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Undergraduate Anatomy Education: Improving Course Assessment to Reduce Student Stress

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Abstract: Anatomy is the foundational and most significant discipline in medical education. It is a field of biology that deals with the structure and organization of living organisms. Along with learning academic skills in the anatomy courses, medical students have the chance to develop their leadership, teamwork, and communication abilities. The majority of medical students experience stress and may even have psychiatric illnesses as a result of their unique medical education. The primary goal of this paper is to contrast the variations in systematic human anatomy education's finer points between China and Canada. Additionally, medical students will be asked to respond to a questionnaire to assess their satisfaction with the educational specifics, stress levels, and recommendations for improvement at their respective institutions. The questionnaire responses were subjected to a meta-analysis in this article using STATA in order to better understand the relationship between student stress and course specifics. The paper concludes by discussing ways to enhance inventive anatomy instruction so that students are more interested in anatomy and experience less stress while learning. These include creating online teaching tools like simulation software or 3D models, broadening the range of tasks, adjusting assessment methods, and extending the duration of anatomy.

Keywords: anatomy learning, curriculum, assessment, medical education, student mental health

1. Introduction

The English word "anatomy" derives from the Greek words "ana" and "tome," both of which mean "up" and "to cut." The anatomical structure of creatures usually involves cutting or analysis [1]. Additionally, human anatomy is a crucial part of medicine. Learning anatomy is challenging because it requires a learner to manage a lot of general knowledge and there isn't much opportunity to apply it to human specimens [2]. In addition, medical students experience a tremendous lot of stress, and multiple studies have revealed that during their medical studies, many students in different countries are actually experiencing severe psychological stress or even having psychological problems [3]. This encompasses but is not restricted to, eating disorders, sleep disorders, and other disorders. This article compares numerous online human anatomy syllabi, cited from each university's website, cross-

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referenced with a few keywords, for example, department of surgery; human anatomy syllabus, etc. Additionally, a survey regarding students' opinions of the current anatomical teaching, stress factors, and areas for improvement was undertaken for the article. The survey findings were also subjected to a meta-analysis, and the topic of how to employ online tools and modify the curriculum design to make learning anatomy more enjoyable for students was ultimately covered. In other words, the learning tactics described in this study may help students become more interested in anatomy while also lowering their level of academic stress.

2. Differences in Anatomy Courses Between Mainland China and Canada

Since there is a sizable number of undergraduate anatomy courses offered at each institution, and each course syllabus's schedule or assessment is fundamentally different, this article broadly analyses the distribution of most course assessments as well as other general comparative analyses. The following comparison summaries are taken from the websites of each university's openly accessible systematic anatomy course syllabi [3-11].

The following section will compare the variations between the two nations in terms of the categorization of anatomy courses, the systematic human anatomy syllabus, the sorts of assessments, and mental problems.

2.1. Categories of Undergraduate Anatomy Courses

The majority of universities in China offer five different types of pre-med courses in anatomy that are only available to undergraduate medical students. Every pre-med student is obliged to take systematic human anatomy and clinical anatomy studies, while only dental students can take oral regional anatomy, sectional anatomy is only available to medical imaging students, and only forensic science students can take pathology anatomy. Advanced anatomy or research courses are typically not offered at universities. In order to conduct any anatomical research, students must find a professor's independent lab to work in off-campus, which means that students will not receive any academic credit for their research in the lab.

In Canada, the number of undergraduate anatomy courses varies from university to university. However, most universities offer systematic human anatomy, neuroanatomy, embryology, advanced anatomy with a focus on dissection, and research courses. A GPA of B+ and a statement of interest are typically required for advanced and research courses. If students take a departmental anatomy-based research course, they will receive academic credit. All courses are open to students who have completed the program prerequisites, regardless of the student's major. If a student has not completed the prerequisites, they may seek assistance from the instructor or department of the program for the opportunity to waive the requirement.

2.2. Syllabus

There are numerous syllabi accessible online because anatomy courses differ from university to university. Since systematic human anatomy is the cornerstone of anatomy, only a general comparison of systematic human anatomy is presented in this article.

2.2.1. Prerequisites and Description

This paper compared the syllabi of numerous universities and discovered that each university requires effective completion of a fundamental course in molecular and cell biology before offering a systematic human anatomy course. Each university's Molecular and Cell Biology curriculum essentially explains how the fundamental elements of life give birth to biological form and function

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and includes a variety of experiments to help students comprehend the material. Requirements for successful completion of the program: a final overall score of 60% in China and 50% in Canada.

Regardless of the country, systematic human anatomy is described in the syllabus. The course covers fundamental histology, neuroanatomy, and gross anatomy. The objective is to learn the fundamental concepts, fundamental structures, and fundamental techniques for studying human specimens to become proficient in basic anatomical positions, terminology, and the axis of the human body and learn how to use them properly.

2.2.2. Duration

In China, basically all courses, including the systematic human anatomy course, last about 1 semester, which is about 16 weeks, excluding the 1-month final exam.

In Canada, systematic human anatomy courses are offered for various durations. Most often, institutions split human anatomy courses into two semesters of roughly 12 weeks each, so the typical length of time to give the entire human anatomy course is about 24 weeks, not including a 1-month final exam. Academic credit policies may fluctuate depending on each university. For instance, they separated human anatomy into two sections, human anatomy I and II, and each section will be worth one credit, making the entire course worth two credits. Some universities allow students to take these sections in any order they choose, while others insist that students take Human Anatomy I first. If human anatomy is not a required course for them, they can decide whether they want to proceed with human anatomy II after earning 1 credit for effectively completing human anatomy I. However, a few institutions have year-long courses that are also 24 weeks long or two semesters. Therefore, if students complete this year-long course, they will receive 2 credits directly due to they are not permitted to withdraw from the course in the middle of it.

2.2.3. Mode of Delivery

All universities provided online education during COVID-19, but as the epidemic is slowly subsiding, each university is starting to offer offline anatomy classes and exams.

The majority of anatomy classes at universities consist of four hours of weekly lectures in addition to three to four hours of laboratory activities. The students will have access to the lecture's slides via online platforms like Canvas and Moodle. The substance of anatomy lectures and lab sessions is typically not recorded because it contains sensitive information, like images of internal organs.

2.2.4. Assessment

In essence, 60% of the final test and 40% of the regular grade make up the evaluation of every course at Chinese universities. The 40% regular grade is primarily made up of 20% lab exams, 10% homework that may include practice problems or diagramming structures, etc., and 10% attendance, which includes questions that students must answer during lectures.

In Canada, the assessment of a course varies depending on the instructor. In most anatomy courses in Canada, unit tests will take the place of mid-term and final exams. For example, four unit tests will make up 60% of the course, which means 15% of each test. The remaining 30% will be equally split between the two lab exams, and 10% will be allocated to the results of each weekly quiz.

2.3. Exam Type

2.3.1. Lab Quiz

The results of lab studies conducted in China and Canada are similar. For lab exams, they typically use a "bell ringer" or "spot test". In a bell-ringer or spot exam, students are given roughly 90 to 120

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seconds at each station to respond to a question before being prompted by a bell to move on to the next station for a new question. The majority of lab tests consist of 20–30 stations of short answers. For instance, the test may ask students to name the specimen's structure, describe its function, and illustrate the significance of that function.

2.3.2. Assignment

In China, homework will include answers to a variety of question types, such as fill-in-the-blank, structured diagrams, etc. There will not usually be any group work, presentations, or posters.

In Canada, there are different types of assignments available to students, like weekly quizzes, posters, presentations, research papers, etc. The weekly quiz is an unlimited-attempt quiz consisting of multiple-choice, fill-in-the-blank, and matching questions that a few Canadian universities offer to students for practice. The lowest 2-3 quiz scores are frequently dropped by instructors to make the quizzes more equitable. Posters and presentations are often interconnected, and students will select a case to analyze and present, which can exercise problem-solving skills, critical thinking skills, and even teamwork skills if this is a group project.

2.3.3. Tests

In China, the midterm and final exams have similar formats. They are both closed-book, cumulative examinations. Essay questions, fill-in-the-blank questions, and explanatory terms are common. In Canada, unit tests are also closed book, but most are not cumulative. Most questions are in the form of multiple-choice and short-answer questions. Essay questions are extremely rare.

2.4. Mental Problem

A meta-analysis study involving 30,817 Chinese medical students in total was mentioned in the paper [12]. Depression, anxiety, suicide tendency, and dietary problems are quite common, with prevalence rates of 29 %, 21 %, 11 %, and 2 %, respectively.

In Canada, 21% of medical students indicated having a mental health problem, the most prevalent of which are an anxiety disorder or a depressive disorder [13]. At 81%, the study was the most frequently mentioned cause of stress. According to Peng's systematic review and meta-analysis findings of 201 studies [3], a significant number of medical students suffer from depression (41%), sleep difficulties (52%), psychological discomfort (58%), and other mental health issues, as shown in figure 1[3].

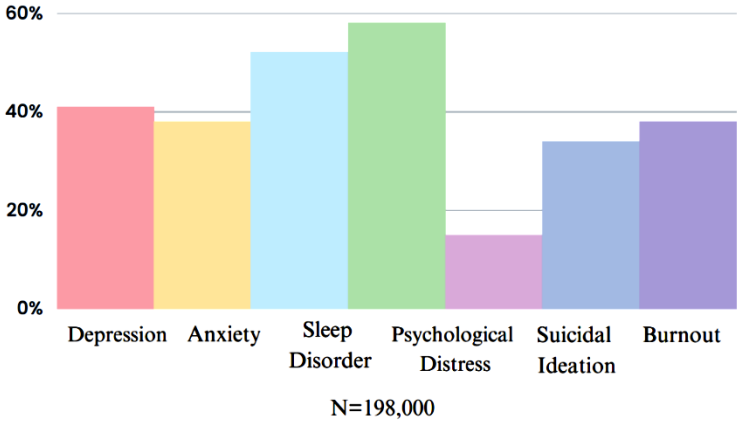

Figure 1: The pooled prevalence of each disease among medical students from 201 studies.

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3. Analysis of Students' Preferences

3.1. Method

3.1.1. Questionnaire Design

The questionnaire was administered to medical students who had studied systematic human anatomy within 5 years, with no restrictions on specialty, age, gender, race, or creed.

In this paper, the main purpose of the questionnaire design is to analyze how differences in Chinese and Canadian educational styles affect medical students' mental health or provide sufficient data for percentages to be computed.

The main subjects of the questionnaire were set as students who intend to study anatomy-related courses (Anatomy-related courses may include but are not limited to forensic pathology, forensic medicine, forensic human identification, forensic anthropology, gross anatomy, clinical anatomy, human anatomy, and forensic toxicology).

The questionnaire questions were thoughtfully created by the authors and focused on the daily activities, academics, and mental state of students who study human anatomy. Among those aspects, the authors selected the students' preference for the delivery method of the anatomy courses, the student's satisfaction with the anatomy course, their own stress value evaluation, and their daily mood after choosing to study anatomy. These aspects are used for regression and other statistical scientific analyses.

3.1.2. Data Collection

The meta-analysis was carried out using STATA and Excel in this paper. The major objective is to investigate the potential influences on anatomy students' pressures using linear regression analysis in order to determine how much of an impact these influences will have going forward (reflected by the value of pressure self-evaluated by students). In order to investigate these issues and variables, the authors employed linear regression.

Trend analysis can be performed using linear regression, which involves fitting a linear line to a series of data points across time. The slope of the line can show whether a trend is rising or falling, and the intercept can show where it originated. Inspecting the residuals will allow the authors to determine how well the linear model fits the data. Additionally, causal analysis can be carried out using linear regression by identifying the relationship between the dependent variable and one or more independent variables. In this case, assuming all other variables are held constant, the slope of the line depicts the change in the dependent variable for a unit change in the independent variable.

This paper used the following linear regression model for analysis:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_i X_i + \varepsilon_i \quad (1)$$

Y_i = Dependent Variable (Outcome)
β_0 = Population Intercept
β_i = Coefficient of Independent Variables (Slope of Y)
X_i = Independent Variables
ε_i = Error Components

The outcome of this model is the students' pressures on self-evaluation. Since there are no additional factors that could impact the pressure value, the minimum pressure level intended for students is 1, hence the Population Intercept is 1. The students' self-stress value feedback, their contentment with the anatomy course, and their emotional evaluation value after deciding to learn

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anatomy are all taken into account in the determination of the students' pressure value. There are five grades for each of the students' self-assessment values (such as stress and contentment values). For the purpose of facilitating machine recognition and regression analysis without compromising the accuracy of the results, the paper separates these five classes into two categories: low values and high values.

The comprehensive definition of students' stress value is made up of 40% of students' self-reported stress, 30% of students' satisfaction with anatomy classes, and 30% of students self-reported mood. The comprehensive definition of students' stress value is made up of 40% of students' self-reported stress, 30% of students' satisfaction with anatomy classes, and 30% of students self-reported mood. This can comprehensively and three-dimensionally portray the magnitude of the students' stress value.

The independent variables are the various types of assignments (final exams, midterm exams, lab activities, weekly quizzes, etc.), the weekly class hours of the students, and the average sleep duration of the students.

In order to more intuitively display the factors that may affect the students' stress value. This article converted all of the data into dummy variables, which are variables that take on the values of 0 or 1 to represent a categorical variable in a regression model.

3.2. Results

Based on data from 1569 surveys, statistics were compiled. There were 812 records of Chinese students and 757 records of Canadian students who were studying or had taken systematic human anatomy, respectively.

3.2.1. Regression Analysis

The authors started by examining how much the format of the course and the high levels of student stress interact. By running regression among three different delivery methods. The following results were generated in Table 1:

Table 1: Regression between stress level and lecture delivery method, including both Chinese and Canadian students.

pressurele~l	Coefficient	Std. err.	t	P> |t|	[95% conf.	interval]
inperson	.5106599	.0285715	17.87	0.000	.4545803	.5667395
online	.4	.0431971	9.26	0.000	.3152135	.4847865
hybrid	.5491892	.030581	17.96	0.000	.4891654	.609213
_cons	3.97e-14	.0276073	0.00	1.000	- .0541872	.0541872

The null hypothesis that there is no association between the predictor variable and the outcome variable is strongly refuted by the available data. A p-value in the regression that is less than 0.015 is seen as being extremely low and is often viewed as providing substantial support for the alternative hypothesis.

The authors then used regression to investigate the effects of various types of assignments, more than 55 hours of lectures a week, and less than 8 hours of sleep on students' stress levels.

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Table 2: Multiple linear regressions between Chinese students' stress levels, sleep duration, lecture time and several assessment types.

			Robust			
cnpressure~l	Coefficient	std,err,	t	P> |t|	[95% conf.	interval]
final	.387296	.0811315	4.77	0.000	.2280519	.5465402
lab	.2210843	.0487765	4.53	0.000	.1253461	.3168224
quiz	.2689314	.0570746	4.71	0.000	.1569059	.3809569
midterm	.2163738	.0627549	3.45	0.001	.093199	.3395486
sleeplack	.038753	.0215387	1.80	0.072	- .0035229	0.0810289
lecbig	.0737455	.0309159	2.39	0.017	.013064	.1344269
_cons	.2275277	.03461	6.57	0.000	.1595955	.2954599

Table 2 shows a positive correlation between the high-stress levels of Chinese students and all independent factors. Among these, the Final Exam has a more pronounced effect on Chinese students' pressure levels. The graph demonstrates that among students studying anatomy, the final exam is the assessment about which they are most anxious.

Run the Regression for Canadian students to determine the element that puts the most pressure on them.

Table 3: Multiple linear regressions on Canadian students and their several types of assessments.

			Robust			
capressure~l	Coefficient	Std. err	t	P> |t|	[95% conf.	interval]
lab	.6827864	.099939	6.83	0.000	.4866276	.8789452
midterm	.3571918	.0648492	5.51	0.000	.2299068	.4844767
final	.3482748	.0450293	7.73	0.000	.259892	.4366577
quiz	.346536	.0496826	6.97	0.000	.2490197	.4440524
_cons	.2928082	.0440687	6.64	0.000	.2063108	.3793056

It is evident that lab activities cause Canadian students the most anxiety and considerably raise their stress levels as we can see in Table 3. Chinese students are more worried about their final examinations than Canadian students, who are much less concerned about the final exams. This may be due to the fact that Canadian institutions substitute unit tests for final examinations.

The impact of sleep length on students' stress levels in China and Canada is the next thing to take into account. Due to "sleep-lack" (students who sleep for fewer than eight hours) having a p-value of approximately 0.042, which is a bit high for the article. Therefore, the authors want to conduct the regression with Pressure Level and Sleep Hours. Below displays the outcome when merely taking the effect of sleep hours into account (the data include both Chinese and North American students). The criteria classify pupils as having "enough sleep" if they get more than 8 hours and classify them as having "lack of sleep" otherwise.

Table 4: Regressions on students' stress levels and the amount of sleep they get, including Chinese and Canadian students.

pressurele~l	Coefficient	Std. err.	t	P> |t|	[95% conf.	interval]
sleeplack	.4342539	.0273782	15.86	0.000	.3805166	.4879912
sleepenough	.4305828	.0304317	14.15	0.000	.3708522	.4903134
_cons	.002	.0263764	3.11	0.002	.0302289	.1337711

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According to Table 4, students who sleep for less than eight hours will experience higher levels of pressure. However, there is no discernible difference in the coefficients for sleep durations of less than 8 hours and more than 8 hours. (0.4342539 and 0.4305828). Therefore, it can be inferred from the Regression result that the amount of sleep a student gets per hour has little bearing on their level of stress.

3.2.2. Possible Bias of the Regression

Based on the linear regression model, the regression result could differ in several ways, such as due to simultaneity bias and omitted variable bias.

Omitted Variables Bias: The authors took into account various forms, of the course's assessments (such as weekly quizzes, midterms, and final exams), sleep time, and weekly course duration in the linear regression model that was utilized this time.

Simultaneity Bias: Lack of sleep might contribute to students' feelings of stress. The students may also experience insufficient sleep and poorer sleep quality as a result of high levels of stress, according to the supplemental questionnaire. Due to the possibility of a feedback loop between the dependent variable and the independent variable, this model may exhibit simultaneous bias when the independent variable is linked with the error term in the regression model.

3.2.3. Summary of the Results

According to the regression results, classroom presentations, assignments, experiments, tests, sleep length, and weekly class hours all affect students' levels of stress, satisfaction with the anatomy course, and mood after learning the subject. To put it another way, these elements might make students feel under pressure to learn anatomy. The result of linear regression can analyze the greatest impact on students' pressure, to improve education methods, help students reduce stress, and ensure the effectiveness and interest of learning.

4. The Way to Improve Anatomy Teaching

4.1. Advanced Research Courses

Comparatively speaking, Chinese students face greater pressure than their Canadian peers to secure research internships because they must simultaneously secure the necessary credits to graduate and seek out research opportunities. Additionally, research experience is crucial for future learning, whether students continue to study or find a job in a laboratory. As a result, it is strongly advised that research courses be provided in undergraduate medical education to ease the burden of research on students and support them in their future academics and careers. However, in order to ensure student quality and lessen the burden on the department or lecturer, applicants must have a minimum GPA of B+. Also, if additional seats are available in the course after all pre-med students have enrolled, the University may open the course to students in other programs who have completed the prerequisites for this course. This allows for a more diverse classroom where students can make friends from different majors and learn together.

4.2. The Duration of the Course

When comparing the length of courses in different countries, there is a difference of at least 8 weeks in the teaching of a systematic human anatomy course. However, the survey's findings revealed that, no matter where they are, a sizable portion of students still lament that it is extremely difficult to retain so much information in such a short time. In China, 38.41% of the 812 medical students surveyed for this article said they would like to extend the duration of the systematic human anatomy

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courses to reduce their stress and learn better. Therefore, depending on the university's schedule, it is highly advised that systematic human anatomy be split into two sections, each lasting one semester, for example, Human Anatomy I and II. Additionally, students are free to choose their own study order, and they are received one credit for each effective section. If students want to challenge themselves, they can enroll in Human Anatomy I and II in the same semester. This plan gives students more time to study and consolidate their knowledge without delaying their program's study plan, which can reduce their stress. The students have the option to select their own speed of study, which enables them to practice their planning skills.

4.3. The Delivery Method

According to the survey findings, 73.58% of Chinese students and 87% of Canadian students preferred all offline human anatomy lectures, including, experiments, tutorials, exams, etc. They believe that going offline will allow them to reduce stress as well as learn anatomy better. Therefore, it is strongly advised to attend lectures and labs in person, but it is more convenient to turn in assignments online.

4.4. Online Learning Tools

Compared to the results of the questionnaires for both countries in this article, a clear majority of students clearly indicated that they would like their universities to provide online animation aids to help them learn anatomy. 62.51% of Chinese students and 65.57% of Canadian students would like to develop online teaching websites or software to help them better understand the human body. Shown in Figure 2.

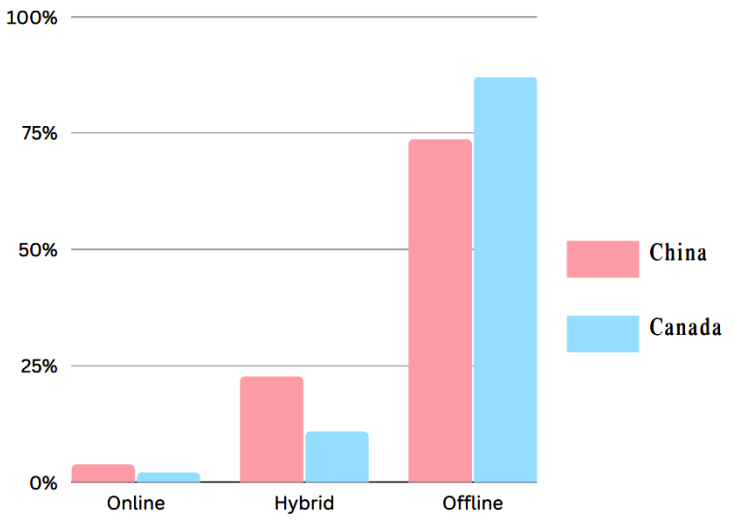

Figure 2: Results of a survey on the preferred delivery method of anatomical teaching for Chinese and Canadian students.

Consequently, it is essential to create online learning resources that are not just confined to 3D models and simulated anatomical procedures. By using similar software to innovate the variety of assignments and increase students' interest in anatomy, for example, these tools not only assist students in comprehending the course material better but also enhance the assessment of the course. This encourages students to learn anatomy effectively while having fun.

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4.5. Assessment

The survey found that 32.84% of Chinese students and 38.74% of Canadian students believed that modifying their human anatomy assessments would help them feel less stressed in addition to offering online learning resources. This includes but is not restricted to, switching from cumulative midterms and finals to non-cumulative unit tests, changing the question types on lab tests and unit tests, and increasing the diversity of assignment types. Shown in Figure 3.

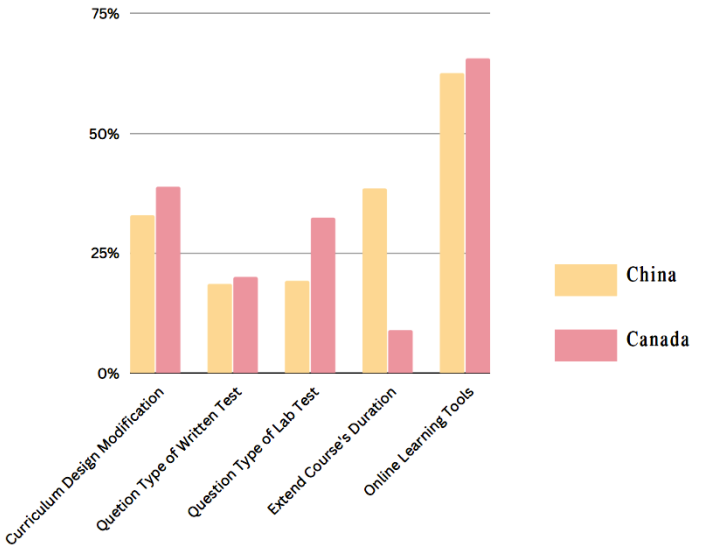

Figure 3: Results of a survey on the preferred adjustment of anatomical teaching for Chinese and Canadian students.

4.5.1. Weekly Quizzes

It is highly recommended that 10% of the course consist of weekly quizzes. Since the purpose of the quizzes is for students to practice, they should be unlimited attempts. The quiz's structure should resemble that of a test, and it may contain multiple-choice, fill-in-the-blank, and matching questions. Additionally, to make it fairer for students and less stressful, the teacher could drop the two lowest quizzes.

4.5.2. Unit Test

80.19% of Chinese students reported they found the final exam to be the most difficult part of the human anatomy course, due to the fact that it accounts for the largest percentage of the final grade, requires so much memorization, and is the most stressful part. Due to the largest portion of course marks being the final exam, the following may happen: The students perform exceptionally well for their lab tests, weekly quizzes, and assignments, but for irresistible reasons, they fail to perform well at the end of the period, and their grades drop qualitatively. This situation actually leads to unfair course grading, so it is strongly recommended here that the midterm and final exams, which are cumulative, be replaced by unit exams, which are not cumulative. Students can have ample time to review, reduce stress, and ensure fairness. To lessen the pressure on students to learn, the sort of questions on the unit tests would only include multiple choices.

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4.5.3. Lab Test

It is evident from the survey findings that students are still anxious about the lab exam, the time constraints, and the challenge of accurately identifying the names and functions of anatomical proper structures. According to the survey findings, 10.21% of Chinese students and 32.3% of Canadian students prefer different types of questions on the lab test, for instance, multiple-choice questions. However, this paper believes that the multiple-choice questions on the laboratory exam cannot ensure that students have completely mastered the necessary material, so it is advised to add experimental manipulation questions to the test. For example, successful dissection of the lunate bone, etc. The most efficient way to learn anatomy is in the lab. By reducing stress, this method successfully guarantees that students have learned about anatomy.

4.5.4. Assignment

The use of online software would enable students to practice the anatomical content practically, improving their comprehension and visualization of body systems. Case analyses, posters, presentations, or other interesting assignments could be done using the software. The diversity of assignments given to students will pique their interest in anatomy and make learning enjoyable and less strenuous.

5. Conclusion

Overall, this article compares the specifics of the teaching strategies, methodologies, and policies for systematic human anatomy at the undergraduate level in Canada and Mainland China that can better comprehend how each specific aspect differs in students' feedback on the benefits and drawbacks of learning anatomical stress, as well as how to enhance it. The paper then examines the relationship between teaching techniques, student stress, and student satisfaction which gain a deeper understanding of the students' perspectives and circumstances, allowing faculty to put students in their position in order to lessen their stress and help them learn anatomy—the most fundamental and crucial medical subject The final section of the article discusses ways to enhance the teaching of the discipline of human anatomy, including but not limited to exam types, course duration, course content, and other elements.

This paper's main drawback is that not all universities in China and Canada participated in the survey, so opinions about anatomy instruction may vary at other institutions. Additionally, it was discovered during the PubMed literature review that only a few studies examined student stress and discussed how to improve the teaching policy of anatomy and that students or professors in each country or even each region have more or less different views on the teaching methods of anatomy, necessitating the need for more in-depth and focused research and experimental studies in the future to make not only systematic human anatomy education but also other medical disciplines.

Finally, the psychological issues that medical students face should receive more focus in schools because studying medicine is so challenging and stressful. Further research may focus on how to develop alternative curriculum designs for medicine to minimize student stress.

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