense of competence.<sup>6</sup> Since we found no statistically significant difference in self-esteem (at the beginning of a study year) between the students who stayed in our cohort and those lost to follow-up (most due to failure or dropout), we can hypothesize that success is one explanatory factor for this rise in self-esteem.

Conversely, a cohort study among British students showed a drastic decline in self-esteem,<sup>2</sup> explained by bullying during internships. This difference might be explained, in part, by differing methodologies; the British study evaluated self-esteem during internships, when the most difficult situations occur. Moreover, there are differences between the health

and educational systems in the two studies. We found a decrease in self-liking at the end of nursing education, although it was not statistically significant. This decrease might be explained by bad internship experiences, as we noted in a qualitative study.<sup>17</sup> Another longitudinal study among British students<sup>18</sup> showed the highest levels of stress and the lowest levels of self-esteem at the end of the training. A study in Brazilian students at the end of their nursing program<sup>19</sup> showed a high level of anxiety and a low level of self-esteem.

Other studies, however, showed results more similar to ours. In a longitudinal study among Turkish students in a four-year nursing program,<sup>3</sup> self-esteem was significantly higher at the end of the fourth year than at the beginning of the program or the end of the other study years. A longitudinal study in Australian nursing students in a three-year program<sup>4</sup> showed a decline in self-esteem from the first to the second year, and an increase from the second to the third year, with final self-esteem higher than in the first year. Lastly, a cohort study measuring self-esteem among Irish nursing students<sup>20</sup> at the start of their program and then two months before its end showed, like in our study, moderate self-esteem at baseline with a slight increase near the end of the program, associated with less fear of a negative evaluation.

This variability in the findings about changes in nursing student self-esteem highlights the need to examine the factors that might explain such changes. We chose to focus on the baseline characteristics of our participants.

The baseline variables predicting self-esteem change over time were gender, secondary school graduation level, state anxiety, intent to continue, and the three self-efficacies (regarding the program, internships, and the profession).

*Gender.* Gender is often associated with self-esteem, with women generally having lower self-esteem,<sup>21</sup> but there are exceptions.<sup>22</sup> In a previous study on first-year nursing student self-esteem,<sup>11</sup> we found no significant association between gender and self-esteem. In the present study we found an association between gender and changes in both self-esteem and self-liking, with males having higher self-esteem than females, as is often reported.

*Secondary school graduation level.* Self-esteem has been reported to be positively associated with educational level.<sup>23</sup> In our study, however, lower secondary education level was associated with more positive self-esteem change over time. We hypothesize that “low educational level” students find participating in higher education – and especially being successful there – very self-affirming, explaining the positive change in self-esteem.

*Intent to continue.* In our study, intent to continue was positively associated with self-esteem change over time. To our knowledge, this variable has never before been studied; we introduced it to get an idea about how important nursing education was to participants, as the domain in which participants find acceptance and/or success influences the effect of these events on self-esteem.<sup>6</sup> Similarly, self-esteem has been found to be associated negatively with attrition,<sup>11</sup> and positively with motivation.<sup>24</sup> When studied using our multivariate model, intent to continue tended to counterbalance the effect of the other variables, suggesting that interactions between variables should be explored in future studies.

*State Anxiety.* Stress,<sup>18,25–28</sup> academic stress,<sup>29</sup> and anxiety<sup>10,30–33</sup> are the variables most consistently negatively associated with self-esteem. In an Australian study,<sup>4</sup> self-esteem was correlated positively with proactive coping behaviours, and negatively with stress. Self-esteem is often correlated with resilience,<sup>22</sup> and acts as a buffer against stress.<sup>6</sup> Our study adds to the evidence that not only is state anxiety associated with self-esteem level, but that it also predicts self-esteem change over time.

*Self-efficacy.* Self-efficacy in general is often found to be positively associated with self-esteem.<sup>9</sup> Our study adds that it predicts self-esteem change over time, and shows the specific situations considered by students, because self-efficacy represents self-confidence in one's performance in specific situations.<sup>34</sup>

According to our study, the modifiable baseline factors that influence self-esteem change are intent to continue, state anxiety, and self-efficacy. Instructors and educational programs should focus on those issues to (1) avoid stressful situations and foster coping ability; (2) promote positive career plans that maintain student motivation; and (3) strengthen self-efficacy by proposing well-calibrated tasks and responding to failures or errors in a constructive way.

Self-esteem could be assessed, or self-assessed, regularly during nursing education, so that students with declining self-esteem can be given special help. A two-dimensional scale might be useful for identifying the nature of the problem – i.e., whether it is more success- or relationship-related – and taking appropriate action.

This is the first study about student self-esteem in French-speaking Belgium's bachelor's nursing degree programs. Its large sample ensures generalizability to nursing students from similar educational systems. It has a strong, coherent theoretical framework, uses validated scales, and explores factors identified in a large literature review.

As approved by the literature,<sup>13</sup> the psychometric properties of the French translation of SLCS-r was not undergone. Even if the Cronbach's alpha was satisfactory, we cannot fully ensure the construct validity of our translation. It is a further and ongoing research project.

The COVID-19 lockdown made it harder to contact students for the T3 survey and may have affected the results from that survey. That, together with our decision to contact only graduating students at that time, explains the large number of participants lost to follow-up at T3 and, as a consequence, the small number of participants with complete data.

This study will be continued with the exploration of the covariates of self-esteem changes at each survey point, the exploration of the effect of self-esteem on grades and dropout throughout the program, and an amalgamation of our quantitative and qualitative results.

Any actions taken to monitor and improve self-esteem should be tested systematically in terms of both self-esteem and other important factors such as success, retention, and competence.

We can conclude that exploring self-esteem can be a methodological challenge, given the number of theoretical frameworks, the variety of its covariates and the mutual influences between them. We proposed a sound framework relevant to higher education of nursing students, and a coherent scale to measure it.

We found nursing student self-esteem to be moderate and to increase slightly during nursing education, due primarily to a steady but modest increase in self-competence over time. While reassuring, these findings are not ideal, because self-esteem is associated with desirable personal and professional outcomes. Assessing and improving state anxiety, self-efficacy, and intent to continue via a strong career plan could help students achieve such positive outcomes and reduce the global nurse retention problem, both during and after nursing education.

## Author contributions

Jacinthe Dancot is the main author. Anne-Françoise Donneau and Nadia Dardenne performed some of the statistical analyses. Pascal Detroz is a member of the thesis committee and re-read the draft text at several stages of writing. Benoît Pétré and Michèle Guillaume are the thesis directors. All authors have agreed on the final version.

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## Conflict of interest

No conflict of interest has been declared by the authors.

## Trial registration

This non-interventional study was approved by the ethics committee (Comité d'Éthique Hospitalo-Facultaire Universitaire de Liège (707)) and assigned reference no. 2017/233.

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