DEPRESSIVE SYMPTOMS AND SEXUAL HEALTH IN UNIVERSITY STUDENTS:

THE ROLE OF SUBSCALES IN A DEPRESSION SCREENING TOOL

by

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DEDICATION

To my mom, dad, aunt, uncle and friends. Your support makes my successes both possible and worthwhile.

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ABSTRACT

Depressive symptoms have been shown to be associated with sexual risk-taking among young adults; however, whether this association is underpinned by specific types of depressive symptoms has not been examined. Using cross-sectional survey data from undergraduate students attending eight universities in the Maritime Provinces in Canada in 2012, I tested the associations between four depressive symptom subscales (i.e., Negative Affect, Anhedonia, Somatic Symptoms, and Interpersonal Problems) and various sexual risk behaviours (e.g., unprotected sex, having multiple partners) Depressive symptoms in general were associated with many forms of sexual risk-taking among female students, with the association being underpinned by the Anhedonia and Somatic Symptom subscales. There were few associations observed among male students, although Somatic Symptoms were associated with having multiple partners in the past year. Depressive symptom subgroups, established using cluster analysis, were defined entirely by symptom severity, and broadly replicated existing cut-points on the measure used. The findings of this study suggest that the often-observed association between depressive symptoms and sexual risk-taking is attributable to specific symptoms of depression, rather than the overall construct. This discovery has the potential to inform further research attempting to discern the mechanism underlying the association between depressive symptoms and sexual health.

LIST OF ABBREVIATIONS USED

WHO: World Health Organization

STI: Sexually Transmitted Infection

CES-D: Center for Epidemiologic Studies Depression Scale

HIV: Human Immunodeficiency Virus

IP: Internet Provider

MP+CN: More than one partner in the last year and condom non-use at last intercourse

MP+CN+NT: More than one partner in the last year, condom non-use at last intercourse, and never having been tested for sexually transmitted infections

SES: Socioeconomic Status

VIF: Variance Inflation Factor

OR: Odds Ratio

CI: Confidence Interval

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CHAPTER 1: INTRODUCTION

Youth and young adults are the age group most at-risk for sexually transmitted infections in Canada.[1] Sexual risk-taking is relatively common among young adults in Canada; about a third of Canadians aged 15 to 24 years had more than one partner in the past year, and a similar proportion did not use a condom the last time they had sex.[2] Considerable research has examined determinants of sexual risk-taking among young adults both in Canada and internationally, finding that a large number of demographic (e.g., gender, race, and socioeconomic status) and behavioural (e.g., binge drinking, and substance use) characteristics are associated with more frequently engaging in sexual risk behaviours.[3–5]

One of the characteristics associated with sexual risk-taking among young adults is depression and depressive symptoms, where those suffering from a greater number of symptoms are more likely to have unprotected sex and to have sex with a greater number of partners.[3,4] Research to-date has done little to examine potential mechanisms underlying this association. One method of elaborating on current knowledge is to examine the effects of specific symptoms of depression as measured by subscales. This approach has been used to examine associations between depressive symptoms and a wide array of non-sexual health behaviours and outcomes, but has yet to be applied in a study examining sexual risk-taking.

In the current study, I use data from a sample of undergraduate students in the Maritime Provinces of Canada to answer the following research questions:

1) Are subscales of depressive symptoms associated with sexual risk behaviours?
2) Can individuals be grouped according to depressive symptom profiles, and are these profiles associated with sexual risk behaviours?
3) Are there sex differences in the nature of observed groups?

Participating students' characteristics were reported, stratified by sex. Several logistic regression models were conducted in order to determine whether depressive symptom

subscales were associated with various forms of sexual risk-taking (e.g., condom non-use at last intercourse, having more than one partner in the last year, and lack of testing for sexually transmitted infections) both before and after controlling for potential confounders. Cluster analysis was used to group students based on their unique profiles of depressive symptoms. By determining whether individual depressive symptoms are associated with sexual risk-taking, we gain the ability to generate hypotheses about potential mechanisms underlying the well-documented association between depression and sexual risk behaviours.

CHAPTER 2. BACKGROUND

2.1 Depression

Depression is a mood disorder characterized by prolonged periods of sadness, despair, and social isolation. Many Canadians suffer from depression. Over the course of their lives, 11.3% of Canadians will have at least one episode of major depression.[5] Experiencing depression is not uniform across the sexes; 4.9% of Canadian women experience an episode of major depression each year, compared to 2.8% of men.[5] These rates appear to be largely stable over time in Canada.[6] Mental illness, of which depression is one of the most common diagnoses, represents a substantial cost-driver within the healthcare system.[7] Annually mental illness generates nearly five billion dollars in direct healthcare costs (e.g., via hospitalizations) and nearly $45 billion in indirect costs (e.g., lost worker productivity) in Canada.[8] However, the consequences of depression are not limited to its symptoms or direct hospitalizations. Depression is a known risk factor for a wide variety of health compromising behaviours and negative health outcomes.

Past research has shown depression to be a risk factor or correlate for a litany of health behaviours and outcomes. Suicidal behaviours are probably the most severe and commonly thought of consequence of depression.[9] Persons with depression are also more likely to smoke heavily,[10] drink frequently and to excess,[11] use marijuana frequently,[12] and to use a wide variety of controlled substances.[5,13] As would be expected, depressed individuals are also more likely to engage in dangerous substance use related behaviours, such as driving under the influence.[14]

Beyond substance use, depression is associated with a general failure to engage in health promoting behaviours or to comply with treatment once in care. For example, depressive patients with cardiovascular disease are less likely to comply with prescribed treatments.[15] Additionally, depression is associated with a heightened perception of health risk; persons with depression perceive themselves as being at a greater risk of cardiovascular disease,[16] and lung[17] and breast cancer.[18] This higher level of perceived risk extends to being more likely to attribute health hazards to innocuous environmental elements, such as cell phone towers.[19] Thus, depression and symptoms

of depression substantially increase the health burdens of those affected in and above the direct effects of the disorder itself.

2.1.1 Among Youth

As noted earlier, the prevalence of depression is not evenly distributed throughout the population. In addition to varying across sex, depression is more prevalent in some age groups. In particular, rates of depression in Canada are highest among younger populations; 5% of Canadians 15 to 25 years of age experience an episode of depression each year, compared to 4.5% of 26 to 45 year olds and 3.7% of 46 to 65 year olds.[6] As would be expected based on the associations observed among adults, depression is correlated with risk-taking activities and poor health among youth and young adults.[11–13]

2.2 Sexual Health

The World Health Organization (WHO) defines sexual health in positive terms (i.e., physical, emotional, mental and social well-being), rather than the absence of disease or other impairments in sexual functioning.[20] As with depression, sexual health represents a major concern for youth and young adults. Many young adults have unprotected sex and sex outside of committed relationships and, as a result, this age group experiences the highest prevalence of sexually transmitted infections (STIs) and unwanted pregnancy of any in Canada.[1] This makes understanding the sexual health of youth and young adults particularly important.

2.2.1 Sexual Risk Behaviours

Sexual risk behaviours (e.g., lack of contraception, condom non-use, multiple partners, and lack of routine STI testing), are prevalent among youths and young adults in Canada. According to a national probability survey of Canadians in 2009/2010, 32.5% of sexually active 15 to 24 year olds had more than one partner in the past year, and 32.1% did not use a condom the last time they had sex.[2] Sexual risk behaviours among young Canadians varied substantially across sub-groups of age; 20 to 24 year olds were less likely than 15 to 17 year olds to have had more than one partner in the past year (30.0% vs. 34.7%), but more likely to report condom non-use at last intercourse (37.2% vs. 20.1%).[2] Neither condom non-use nor having more than one partner in the past year

were higher in the Maritime Provinces than in Canada as a whole when comparing across all age groups.[2]

By Grade 12, nearly 70% of high school students in the province of Nova Scotia are sexually active.[21] Of these sexually active students in the same province, surveys suggest that only little more than half used a condom at last intercourse (somewhat higher than the national survey described above), and 43.2% had more than one sexual partner in the past year. Likewise, sex under the influence of alcohol or other substances is relatively common (32.1% of sexually active students in the past year).[21]

Risk behaviours are also highly prevalent among university students. In a survey of over 75,000 North American (United States and Canada) university students, 39% had more than one sexual partner in the past year, and 45% did not use a condom the last time they had sex.[22] Data on Canadian university students' sexual risk behaviours is much more limited; however, a study of the Canadian sub-sample of the survey mentioned above noted that 12% of students had unprotected sex due to intoxication in the past month.[23] In a probability sample of over 6,000 full-time undergraduate students in Canada, alcohol-related sexual risk behaviours were prevalent among respondents: 14.1% had unplanned sex due to alcohol, and 6.0% had unsafe sex due to alcohol since the beginning of the current school year.[24]

2.2.2 Sexual Health Outcomes

As would be predicted based on the prevalence of risk behaviours detailed above, negative sexual health outcomes are present among a large number of Canadian youth and young adults. The highest rates of STIs observed in Canada are among those aged 20-24 years; this is followed by those aged 15-19, and then those aged 25-29.[25] The number of reported cases of STIs in Canada has been increasing in recent years. Rates of chlamydia, the most commonly diagnosed STI in Canada, increased by 72% between 2001 (161.4 cases per 100,000 population) and 2010 (277.6 cases per 100,000 population). During this period, the prevalence of chlamydia increased among young adult women by 62% to 2005.5 cases per 100,000, and by 80% among young adult men to 961.8 per 100,000.[1] This increase in the prevalence of STIs may contribute substantially to burden of disease going forward, and a history of STIs can increase the risk of pelvic inflammatory disease and ectopic pregnancies in the future.[26] In addition

to STIs and their consequences, sexual risk behaviours can increase the chances of unwanted pregnancy, which are most prevalent in Canada among youths and young adults.[1,27]

2.2.3 Risk Factors for Poor Sexual Health

Given the importance of understanding youth sexual health and the context in which sexual risk behaviours occur, a considerable amount of research has been conducted with the goal of identifying key correlates for both sexual risk behaviours and negative sexual health outcomes. Social background factors have substantial effects on the sexual health of young adults. The economic context of youths is known to be associated with poorer youth sexual health; teens from low-income family backgrounds are more likely to be sexually active,[28] to have unprotected sex,[29] and to become pregnant during adolescence.[30] Likewise, the home context in which youths live can affect their likelihood of engaging in sexual risk behaviours. Youths from single-parent homes are more likely to be sexually active and to engage in other sexual risk behaviours.[4]

Individual factors are also important to consider when attempting to screen for or predict sexual health risks among youths. Numerous behaviours, such as alcohol or substance use, are known to be associated with sexual risk-taking behaviours. College students with poor academic performance are more likely than their peers to have unprotected sex and to have casual sex outside of a committed relationship.[31] Attributes such as racial or ethnic background can play a substantial role in influencing university students' likelihood of engaging in sexual risk behaviours.[31]

A past history of sexual risk behaviours is, itself, a risk factor for ongoing threats to sexual health. For instance, early age of sexual debut is known to be associated with engaging in numerous sexual risk behaviours during adolescence, and engaging in sexual risk behaviours during high school predicts having unprotected sex, sex outside of a committed relationship, and engaging in unprotected sex with casual partners during university.[31] One possibility is that the effect of early debut is attributable to an underlying individual-level trait, such as impulsivity or sensation seeking, which also predisposes youth to subsequent sexual risk behaviours. Thus, many background and behavioural characteristics can affect youths' sexual health.

2.2.4 Depression and Sexual Health

Depression has received considerable empirical attention as a correlate of risky sexual health behaviours and negative sexual health outcomes. Adolescents with depression are more likely to perceive themselves as being at risk for STIs and pregnancy.[32] Several studies in Canada and other countries suggests that the belief is justified. For example, among a convenience sample of adults presenting to a sexual health clinic in Baltimore, Maryland, over half of women and nearly a third of men screened positive for having 'probable depression' by a self-report screening measure, rates much higher than would be expected from the general public.[33] In a survey of adolescent (14 to 19 years of age) and young adult women (20 to 25 years of age) in clinical settings in Pennsylvania, adolescents (but not adults) with high scores on a screening measure of depression were twice as likely to have two or more partners in the past year, half as likely to report always using a condom during sex, and those using condoms were twice as likely to have experienced problems using them correctly. Similarly, adolescents scoring high on a screening measure of depression were nearly twice as likely to have a past history of STI diagnosis, as well as twice as likely to currently have a diagnosed STI.[34] In a sample of adolescent and young adult STI clinic outpatients in committed relationships across multiple health centres in the United States, dyads with at least one depressed partner were more likely to engage in sexual risk behaviours in the past month (e.g., heavy substance use before sex); all dyads where both partners were depressed engaged in heavy substance use before sex in the past month.[35] Likewise, in a survey of 353 college students in the United States, psychological distress, a construct which includes depression and anxiety, was moderately positively correlated with self-reported current number of sexual partners (i.e., greater psychological distress was associated with having more current sexual partners), but was not associated with self-reported frequency of having sex without a condom.[36] Beyond this, relatively little work has been done examining the association between depression or related constructs and sexual health among university students.

Studies using clinical diagnoses for depression instead of screening measures for the disorder have reported similar results. In a survey comparing clinically depressed African American adolescent women (sampled from outpatient mental health treatment

programs) and a convenience sample of non-depressed, demographically similar women from the community, the depressed participants were more likely to be sexually active and to engage in high-risk sex (i.e., younger age at sexual debut, greater number of sexual partners in the past three months, and a larger number of lifetime unprotected sexual partners).[37] Despite this elevated level of risk-taking, the women with clinical depression were no more likely to have ever been tested for STIs than the non-depressed comparison group.[37]

Research in Canada examining the association between depressive symptoms and sexual health has generally revealed similar findings. One survey of nearly 2,300 high school students in central Nova Scotia, Canada found that high scores on a screening measure for depression were associated with contraception non-use among girls, having more than one partner in the past year among boys, and having unplanned sex due to alcohol or substance use among students of both sexes.[4] In a separate survey of nearly 900 northern Nova Scotia high school students, depression screening measure scores were associated with engaging in a greater number of sexual risk behaviours.[3] Finally, in a national, representative sample of Canadians aged 15 to 49 years, self-reported depression symptoms were associated with a near tripling of the risk of having a self-reported history of STIs. Interestingly, this association was observed in the younger study participants (34 years or younger), but not older respondents.[38]

There are several potential causal pathways between depressive symptoms and sexual risk-taking. One most frequently considered paths considered, at least implicitly, is that depression causes sexual risk-taking.[4,39] Conversely (or additionally), it could be the case that sexual risk-taking causes depressive symptoms, for instance by increasing social stigma or the experience of symptoms related to STIs.[40] It might also be the case that the association found in the literature is spurious, and ultimately explained by some unknown third variable.

Longitudinal research on the topic suggests that the association between depression and sexual risk-taking is bi-directional in nature. In numerous studies, depressive symptoms predict sexual risk behaviours in the future.[41–45] This association is present even when adjusting for the effects of baseline sexual risk-taking.[42] Conversely, several studies have reported that prior sexual risk behaviours predict later

depressive symptoms.[46] The best evidence in support of the causal pathway between depressive symptoms and sexual risk behaviours can be found from a natural experiment from an ongoing longitudinal study of teenagers in the United States. In this study, a cycle of routine data collection occurred both immediately before and after the September 11, 2001 terrorist attacks, allowing researchers to measure increases in resulting depressive symptoms as well as determine its effects on sexual risk behaviours. Ultimately, self-reported depressive symptoms were found to predict frequency of engaging in vaginal sex and being less likely to use condoms during sex.[39]

As can be seen from the literature reviewed above, there is a robust association between depression, assessed either by clinical diagnosis or screening tools, and both engaging in sexual risk-taking and experiencing negative sexual health outcomes. However, past research has not examined why this might be the case. There is some evidence that depression is associated with reduced self-efficacy (i.e., individuals with high levels of depression may be less likely to believe themselves capable of acting to protect or improve their own health).[47] In past investigations, depressive symptoms have been treated as a single construct rather than a disorder representing numerous clusters of varied symptoms. How these symptoms are quantified and ultimately used in examining the association between depression and sexual health depends strongly on how depression is measured across studies.

2.3 Measuring Depression

An enormous amount of research has been conducted examining depression's prevalence, correlates, and amenability to a wide variety of treatments. Across studies, depression has been operationalized and measured in many different ways. Due to the time and resource costs of clinically diagnosing large numbers of study participants (i.e., performing a formal diagnosis requires that patients spend considerable time with a trained clinician), many investigators rely instead either on clinical checklists or self-report measures of depressive symptoms to assess individuals' current level of depressive symptoms (risk state) or risk for depression (risk trait). Many such self-report measures have been developed over decades of depression research; however, a few have been become commonly used.[48]

2.3.1 Screening Measures for Depression

In recent years, the *Center for Epidemiologic Studies – Depression Scale (CES-D)* has become one of the most popular and commonly used measures of depressive symptoms in social science and public health research.[49] The 20-item self-report scale asks respondents to rate how frequently a series of depressive symptoms (e.g., "I had crying spells", "I thought my life had been a failure") have been present for them over the course of the past week. Responses for each item are coded on a scale from zero ("rarely or none of the time (less than one day)") to three ("most or all of the time (5-7 days)"), allowing a range of scores from 0 to 60. Most, but not all, of the items on the original CES-D were designed to map on to specific symptoms of depression, as assessed by the Diagnostic and Statistical Manual.[50]

One of the ways in which self-report screening measures such as the CES-D have been evaluated has been to examine their factor structure. For a given set of questions, unobserved variables (referred to as factors or subscales) can affect participant responses to sub-groups of items, often corresponding to theoretically meaningful constructs (e.g., indicators of depression). The factor structure of the CES-D has been examined numerous times, but remains a matter of some debate.[48,49,51] One meta-analysis of studies examining the factor structure of the CES-D concluded that a four-factor model (the one originally observed during the instrument's development) best fit the data. The four factors have been given the descriptors Negative Affect, Anhedonia (or the absence of Positive Affect), Somatic Symptoms, and Interpersonal Problems (see Table 1 for a breakdown of factor loadings).[48] Another recent review of factor analysis studies of the CES-D reported that 40% of studies found a four-factor model, 20% a three-factor model, 15% a two-factor model, and 24% a one-factor model. Using confirmatory factor analysis to fit the previously described models to novel data, the authors of the meta-analysis concluded that a three-factor model best fit their data: Somatic Symptoms (e.g., experiencing loss of appetite or trouble concentrating), Negative Affect (e.g., feeling sad, feeling depressed, or having crying spells), and Anhedonia (e.g., not feeling happy, not having hope for the future); however, the observed model was nearly identical to the traditional four-factor model (see Table 1, Figure 1), differing essentially by excluding items measuring the Interpersonal Problems (e.g., feeling that people disliked the

respondent) factor.[51] Scores within factors can be calculated, generating subscale scores measuring various indicators of depressive symptoms.

In recent years, a 12-item short-form version of the CES-D has been tested and used in numerous surveys, commonly referred to as the CES-D-12.[50] This shortened version of the original CES-D was designed to allow for faster evaluation of individuals' level of depressive symptoms, and has been shown to have psychometric qualities similar to the original scale.[50] Each of the four factors observed during the development of the original scale (see above as well as Table 1) are represented on the 12-item version by at least one item.

2.3.2 Depressive Symptom Subscales as Risk Factors

Several past studies have examined associations between CES-D subscale scores and various health behaviours. In a survey on smoking and weight, current and former smokers scored higher on all subscales of the CES-D, except for the Interpersonal Problems factor.[52] In a sample of over 6,800 middle-aged workers in Japan, high Negative Affect scores were associated with increased suicidal ideation among both men and women who scored high in depressive symptoms overall. Scores on the Interpersonal Problems subscale were associated with suicidal ideation among men but not women.[53]

Some previous research has examined the association between subscales on the CES-D and health outcomes as well. In a community sample of adult women in New Zealand, participants self-reporting poor health had higher scores on the Negative Affect, Anhedonia, and Somatic Symptoms, but not Interpersonal Problems.[54] Among HIV-positive participants in a prospective study in San Francisco, Anhedonia scores predicted increased mortality after 12 months, whereas other subscale scores did not.[55] Scores on a combined Negative Affect/Somatic Symptoms subscale were associated with cardiovascular disease even after adjusting for known predictors of that outcome; neither Anhedonia nor Interpersonal Problems scores was associated with cardiovascular disease.[56] Similarly, scores on the Negative Affect and Somatic Symptoms subscales both predict increases in white matter lesion volume over time among the elderly.[57] Finally, in an investigation of over 600 men and women in China and Boston (the latter having immigrated from China), Negative Affect and Somatic Symptom subscale scores were associated with a wide variety of chronic health conditions and problems (e.g., heart

problems, lung/breathing problems, walking problems, etc.), as well as health behaviours (e.g., exercising less, requiring more help for daily living, contacting friends less frequently).[58] To date, there has been no investigation into the association between depressive symptom subscales and sexual health.

2.3.3 Depressive Symptom Profiles as Risk Factors

The existence of clusters of depressive symptomology (or depressive symptom subscales in the case of self-report screening measures) makes possible the measurement of profiles of depressive symptoms across individuals. That is, rather than a continuum based on overall number of symptoms endorsed, individuals may be grouped based on the extent to which they report specific clusters of symptoms. As an example, an observable group of individuals may exhibit elevated Somatic Symptoms, but not elevated Negative Affect, Anhedonia or Interpersonal Problems. Such a group may not have high overall CES-D scores, but might be at heightened risk nonetheless.

A systematic review of ten studies examining subtypes of major depression [59] reported that the vast majority of studies identified subgroups based on symptom severity, rather than unique symptom profiles. Among studies deviating from this trend, a subtype of depressed individuals who experienced predominantly Somatic Symptoms related to depression (e.g., weight gain/loss, trouble sleeping) was identified.[59]

To date, very little research has examined subgroups, or clusters, based on depressive symptom subscale profiles on the CES-D, although those that typically find that, as with major depression, subgroups differ primarily in terms of symptom severity. In a longitudinal study of seniors diagnosed with major depression in the United States, latent class analysis revealed four groups of patients, which were distinguished by the severity of symptoms experienced.[60] In a later study examining older adults in the community, the same investigators found three groups: one defined by low overall depressive symptoms, one by elevated Negative Affect and Somatic Symptom scores, and one defined by high levels of all depressive symptoms.[61] In a study examining depressive symptoms among both adolescents and older adults in Mexico City, four groups, differentiated in terms of symptom severity, were identified using latent class analysis.[62] Finally, in a recent study of cancer patients seeking psychological care in

the Netherlands, investigators reported that patients could be clustered into three severity-based groups.[63]

2.4 Limitations of Past Research

Previous research examining the association between depressive symptoms and sexual health has suffered from a lack of specificity by treating depressive symptoms as a uniform construct, rather than as a collection of related but theoretically distinct symptoms. As a result, past examinations of this association have been largely atheoretical in nature; while the literature to date allows us to be relatively certain that there is an association between depressive symptoms and various aspects of sexual health (e.g., unprotected sex, lack of testing for STIs), it has done little to advance our understanding as to why such an association might exist. Past research suggests that examining the subscales of depressive symptoms can reveal differential associations with various health outcomes.

In terms of identifying typologies of depressive symptoms, much of the existing literature has been limited to clinical populations with diagnosed depression or symptoms sufficiently severe to elicit help-seeking from mental health professionals. Additionally, no research to date has examined whether typologies based on depressive symptoms differ according to sex.

This study addresses these limitations by:

1. Relating each of the depressive symptom subscales (i.e., Negative Affect, Anhedonia, Somatic Symptoms, and Interpersonal Problems) to sexual health behaviours.
2. Controlling for potential confounders when examining these relationships.
3. Establishing subgroups of based on depressive symptom profiles and relating them to sexual health behaviours and outcomes.

The purpose of this study is to address, using online survey data from university students in Maritime Canada, answers to the following research questions:

1. Are subscales of depressive symptoms associated with sexual risk behaviours?
2. Can individuals be grouped according to depressive symptom profiles, and are these profiles associated with sexual risk behaviours?
3. Are there sex differences in the nature of observed profiles?

2.5 Hypotheses

Given the literature relating depressive symptoms subscales and individual health behaviours and outcomes, as well as past literature on sexual health, some hypotheses can be offered even in the absence of literature directly testing such associations. First, past research has identified Negative Affect as a potential pathway to perceived likelihood of having sex with poorly known partners among college women.[64] This finding suggests that women with high levels of Negative Affect will be more likely to have had more than one partner in the past year. Second, Somatic Symptoms have been shown to be related to self-reported poor physical health.[58] In this study, this may manifest as respondents with high levels of Somatic Symptoms being more likely to access health services and, subsequently to have been tested for STIs while at university. Third and finally, an association between Anhedonia (or the absence of Positive Affect) and health outcomes has been observed in the literature;[55] one explanation offered by the authors of this study is that high-Anhedonia individuals, being pessimistic, ignore health-related information and engage in health-compromising behaviours.[55,65] This would lead to the prediction that high Anhedonia scores will be associated with engaging in a wide variety of behaviours with clear potential for negative health impacts (e.g., condom and/or contraception non-use, and lack of STI testing).

In terms of empirically derived subgroups based on depressive symptom profiles, the literature to date using the CES-D suggests that a relatively small number of clusters (two to five) will be observed, and that they will vary primarily in terms of symptom

severity. As no previous studies have examined CES-D subgroups as a function of sex (i.e., males and females), analyses will be conducted on an exploratory basis.

CHAPTER 3: METHODS

3.1 Research Design and Rationale

All data in the present study was collected via a cross-sectional survey administered to undergraduate students in eight universities in 2012 in the three Maritime Provinces: New Brunswick (University of New Brunswick), Nova Scotia (Dalhousie University, Saint Mary's University, Mount Saint Vincent University, Acadia University, Saint Francis Xavier University, and Cape Breton University), and Prince Edward Island (University of Prince Edward Island). Collectively, these schools represent approximately 81.4% of all university students enrolled in the Maritime Provinces. Survey respondents were asked about a wide variety of topics, including demographic characteristics, current and past health status and related risk behaviours, sexual health knowledge, and use of university and other health services.

The survey was cross-sectional in nature, a one-time sampling of undergraduate students in the fall of 2012. This design allows for the description of depressive symptoms and sexual risk behaviours, and the association between the two; however, it does not permit the establishment of a causal relationship due to the inability to determine the temporality of the symptoms versus sexual risk behaviours.

3.2 Sampling and Recruitment

The available population for the proposed study is all undergraduate students at the participating universities in the fall of 2012. All of the universities were majority English-speaking. Students were recruited through their university registrar's listserver via an email sent to the all current undergraduate students. All undergraduate students were invited to participate in the survey. Because not all students chose participate, this study utilizes convenience samples of students.

The analytic sample was a subset of the full sample described above. Analyses were limited to respondents indicating their sex as being either male or female and who were under the age of 30 years. The analysis was further restricted to participants with data on all variables of interest (described below).

3.3 Survey Content, Development and Administration

3.3.1 The Survey

The survey included primarily multiple choice questions derived from piloted and well-validated self-report instruments used in prior studies; additional items were added based on feedback following pre-testing of the survey. The survey asked participants about a wide array of subjects, including: demographic details, health and health knowledge, health behaviours, and use of university health services. The survey took approximately 20-25 minutes to complete (see Appendix C).

3.3.2 Survey Development

The content of the survey was developed with aid from a Nova Scotia Health Research Foundation operating grant in 2009 and 2010. The original content for the survey was revised based on feedback collected from focus groups of undergraduate students held at two universities within the sampling frame: Dalhousie University (Halifax, Nova Scotia) and Acadia University (Wolfville, Nova Scotia). Individual items in the original survey included validated scales and measures with acceptable psychometric properties (e.g., internal consistency and/or test-retest reliability) as established previously in adolescents in Nova Scotia.[66] Some untested items were included in the survey in order to explore topics not covered by previous surveys but identified as important by the undergraduate student focus groups. This survey was pilot tested online with a sample of 220 undergraduate students at Dalhousie and Acadia Universities in order to elicit feedback on ease of completion and additional desired content. Anonymity of pilot test participants (as well as participants in the main survey) was retained, as directly identifying information was not requested from survey respondents.

3.3.3 Survey Administration and Consent to Participate

The main survey was administered via an online service hosted by Dalhousie University and known as Opinio, which collected and temporarily stored the data until the survey was closed and the data were transferred to the research team. Opinio is a commonly-used, research service that complies with ethical guidelines concerning the maintenance of security and the privacy of participant responses.

The survey was advertised and made available to students in the participating universities in the fall of 2012, first to students at Dalhousie University (September 2012) and then to students in all of the seven remaining universities (October and November of 2012). A modified Dillman approach was employed, wherein students were advised (via their university email system) that the survey was available, and then reminded a week later of their eligibility to complete the survey.[67] The survey concluded at the end of November 2012.

Before completing the survey, respondents read an online information page and gave their consent to participate in the study after being (broadly) made aware of its contents. The consent form met the ethical standards of the Tri-Council Policy Statement (2nd Edition): Ethical Conduct for Research Involving Humans.[68] Participants were restricted from participating more than once via a feature of Opinio that recognizes participants' internet provider (IP) address and blocks repeated participation. An incentive for participation was offered in the form of participants being anonymously eligible to win an iPad via a random draw, with separate draws being conducted at each of the participating universities.

3.3.4 Survey Response Rate

The overall response rate was 20.4%. It was somewhat lower than was expected by the research team, and ultimately about half of what is commonly achieved by web-based surveys, according to one meta-analysis.[69] The response rate was substantially lower for men (17.4%) than for women (30.8%). This level of non-response and its potential for introducing bias is discussed in greater detail below.

3.4 Variables of Interest and Measurement Properties

3.4.1 Outcome Variables

Aspects of sexual health were the outcomes of interest in the study. Six outcome variables were used: 1) more than one sexual partner in the past year, 2) condom non-use at last intercourse, 3) more than one partner in the past year and condom non-use at last intercourse (denoted by MP+CN throughout this document), 4) lack of STI-testing, and 5) lack of STI testing and engaging in unprotected sex while having had multiple partners in the past year (denoted by MP+CN+NT). An additional outcome, 6) non-use of any effective form of contraception at last intercourse, was examined among women.

Participants were asked their number of past sexual partners with the item, "*In the past 12 months, how many people have you had vaginal sex with?*" Condom non-use at last vaginal sex was assessed by asking, "*Did you or your partner use a condom the last time you had heterosexual vaginal intercourse?*" Testing for STIs was assessed using the items, "*Have you ever seen a health professional in order to obtain the following services? If you answer 'Yes' for a particular service, please indicate the location where you access that service.*" with "STI testing" being one of the services able to be selected. Among women, use of any effective form of contraception at last intercourse was assessed by combining the survey item about condom use at last intercourse (see above) and the related item asking, *"Which of the following forms of contraception did you and/or your partner use the last time you had heterosexual vaginal intercourse?"* Among the options listed were a series of effective forms of contraception (i.e., oral contraception, intrauterine devices, Depo-Provera, or the contraceptive patch). This variable was limited to female participants on the assumption that male students would not reliably know whether or not their partner was using an inconspicuous form of contraception at the time of last intercourse (e.g., the contraceptive pill).

3.4.2 Main Exposure Variable

The main independent variable of interest for this study was individuals' self-reported depressive symptom subscale scores, as measured by the 12-item version of the CES-D. As noted previously, the full, 20-item version of the CES-D is one of the most commonly used screening measures for depression symptomology in general population samples.[51] As with the original version, the CES-D-12 has demonstrated excellent internal consistency ($\alpha = 0.85$ in this sample) and is able to accurately discriminate between those potentially requiring help for depression and those not.[50] In this study, I examined the four subscales observed in the literature: Negative Affect ($\alpha = 0.80$), Anhedonia ($\alpha = 0.73$), Somatic Symptoms ($\alpha = 0.65$), and Interpersonal Problems (α cannot be calculated as this subscale is comprised of a single item).[49,51] Individual levels of depressive symptoms, as measured by the CES-D-12, were analyzed using total scores on the scale standardized within each sex. Subscale scores based on the four factor model observed in the literature (see Table 1)[48,49,51] were calculated by adding

together scores for each of the individual items loading onto each of the subscales, creating four scores representing each of the subscales observed in the literature. Each item was weighted equally when creating subscale scores. Standardized scores were calculated for each sex, so as to allow for greater ease of interpretation during analysis and more appropriate use during cluster analysis. Missing values on CES-D-12 items were coded as zeroes, and sensitivity analyses excluding participants missing any item on the scale were conducted.

3.4.3 Potential Confounders

The survey asked respondents about a wide array of topics, providing source of information about potential confounders. Variables were considered as potential confounders if known to be associated with both sexual health behaviours as well as depressive symptoms in the literature.

Age: As noted earlier, the prevalence of both depression[6] and STIs[1] vary according to age. Indeed, several studies have shown that the association between depression and sexual health outcomes appears to be primarily among younger subgroups.[38] In the survey, participants were asked to state their current age in years. The responses to this question were converted to numeric values in years where necessary. For instance, if a participant entered their birth year, this was calculated by subtracting the birth year data was collected (2012). Age was analyzed as a continuous variable in the present research.

Sex: Past research has frequently,[4] but not consistently,[3] found significant sex differences in terms of sexual risk behaviours. At the same time, women consistently report higher levels of depression than do men.[51] In the present study, sex was measured using a simple multiple choice item, where participants had the option of selecting ‘male’, ‘female’, ‘transgender’, or ‘other’, with the latter option providing a space to specify what is meant. For the purposes of the present study, analysis was limited to respondents who indicated their sex as being either ‘male’ or ‘female’ due to the limited number of respondents in the other categories.

Race: Past studies have shown that sexual risk behaviours can vary based on respondents' race.[70] In the present study, race was assessed using a check box option system, wherein respondents could choose one or several racial backgrounds that applied to them. The options presented were: White (Caucasian), African descent, Aboriginal, Asian, Middle Eastern, and Other. For the purposes of the present study, each of these groups were represented in analyses, in addition to a group comprised of students reporting multiple racial backgrounds. White students served as the reference group in analyses.

***Socioeconomic Status (SES)*:** Lower economic status is associated with both depression[71] and sexual risk behaviours.[72] Participants in the present study were asked how wealthy they perceived their family as being, and given five options from which to choose the most appropriate answer (very wealthy, quite wealthy, average, not so wealthy, not wealthy at all). Participants in the 'not at all wealthy' category served as the referent group in analyses.

Living Arrangement: As noted in the literature review above, current living situation is strongly associated with the tendency to engage in sexual risk-taking.[3,4] In the present study, participants were asked with whom they lived, and given four options from which to select: living alone, living with one or both of their parents, living with a partner (i.e., sexual or romantic partner/boyfriend or girlfriend), or living with a roommate(s) without any kind of sexual relationship. Participants currently living alone served as the reference group in analyses.

Marijuana Use: Heavy use of marijuana is known to be associated with sexual risk behaviours.[4] In the present study, marijuana use was measured using a multiple choice item asking about marijuana use in the past 30 days, with six options available to participants: zero times, one or two times, three to nine times, 10-19 times, 20-39 times, and 40 times or more. For the purposes of the present study, participants using marijuana three or more times in the past month were categorized as heavy users, while those using it only two times or less in the past month served as the reference group in analyses.

Alcohol Use/Binge Drinking: Like marijuana use, heavy alcohol use (particularly in the case of binge drinking) is known to be strongly associated with sexual risk-taking.[3,4]. In the present study, participants were asked how often in the past 30 days they had engaged in binge drinking (consumed five or more drinks in a single setting). The available options were: zero days, one day, two days, three to five days, six to nine days, 10-19 days, and 20 days or more. For the purposes of the present study, respondents' binge drinking three or more days in the past month and those binge drinking one or two days in the past month were compared to those who had not engaged in binge drinking in the past month.

Forced Sex: Past research has identified the experience of forced sex or sexual violence as a predictor of future sexual risk behaviours and negative sexual health outcomes.[70] In the present study, students were asked whether they had, *"Since coming to university have you ever been forced to have sex of any type against your will?"* Those responding positively to the question were categorized as having experienced forced sex. Participants who have not experienced forced sex served as the reference group in analyses.

***Sexual Orientation*:** Past research has shown that sexual minorities are more likely to be depressed than are heterosexuals,[73] as well as more likely to engage in sexual risk behaviours.[74] In this survey, sexual orientation was measured with an item asking participants to which sex they were attracted, ranging from 100% heterosexual to 100% homosexual, with a total of seven options (including 'transgender' and 'not sure'). Participants were categorized as being heterosexual (100% or mostly heterosexual), homosexual (100% homosexual or mostly homosexual), bisexual (attracted to both males and females) and other (all other options).

3.5 Statistical Analyses

The data for this study were analyzed using Stata Version 13,[75] which allows for the application of sampling weights as well as the adjustment of standard errors for correlated errors within individual sampling frames (i.e., within each university). Population weights have been created using known proportions (based on university

administrative records) of students' age, sex, and university. All analyses were weighted, save for the cluster analysis, which is a sorting algorithm rather than a modeling technique and therefore can't be weighted.

Weighted and unweighted descriptive statistics (means and proportions) were calculated. Due to the potential for multicollinearity among depressive symptom subscale scores, diagnostic tests in the form of Pearson correlations and variance inflation factor (VIF) statistics were used to determine whether multicollinearity was present among the CES-D-12 subscales. The VIF statistic is a measure of the extent to which scores on one subscale can be predicted using scores on the other three subscales. In this study, a VIF of ten or more was considered evidence of excessive multicollinearity.[76]

To address the first research question, unadjusted associations between each of the subscale scores and each outcome variable were tested using weighted binary logistic regression models. In these models, linearity was assessed by visual inspection of locally weighted regression plots and non-linear effects were not observed. The initial unadjusted regression models were then adjusted for potential confounders. A third set of regression models were conducted including all of the subscales, but without the potential confounders. A final set of regressions were conducted including all of the subscale scores as regressors for each of the outcomes along with each of the potential confounders mentioned previously. For comparison, the associations between total CES-D-12 scores and sexual risk behaviour were assessed. All analyses were stratified by participant sex, save for the analysis of effective contraception non-use, which was limited to females.

In order to address the second research question to determine whether there are identifiable profiles of depressive symptoms, cluster analysis was conducted, stratified by sex. Agglomerative hierarchical cluster analysis was used to determine the appropriate number of clusters for each sex, with scores on each of the subscales acting as the clustering variables and Euclidean distance as measure of similarity. Average-linkage was used to define the distances between clusters (i.e., the distance between each cluster was defined as the average distance between all pairs of members within each cluster). In agglomerative clustering, each individual participant begins as a member of their own cluster (see Figure 2, Panel A). The two clusters that are the most similar (i.e., are the

least distant) are merged into a single cluster (Figure 2, Panel B). This process is repeated until all participants are a member of the same cluster (Figure 2, Panel C).

This clustering procedure on its own does not indicate a stopping point for how many clusters are appropriate given the data. Many stopping rules have been proposed over the years. The most effective in terms of identifying known subgroups are based on the Calinski & Harabasz pseudo-*F* and the Duda-Hart Je(2)/Je(1) index and pseudo-t^2,[77] both of which can be calculated in Stata.[75] The Calinski & Harabasz pseudo-*F* can be interpreted similarly to that of an ANOVA, with the highest value indicating the greatest separation between clusters. The Duda-Hart Je(2)/Je(1) index and pseudo-t^2 are used in conjunction, with the optimal number of clusters being determined by greater values for Je(2)/Je(1) (the ratio of within-cluster error before and after a cluster is split hierarchically) and low values for pseudo-t^2 (a related measure that takes into account the sizes of the clusters being formed). An additional measure of a clustering solution's appropriateness is to examine a scree plot showing the percent of variation explained by the clustering at each stage, looking for a distinctive bend (or 'elbow') wherein further clustering does not produce substantially more homogeneous groups.[78] Stata does not produce such plots by default and to my knowledge no user-made program is available for download. Therefore a custom program, *cluster elbow*, was created based on existing user-written programs that calculate distances in the context of clustered data. Annotated code for the *cluster elbow* program can be seen in Appendix D. In the present study, all three of these stopping criteria were examined to determine the optimal number of clusters within each sample (Figure 2, Panel D).

Once the optimal number of clusters was determined, a second stage of cluster analysis was conducted using the cluster centroids established in the first round as start-points for k-means partitioning cluster analysis (Figure 2, Panel E). K-means cluster analysis assigns all participants to one of a pre-specified number of clusters based on distances to the initial cluster centroids (which are themselves based on the centroids derived from the previous stage). The centroids are recalculated based on the new group assignments, and new centroids are again calculated. This process is repeated many times (10,000 in this study) with the hopes of achieving stable cluster groupings (Figure 2, Panels F, G, and H). This two-stage approach to cluster-analysis is thought to improve

upon both hierarchical and partitioning approaches by allowing group membership to shift to better fit the data (as opposed to being fixed by initial assignment as in hierarchical) and by setting non-random start points for k-means partitioning.[77,79] Group assignments based on this two-stage clustering analysis were made, and depressive symptom subscale scores were used to characterize each of the observed clusters. Cluster memberships were entered into logistic regression models against each of the outcome variables with the same modeling approach described above for the first research question.

CHAPTER 4: RESULTS

4.1 Characteristics of the Sample

Weighted and unweighted descriptive statistics for the male students are presented in Table 2. The 1,982 male students included in the analysis had a mean age of 21.4 years (standard deviation of 2.2 years). The vast majority of male students were White/Caucasian (86.0%), with a majority (54.6%) considering their family's wealth to be average. An additional 26.4% considered their family to be 'quite' or 'very' wealthy, and 19.1% considered them to be 'not so' or 'not at all' wealthy. The largest group of male students in terms of their current living situation were those living with a roommate (44.6%), followed by 21.8% living with parents, 19.3% living alone, and 14.3% living with a romantic partner. 22.9% of male students used marijuana twice or more in the past 30 days. Half (50.4%) of male students engaged in binge drinking two or more times in the last 30 days; an additional 26.3% binge drank on one occasion in the past month. A small proportion of male students (2.3%) had experienced forced sex while at university. The vast majority of male students reported their sexual orientation as heterosexual (95.3%), while 5.3% were bisexual and 1.2% were gay. Many male students engaged in sexual risk behaviours: 39.2% of male students had more than one partner in the past year, 39.6% did not use a condom the last time that they had vaginal sex, and 72.4% had never been tested for STIs. A minority (15.9%) of male students had more than one sexual partner in the last year and did not use a condom at last vaginal sex, and 8.5% had done so without ever having tested for STIs.

Weighted and unweighted descriptive statistics for the female students are presented in Table 3. The 5,183 female students included in the analysis had a mean age of 21.1 years (standard deviation of 2.9 years). The vast majority of female students were White/Caucasian (89.5%), with the majority (57.7%) considering their family's wealth to be average. An additional 22.0% considered their family to be 'quite' or 'very' wealthy, and 20.4% considered them to be 'not so' or 'not at all' wealthy. The largest group of female students in terms of their current living situation were those living with a roommate (42.6%), followed by 23.0% living with parents, 19.3% living alone, and 14.3% living with a romantic partner. A minority (15.5%) of female students used marijuana twice or more in the past 30 days. A substantial proportion (38.0%) of female

students engaged in binge drinking two or more times in the last 30 days; an additional 31.7% binge drank on one occasion in the past month. Almost 8% of female students (7.7%) had experienced forced sex while at university. The vast majority of female students reported their sexual orientation as heterosexual (93.5%), while 2.8% were bisexual and 1.23% were gay. Sexual risk behaviours were common: 37.6% of female students had more than one partner in the past year, 45.5% did not use a condom the last time that they had vaginal sex, and 53.7% had never been tested for STIs. A minority (16.9%) of female students had more than one sexual partner in the last year and did not use a condom at last vaginal sex, and 6.3% had done so without having tested for STIs. A relatively small proportion of female students did not use an effective form of contraception at last intercourse (8.9%).

4.2 Collinearity Diagnostics among Depressive Symptom Subscales

As can be seen in Table 4, all correlations among depressive symptom subscale scores were moderate or large for both male and female students. The variance inflation factors (VIFs) for each of the subscales ranged from 1.5 to 4.9 for males and 1.5 to 4.3 for females (see Table 5). The variables with the highest VIFs for each of the sexes were Negative Affect and Interpersonal problems, which is to be expected given the high correlations between scores on those two subscales (see Table 4). None of the variables met the cut-off for excessive collinearity (i.e., a VIF greater than ten). Based on this, no changes were made to the analytic strategy outlined above.

4.3. Regression Models for Male Students

4.3.1 Unadjusted Models (Male Students)

Among male students, there were few associations between CES-D subscale scores and any of the sexual health risk behaviours (see Table 6, first row). Total depressive symptom scores were not associated with any of the risk behaviours. For each standard deviation increase in Negative Affect scores, male students' odds of having not used a condom at last intercourse increased by 11%. For each standard deviation increase in Somatic Symptoms scores, male students' odds of having had more than one partner in the past year increased by 12%. For each one standard deviation increase in Interpersonal Problems scores, male students' odds of condom non-use at last intercourse by 12%.

4.3.2 Adjusting for Confounders (Male Students)

After entering each of the depressive symptom subscales into a model along with all of the control variables, there were no associations between subscale scores and any of the sexual health risk behaviours among male students (see Table 6, second row).

4.3.3 Adjusting for All Subscales (Male Students)

When entering each of the depressive symptom subscale scores into a model together (without the other control variables), only Somatic Symptoms were associated with having more than one sexual partner in the past year. For each standard deviation increase in Somatic Symptom scores, the odds of having more than one partner in the past year increased by 21%. No other subscales were significantly associated with any sexual health risk behaviours for male students.

4.3.4 Adjusting for All Subscales and All Confounders (Male Students)

In the model including all of the subscales as well as the control variables, only one depressive symptom subscale was significantly associated with sexual health risk behaviour among male students. For each standard deviation increase in Somatic Symptom scores, there was a 17% increase in male students' odds of having had more than one partner in the past year (see the fourth row of Table 6).

4.4. Regression Models for Female Students

4.4.1 Unadjusted Models (Female Students)

Among female students, significant associations were seen between all depressive symptom subscale scores and sexual health risk behaviours (see Table 7, first row). Total CES-D scores were positively associated with each of the sexual health risk behaviours examined, save for not having been tested for STIs. For each standard deviation increase in CES-D total scores, female students' odds of having more than one sexual partner in the last year increased by 16%, condom non-use increased by 10%, odds of having unprotected sex at last intercourse and more than one partner in the past year MP+CN increased by 22%, the odds of MP+CN+NT increased by 26%, and the odds of not using any effective form of contraception at last intercourse increased by 33%. Similar associations were seen for each of the subscale scores, with the only major differences being that for Negative Affect, Somatic Symptoms, and Interpersonal Problems were

each negatively associated with not having been tested for STIs (i.e., female students with higher scores on these subscales were more likely to have been tested for STIs) (see Table 7, first row).

4.4.2 Adjusting for Confounders (Female Students)

As with the unadjusted models, there were significant associations between most of the depressive symptom subscales and the sexual health risk behaviours among female students. The pattern off associations mirrored those in the unadjusted analyses discussed above (see Table 7, second row).

4.4.3 Adjusting for All Subscales (Female Students)

Among female students, many of the associations between depressive symptom subscale scores and sexual health risk behaviours observed in both the unadjusted models and models including control variables were no longer significant after including all subscales in the same model (see Table 7, third row). Negative Affect was associated with increased odds of having had more than one sexual partner in the past year; for each one standard deviation increase in Negative Affect scores, female students' odds of having more than one partner increased by 20%. Anhedonia scores were positively associated with several of the outcomes; for each standard deviation increases in Anhedonia scores, the odds of condom non-use at last intercourse increased by 9%, the odds of not having been tested for STIs increased by 17%, and the odds of MP+CN+NT increased by 29%. Somatic Symptoms also were associated with several of the outcomes; for each standard deviation increase in Somatic Symptom scores, there was a 9% increase in the odds of having more than one partner in the past year, a 17% increase in the odds of MP+CN, and a 19% increase in the odds of MP+CN+NT (see Table 7, third row).

4.4.4 Adjusting for All Subscales and all Confounders (Female Students)

Among female students, several depressive symptom subscale scores were significantly associated with sexual health risk behaviours. Neither Negative Affect nor Interpersonal Problems were significantly associated with any of the outcomes, whereas both Anhedonia and Somatic Symptoms were associated with several of the outcomes. For each standard deviation increase in Anhedonia scores, female students' odds of having not used a condom at last intercourse increased by 9%, their odds of not having

been tested for STIs increased by 17%, and their odds of MP+CN+NT increased by 29%. For each standard deviation increase in Somatic Symptoms score, female students' odds of MP+CN increased by 13%, and their odds of not using effective contraception at last intercourse increased by 16%. Somatic Symptoms were also marginally associated with condom non-use at last intercourse (8% increase in odds per standard deviation increase in score, $p = 0.056$) and not having been tested for STIs (8% decrease in odds per standard deviation increase in score, $p = 0.056$) (see the fourth row of Table 7).

4.5 Identification of Depressive Symptom Subscale Clusters among Male Students

4.5.1 Establishing the Optimal Number of Clusters (Male Students)

In the average-linkage hierarchical cluster analysis conducted among male students, the Calinski and Harabasz pseudo-*F* value was maximized with two clusters (1519.1). The Duda and Hart Je(2)/Je(1) index was maximized with two (0.95), and pseudo-t^2 was minimized at two clusters (14.2). This range for the optimal number of clusters for male students is presented in Figure 3 as the shaded area. As can be seen by the vertical dashed line in the plot, there is a distinctive bend or elbow in the percent of variance accounted for by the clustering solution, alternatively interpreted as how dissimilar clusters are from one another, at four clusters. As such, two clusters was selected as the optimal number for male students going into the second phase of the cluster analysis (see below).

4.5.2 Interpreting and Describing Observed Clusters (Male Students)

Means for the two observed clusters among male students across the depressive symptoms subscale scores used in the cluster analysis are shown in Figure 4. As can be seen, the clusters were defined by depressive symptom severity rather than unique profiles of symptoms. One cluster was defined by low scores across all subscale scores (i.e., a low depressive symptoms cluster) and the other was defined by high scores across all subscales (i.e., an elevated depressive symptoms clusters). As can be seen in Table 8, male students belonging to the different depressive symptom clusters did not vary substantially across most background and demographic characteristics, although they did for some. Members of the cluster with more severe depressive symptoms were more likely to report lower socioeconomic status, more likely to have used marijuana two or

more times in the past month, and more likely to have experienced forced sex while at university. For illustrative purposes, the observed depressive symptom clusters among male students can be observed in comparison to the traditional cut-off score for the CES-D-12 (scores of 12 or higher indicating elevated depressive symptoms; see Table 9).

4.5.3 Regression Models of Sexual Risk Using Observed Clusters (Male Students)

In the unadjusted models among male students, membership in the elevated depressive symptom cluster was significantly associated with condom non-use at last intercourse (31% increase in the odds of condom non-use); however, this association was no longer significant after adjusting for confounders (see Table 10).

4.6 Identification of Depressive Symptom Subscale Clusters among Female Students

4.6.1 Establishing the Optimal Number of Clusters (Female Students)

Among female students, the hierarchical cluster analysis revealed that the Calinski and Harabasz pseudo-F value was maximized with two clusters (4075.9), while the Duda and Hart Je(2)/Je(1) index was maximized with two (0.98) and four (0.93) clusters, and pseudo-t^2 was minimized at four (17.8) and two clusters (99.6). This range for the optimal number of clusters for female students (two or four clusters) is presented in Figure 5 as the shaded areas. As can be seen by the vertical dashed line in the plot, there is a distinctive bend or elbow in the percent of variance accounted for by the clustering solution at two clusters. As such, two clusters was selected as the optimal number for male students going into the second phase of the cluster analysis (see below). The cluster groups described above (two clusters for both male students and female students) were used as the starting points for the previously mentioned second stage of cluster analysis (k-means partitioning).

4.6.2 Interpreting and Describing Observed Clusters (Female Students)

A similar identical clustering was apparent among female students as was seen among males; the two observed clusters were defined by severity of overall depressive symptoms (see Figure 6). Demographic and behavioural characteristics across the two clusters can be seen in Table 11. Female students with elevated levels of depressive symptoms were more likely to report their family as being not so well off or not at all well off, more likely to have used marijuana two or more times in the past month, more

likely to have experienced forced sex while at university, and more likely to be bisexual (but not gay). For both male and female students, the established and widely used cut-off score of 12 for the CES-D-12[50] appeared to broadly demark cluster membership (see Table 9).

4.6.3 Regression Models of Sexual Risk Using Observed Clusters (Female Students)

Among female students, being in the elevated depressive symptoms cluster was associated with increased odds for all sexual health risk behaviours (see Table 12). Before adjusting for other variables, students in the elevated depressive symptom cluster had 33% greater odds of having had more than one partner in the past year, 15% greater odds of not having used a condom at last intercourse, a 27% increase in the odds of MP+CN, a 39% increase in the odds off MP+CN+NT, and a 65% increase in the odds of not having used an effective form of contraception at last intercourse. The odds of not having been tested for STIs were 13% lower among female students in the high depressive symptoms cluster. The pattern of results were largely the same after adjusting for the potential confounders (see Table 12), the one exception being that membership in the elevated depressive symptom group was no longer associated with lower odds of having gone untested for STIs.

CHAPTER 5: DISCUSSION

Past research has identified depression and depressive symptoms as a predictor of sexual risk-taking among younger segments of the population, particularly among girls and young women;[3,4] however, no work to-date has examined whether this association is attributable to specific symptoms or groups of depressive symptoms (i.e., Negative Affect, Anhedonia, Somatic Symptoms, and Interpersonal Problems), and relatively little work has been done to determine whether such symptoms define clinically-relevant subgroups in relation to sexual health risk behaviours. This study attempted to answer this question, in addition to testing the extent to which subscales acted as markers for clinically-relevant subgroups of students.

5.1 Depressive Symptom Subscales and Sexual Risk-Taking among Male Students

In this study, total depressive symptom score, as measured by the CES-D-12, was not associated with any of the sexual health risk behaviours among male students. In examining the individual symptom subscales in males, the results were much the same as few of the subscales were associated with sexual health risk behaviours. After adjusting for potentially confounding factors, only the Somatic Symptoms subscale was significantly associated with any of the sexual health risk behaviours (i.e., having more than one sexual partner in the past year). This is in line with past research, wherein the association between depression or depressive symptoms and sexual health behaviours is less frequently seen among males than females.[3,4]

The relationship between the Somatic Symptoms subscale and having had more than one partner in the last year is difficult to interpret, although several possible explanations present themselves. The first possible explanation is that the association between Somatic Symptoms and having more than one partner in the last year is due to increased impulsivity. Many of the Somatic Symptoms items of the CES-D-12 describe troubles sleeping or concentrating. It may be the case that male students scoring high on Somatic Symptoms are more likely to engage in risk-taking due to reduced impulse control stemming from sleep deprivation or concentration problems. Past research suggests that sleep disruption is associated with impulsivity among children, although evidence is limited.[80] Contrary to this explanation, we would expect Somatic

Symptoms to be associated with sexual risk-taking more generally, rather than just one risk behaviour (having more than one partner). A second explanation is that the observed association is due to unmeasured confounders. Specifically, rather than observing an association between Somatic Symptoms stemming from or relating to depression more generally, we might simply have found evidence for an association between having more than one partner in the past year and Somatic Symptoms relating to recent or chronic partying (e.g., limited sleep, trouble concentrating). That is, having more than one sexual partner in the last year might simply be associated with the after-effects of somatic or cognitive effects of partying. Contrary to this point, one might expect several of our control variables (i.e., relationship status, binge drinking, or marijuana use) to severely weaken or completely eliminate this apparent relationship; however, this was not the case. In fact, the association became stronger after taking account of these factors. An alternate interpretation, as noted earlier, is that having more than one partner in the past year can increase Somatic Symptoms among males, possibly by increasing feelings of guilt or stigma.

5.2 Depressive Symptom Subscales and Sexual Risk-Taking among Female Students

In contrast to the above, there was an association between total depressive symptom scores and sexual health behaviours among female students; depressive symptoms were associated with all but one of the sexual risk behaviours (not having been tested for STIs) across all models. In examining the associations between the subscales and outcome variables, some interesting patterns emerged. In the unadjusted models, all of the subscales were associated with nearly all of the outcomes, likely due to the high correlations between the subscale scores and the total depressive symptom scores. Including all of the subscales into the same model alongside the control variables eliminated many of the associations, leaving Anhedonia and Somatic Symptoms as the subscales driving the association between depressive symptoms and sexual health risk behaviours. Specifically, Anhedonia was associated with condom non-use at last intercourse, STI non-testing, and having multiple partners in the past year while not having used a condom at last intercourse and not testing for STIs. As measured by the CES-D-12, Anhedonia describes both the absence of present happiness as well as pessimism about one's future. The observed association between Anhedonia and sexual

risk-taking, then, has two obvious explanations stemming from the nature of the items in the subscale. The first is that the absence of present happiness or experience of pleasure might lead to compensatory behaviour on the part of female students. One would expect that this would be reflected in high-Anhedonia female students being more likely to have had more than one partner in the last year, but not necessary more likely to have had unprotected sex or to have forgone STI testing while at university. This predicted pattern of associations is essentially the opposite of what was observed in the present study, with Anhedonia being associated with condom non-use, lack of STI testing, and having engaged in MP+CN+NT.

An alternative explanation for the association between Anhedonia and sexual risk-taking observed among female students is that Anhedonia reflects how female students perceive their futures. Specifically, risk taking might be seen as reasonable by women with higher levels of pessimism and anhedonia if they either assign a lower level of value or reward to being healthy in the future or if they believe that they have a lower probability of maintaining their health going forward. Both of these hypotheses can be related to the behavioural-economic concept of *delay discounting*, wherein decision-makers prefer immediate rewards to those occurring in the future despite equal or greater value.[81] A common example of delay discounting is determining the timeframe over which a person prefers a smaller reward (e.g., $100) to a larger one (e.g., $110), although it can be applied to sexual health contexts (see Figure 7 for an example as pertains to this discussion).

Delay discounting is a universal aspect of decision-making, and can even be observed among non-humans under instances of delayed reward.[82] However, some groups, most notably those diagnosed with substance use disorders, demonstrate more extreme delay discounting than others.[83,84] This same association has been observed among those diagnosed with depression or who have elevated levels of depressive symptoms. In a sample comprised of patients over the age of 60 years diagnosed with depression, greater delay discounting as measured by a set of binary choice monetary survey items was associated with less lethal suicide attempts (i.e., depressed patients who greatly discounted future rewards were more likely to have attempted suicide using a low-

lethality approach versus a high-lethality approach).[85] In a sample of adolescent smokers and non-smokers, teens with high levels of depressive symptoms demonstrated greater delay discounting on a computerized monetary task.[86] Similarly, in a study of post-partum smoking relapse among new mothers, participants experiencing recent depressive symptoms demonstrated significantly greater delay discounting than those not experiencing elevated depressive symptoms.[87] In a sample of men who have sex with men using crowdsourcing applications, delay discounting in a sexual decision making task was associated with both depression diagnosis and having had unprotected anal sex.[84]

Although most studies testing this relationship have found a significant, positive association between depressive symptoms and delay discounting, others have not. In a study of drinking-related problems among college students in the United States, delay discounting was not significantly associated with depressive symptoms, although delay discounting was also not associated with self-report alcohol problems, either.[88] In another study, the only one to specifically examine the association between Anhedonia and delay discounting, high-Anhedonia undergraduate students demonstrated *reduced* delay discounting. This negative association persisted even after controlling for other, theoretically related variables, such as self-reported depression, impulsivity, and working memory.[89] The authors of this latter study suggested that Anhedonic individuals might demonstrate reduced delay discounting due to more limited reactivity to immediate reward (i.e., those who are less able to experience pleasure or happiness in the present are less likely make decisions biased in favor of short-term reward). Thus, there is an empirical literature linking depression to delay discounting; however, the one study directly assessing the relationship between Anhedonia and delay discounting suggests a relationship opposite of what would be predicted based on our results. More work is needed to clarify the nature of this relationship.

Aside from Anhedonia, Somatic Symptoms were also positively associated with sexual risk-taking among female students. Those reporting higher levels of Somatic Symptoms were more likely to report effective contraception non-use, being high-risk (MP+CN), and were marginally associated with increased odds of condom non-use. As

hypothesized, female students with high levels of Somatic Symptoms were less likely to report forgoing STI testing (i.e., more likely to have been tested for STIs). This latter finding is the most intuitive and in-line with the literature; past research has identified Somatic Symptoms and somatization as being associated with greater health service use.[90,91] In the context of this study, female students experiencing high levels of Somatic Symptoms might have been more likely to either directly seek out STI testing (as a means of determining from where their symptoms originate) or more likely to access health services and perhaps be exposed to STI testing opportunities as a consequence.

Past research has also identified Somatic Symptoms as being related to a wide array of health behaviours and outcomes.[54] To my knowledge, however, the current study is the first to specifically show an association with sexual risk-taking. One possible explanation is that the items of the Somatic Symptoms subscale of the CES-D, which focus heavily on sleep disturbances and trouble concentrating, may correlate with poor decision-making and impulsivity more generally. This explanation should be explored in future research.

In this study there were marked sex differences in terms of the association between depressive symptoms and sexual risk-taking; there was an association for nearly all of the outcomes examined among female students, even after adjusting for covariates, but for none of the outcomes among male students. Past research has shown an association between depressive symptoms and sexual risk-taking among both male and female youths; however, there are some differences across the sexes in terms of which sexual risk behaviours are more likely to be associated with elevated levels of depressive symptoms.[3,4] For instance, in my previous investigations, depressive symptoms have been associated with various forms of unprotected sex among female youths (e.g., condom and effective contraception non-use), but having larger numbers of partners and having unplanned sex due to alcohol/substance use was more prominent among male youths.[3,4] In the current study, depressive symptoms (specifically Somatic Symptoms) were associated with having more than one sexual partner in the last year among male students, even after adding covariates to the model, although overall depressive symptom scores were not associated with this outcome. Unfortunately, a measure of alcohol-related

sexual risk-taking was not included in our analysis, meaning that one of the most commonly observed associations for men was not available to test, which may account for the few observed associations between depressive symptoms and risk-taking among male students.

5.3 Subtypes Based on Depressive Symptoms

The current study also examined clusters of students based on the pattern of depressive symptoms displayed. Across both sexes, subgroups were defined entirely by depressive symptom severity, rather than unique combinations of symptom subscales. Two clusters were apparent among both male and female students. One was defined by high scores on all depressive symptom subscales and the other by low scores on all subscales (see Figures 5-6). Interestingly, the traditional cut-off score of 12 on the CES-D-12 reasonably distinguished members of the two clusters among both male and female students (see Figures 6 and 8). Among female students, members of the cluster with greater depressive symptoms was more likely to engage in all types of sexual risk-taking assessed in the current study, save for not having been tested for STIs. No such associations were observed among male students.

This is the first study to investigate clusters of individuals based on depressive symptoms while stratifying by sex; however, the finding that clusters are defined by symptom severity is in line with the literature to-date.[60,61,63] Consistent with this severity-based clustering, associations between cluster membership and sexual risk-taking mirrored associations between individual subscale scores and sexual risk-taking. For instance, Anhedonia and Somatic Symptoms were associated with sexual risk-taking among female students, and the cluster with overall elevated depressive symptoms (including Anhedonia and Somatic Symptoms) were similarly more likely to engage in risk-taking. Likewise, neither any of the symptom subscale scores nor the cluster with elevated depressive symptoms were associated with sexual risk-taking among male students.

5.4 Implications

The findings of the present study have several implications. First, the association between depressive symptoms and sexual risk-behaviours seen in the literature were replicated. That the association was specific to female students, however, is at odds with the literature, which has typically reported that there is an association between depressive symptoms and sexual risk-taking among both females and males, although the sexes often differ in terms of which specific risk behaviours are associated with depressive symptoms.[3,4] Among female students, the association between depressive symptoms and sexual risk-taking was underpinned by two subscales: Anhedonia and Somatic Symptoms. This detail will allow future research to focus on determining causal mechanisms for these associations (e.g., delay discounting and lack of concentration, as discussed above).

A second implication of this study is that, while the results narrow where future research should look for mechanisms underlying the association between depressive symptoms and sexual risk-taking, these subscales did not define identifiable subgroups at increased risk of compromised sexual health. For instance, there were no apparent subgroups defined specifically by Anhedonia or Somatic Symptoms among female students. Instead, they were categorized into groups of low and high depressive symptoms; the latter had high levels of both Anhedonia and Somatic Symptoms (as well as Negative Affect and Interpersonal Problems), and therefore were more likely to engage in the various sexual risk behaviours than were members of the group with low levels of depressive symptoms overall. Interestingly, the approximate cut-point for membership in the high depressive symptoms cluster among male and female students was similar to the cut-point used for this measure in the literature.[50] Among male students, members of the cluster with elevated levels of sexual risk taking were no more likely to engage in any of the sexual risk behaviours. These findings suggests that although individual subscales can be identified as being associated with sexual risk-taking, these associations do not necessarily translate into identifiable sub-groups of at-risk students defined specifically by said traits. Additionally, the observed clusters corresponded nearly perfectly to established cut-offs on the CES-D-12, providing additional support for the validity of often-used high- and low-risk groupings.[50]

5.5 Limitations

The findings of the present study must be considered in the context of the limitations of my methods and data. The used sample is both non-representative and cross-sectional in nature. The former suggests that this study may not reflect associations as they exist in the student population, while the latter makes it impossible to establish temporal ordering for the variables being examined, and therefore we are not able to establish causal relationships. The low overall response rate, particularly among male students, may have affected the outcomes of this study; male students prone to sexual risk-taking may have been less likely to participate in the survey, and so our results for this sex may have been biased towards the observed null result. Although this is a possible explanation, it is far from conclusive; at least one prior study using representative sampling techniques reported an association between depression and condom non-use among women but not men in Canada.[92] Additionally, all of the data discussed in the current study are self-report in nature, and as such may be subject to bias of recall and social desirability. Finally, the large number of statistical comparisons examined in this study will have inevitable inflated the likelihood of having found false-positive results in terms of statistical significance.

Despite these limitations, my study tackles novel research questions using a large sample and in the context of controlling for a large number of relevant covariates. The results suggest that the well-documented association between depressive symptoms and sexual risk-taking among women may be due to elevated levels of Anhedonia and Somatic Symptoms specifically, rather than the emergent effects of depressive symptoms in general, and this finding should provide an interesting start-point for future research.

The present study, as well as much of the literature on this topic, has relied on cross-sectional surveys of various populations.[3,4,93] To mitigate this study's inability to establish causal associations, and to advance knowledge on this topic, future research should adopt longitudinal designs to allow more concrete causal modeling. For example, one solution would be for future research to use panel designs with either fixed effects or hybrid modeling techniques (also sometimes referred to as between-within

modeling),[94] which allow for the assessment of the effects of both state (i.e., the effect of increasing or decreasing an individual's depressive symptoms) and trait (i.e., the effect of having higher or lower levels of depressive symptoms) effects of depressive symptoms on sexual risk behaviour among students (or other populations). Due to the fact that such modeling techniques inherently control for all time-invariant effects (e.g., race), more valid causal inferences could be made.[94]

5.6 Conclusions

In conclusion, the present study tested the association between depressive symptoms and sexual risk-taking among university students in the Maritime Provinces of Canada. I found the depressive symptoms were associated with increased sexual risk behaviours among female but not male students. Additionally, the overall association between depressive symptoms and sexual risk-taking among female students was underpinned by two subscales: Anhedonia and Somatic Symptoms. Although several hypotheses have been offered within this paper with regard to possible causal mechanisms, this study and the literature as a whole are presently not capable of fully testing them. Subgroups based on students' self-reported depressive symptoms were defined based on depressive symptom severity, rather than individually identifiable symptom profiles, effectively limiting the ability to identify high risk students based on depressive symptoms to the status quo of partitioning individuals based on high and low levels of depressive symptoms. This also suggests that existing cut-points for this specific measure of depressive symptoms are useful in terms of identifying meaningful subgroups in terms of elevated symptoms.

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APPENDIX A: TABLES

Table 1. Factor structure of the CES-D observed in the literature.

Factor 1: Somatic
I did not feel like eating, my appetite was poor.
My sleep was restless.
I could not get "going."
I had trouble keeping my mind on what I was doing.
I felt that everything I did was an effort.
I talked less than usual.
I was bothered by things that usually don't bother me.
Factor 2: Negative Affect
I felt sad.
I had crying spells.
I felt fearful.
I felt that I could not shake the blues, even with the help of family or friends.
I felt depressed.
I felt lonely.
I thought my life had been a failure.
Factor 3: Anhedonia
I was happy.
I felt hopeful about the future.
I enjoyed life.
I felt that I was just as good as other people.
Factor 4: Interpersonal Problems
I felt that people disliked me.
People were unfriendly.

Note: Adapted from Shafer et al.[48]
Items included in the 12-item version are in italics.

Table 2. Descriptive statistics for male students (N = 1,982).

	Unweighted	Weighted
Age (years)	21.1 (2.6)	21.4 (2.2)
Ethnicity		
White	85.9%	86.0%
African	2.0%	2.1%
Aboriginal	0.9%	1.0%
Asian	4.3%	4.3%
Middle Eastern	1.5%	1.4%
Other	2.2%	1.9%
Multiple	3.2%	3.1%
Socioeconomic Status		
Not at all Wealthy	5.4%	5.9%
Not so Wealthy	12.3%	13.2%
Average	54.2%	54.6%
Quite Wealthy	24.3%	22.8%
Very Wealthy	3.9%	3.6%
Living Situation		
Alone	20.3%	19.3%
With Parent(s)	21.0%	21.8%
With Romantic Partner	13.5%	14.32%
With a Roommate	45.1%	44.6%
Marijuana Use (past month)		
> 2 Times	22.9%	22.9%
Binge Drinking (post month)		
0 times	22.8%	23.4%
1-2 Times	25.2%	26.3%
> 2 Times	52.0%	50.4%
Experienced Forced Sex	2.2%	2.3%
Sexual Orientation		
Heterosexual	95.5%	95.4%
Bisexual	2.7%	2.8%
Gay	1.8%	1.9%
Depression Score (0-36)	8.8 (6.1)	8.9 (5.0)
Negative Affect (0-12)	2.1 (2.4)	2.1 (2.0)
Anhedonia (0-9)	2.5 (2.1)	2.6 (1.7)
Somatic Symptoms (0-12)	3.7 (2.5)	3.7 (2.0)
Interpersonal Problems (0-3)	0.7 (0.9)	0.6 (0.70)
> 1 Partner (N = 1,982)	40.6%	39.2%
Condom Non-Use (N = 1,971)	38.8%	39.6%
MP+CN (N = 1,971)	16.2%	15.9%
No STI-Testing (N = 1,870)	73.3%	72.4%
MP+CN+NT (N = 1,861)	9.4%	8.5%

Table 3. Descriptive statistics for female students (N = 5,183)

	Unweighted	**Weighted**
Age (years)	20.7 (2.4)	21.1 (2.9)
Ethnicity		
White	89.5%	89.5%
African	1.5%	1.4%
Aboriginal	1.3%	1.6%
Asian	1.9%	1.9%
Middle Eastern	0.4%	0.4%
Other	1.4%	1.4%
Multiple	4.1%	3.8%
Socioeconomic Status		
Not at all Wealthy	5.8%	6.2%
Not so Wealthy	13.6%	14.3%
Average	57.4%	57.7%
Quite Wealthy	21.0%	19.9%
Very Wealthy	2.2%	2.0%
Living Situation		
Alone	17.8%	16.5%
With Parent(s)	22.2%	23.0%
With Romantic Partner	16.2%	17.9%
With a Roommate	43.9%	42.6%
Marijuana Use (past month)		
> 2 Times	16.1%	15.5%
Binge Drinking (post month)		
0 times	28.9%	30.2%
1-2 Times	30.9%	31.7%
> 2 Times	40.2%	38.0%
Experienced Forced Sex	7.1%	7.7%
Sexual Orientation		
Heterosexual	93.8%	93.5%
Bisexual	5.0%	5.3%
Gay	1.2%	1.2%
Depression Score (0-36)	10.3 (6.4)	10.4 (7.4)
Negative Affect (0-12)	2.8 (2.7)	2.8 (3.1)
Anhedonia (0-9)	2.6 (2.0)	2.6 (2.3)
Somatic Symptoms (0-12)	4.4 (2.5)	4.4 (2.8)
Interpersonal Problems (0-3)	0.6 (0.9)	0.6 (1.0)
> 1 Partner (N = 5,183)	38.4%	37.6%
Condom Non-Use (N = 5,163)	44.9%	45.5%
MP+CN (N = 5,163)	17.0%	16.9%
No STI-Testing (N = 4,730)	55.5%	53.7%
MP+CN+NT (N = 4,713)	6.6%	6.3%
Effective Contraception Non-Use (N = 5,170)	8.6%	8.9%

Table 4. Correlations between depression subscales by respondent sex.

	Total Scores	Negative Affect	Anhedonia	Somatic Symptoms	Interpersonal Problems
Total Scores	1.00	0.89	0.75	0.81	0.80
Negative Affect	0.88	1.00	0.57	0.59	0.86
Anhedonia	0.77	0.57	1.00	0.41	0.54
Somatic Symptoms	0.81	0.58	0.40	1.00	0.54
Interpersonal Problems	0.80	0.88	0.54	0.54	1.00

Note: Correlations for males are below the diagonal; those for females are above the diagonal.

Table 5. Collinearity diagnostic (variance inflation factor) for males and females.

	Males	Females
Negative Affect	4.92	4.34
Anhedonia	1.50	1.50
Somatic Symptoms	1.51	1.54
Interpersonal Problems	4.47	3.90

Table 6. Unadjusted and adjusted logistic regressions between standardized depression subscale scores and sexual health risk behaviours among male students (OR and 95% Confidence Intervals).

	Depressive Symptoms	Negative Affect	Anhedonia	Somatic Symptoms	Interpersonal Problems
			Unadjusted		
> 1 Partner	1.01 (0.92, 1.12)	0.99 (0.90, 1.10)	0.92 (0.83, 1.01)	**1.12 (1.01, 1.23)**	0.99 (0.90, 1.10)
Condom Non-Use	1.09 (0.99, 1.22)	**1.11 (1.01, 1.23)**	1.01 (0.91, 1.12)	1.09 (0.99, 1.21)	**1.12 (1.02, 1.24)**
MP+CN	1.08 (0.95, 1.23)	1.07 (0.94, 1.22)	0.98 (0.86, 1.12)	1.11 (0.98, 1.27)	1.06 (0.93, 1.21)
STI Non-Testing	0.92 (0.82, 1.03)	0.91 (0.81, 1.02)	0.94 (0.84, 1.05)	0.95 (0.85, 1.06)	0.95 (0.85, 1.06)
MP+CN+NT	1.09 (0.93, 1.28)	1.10 (0.93, 1.29)	1.00 (0.86, 1.16)	1.10 (0.93, 1.30)	1.09 (0.92, 1.29)
			Adjusted (Each Scale With Controls)		
> 1 Partner	1.01 (0.91, 1.13)	0.97 (0.87, 1.08)	0.98 (0.88, 1.09)	1.09 (0.98, 1.21)	0.98 (0.88, 1.09)
Condom Non-Use	1.09 (0.98, 1.21)	1.11 (1.00, 1.23)	1.02 (0.92, 1.13)	1.04 (0.93, 1.16)	1.09 (0.98, 1.21)
MP+CN	1.08 (0.94, 1.24)	1.05 (0.91, 1.20)	1.06 (0.92, 1.21)	1.07 (0.93, 1.23)	1.03 (0.90, 1.19)
STI Non-Testing	0.94 (0.84, 1.07)	0.93 (0.83, 1.05)	0.95 (0.84, 1.07)	0.98 (0.87, 1.11)	0.97 (0.86, 1.10)
MP+CN+NT	1.13 (0.95, 1.34)	1.12 (0.94, 1.33)	1.08 (0.93, 1.27)	1.09 (0.91, 1.31)	1.10 (0.92, 1.30)
			Adjusted (All Scales, No Controls)		
> 1 Partner	1.01 (0.92, 1.12)	0.97 (0.78, 1.20)	0.87 (0.77, 0.99)	**1.21 (1.07, 1.37)**	1.00 (0.81, 1.22)
Condom Non-Use	1.09 (0.99, 1.22)	1.06 (0.85, 1.03)	0.91 (0.81, 1.03)	1.04 (0.92, 1.18)	1.10 (0.89, 1.36)
MP+CN	1.08 (0.95, 1.23)	1.06 (0.82, 1.38)	0.91 (0.78, 1.07)	1.13 (0.96, 1.33)	0.99 (0.77, 1.27)
STI Non-Testing	0.92 (0.82, 1.03)	0.82 (0.64, 1.04)	0.98 (0.85, 1.13)	1.00 (0.87, 1.14)	1.15 (0.91, 1.45)
MP+CN+NT	1.09 (0.93, 1.28)	1.09 (0.80, 1.49)	0.92 (0.76, 1.11)	1.08 (0.87, 1.34)	1.02 (0.75, 1.39)
			Full Model		
> 1 Partner	1.01 (0.91, 1.13)	0.87 (0.69, 1.11)	0.98 (0.85, 1.12)	**1.17 (1.02, 1.34)**	1.03 (0.82, 1.30)
Condom Non-Use	1.09 (0.98, 1.21)	1.18 (0.94, 1.48)	0.94 (0.83, 1.07)	0.98 (0.86, 1.12)	0.98 (0.80, 1.22)
MP+CN	1.08 (0.94, 1.24)	1.04 (0.78, 1.38)	1.04 (0.87, 1.24)	1.06 (0.88, 1.26)	0.95 (0.73, 1.25)
STI Non-Testing	0.94 (0.84, 1.07)	0.82 (0.63, 1.07)	0.96 (0.83, 1.13)	1.04 (0.89, 1.20)	1.17 (0.90, 1.52)
MP+CN+NT	1.13 (0.95, 1.34)	1.12 (0.80, 1.56)	1.02 (0.83, 1.26)	1.04 (0.83, 1.30)	0.97 (0.70, 1.33)

Notes: Bolded values are statistically significant ($p < 0.05$). Controls include: age, ethnicity, socioeconomic status, current living situation, marijuana use and binge drinking in the past 30 days, experience of forced sex while at university, and sexual orientation.

Table 7. Unadjusted and adjusted logistic regressions between standardized depression subscale scores and sexual health risk behaviours among female students (OR and 95% confidence intervals).

	Depressive Symptoms	Negative Affect	Anhedonia	Somatic Symptoms	Interpersonal Problems
			Unadjusted		
> 1 Partner	**1.16 (1.09, 1.23)**	**1.16 (1.09, 1.24)**	**1.07 (1.00, 1.13)**	**1.15 (1.08, 1.22)**	**1.12 (1.05, 1.19)**
Condom Non-Use	**1.10 (1.03, 1.17)**	**1.07 (1.00, 1.14)**	**1.10 (1.03, 1.17)**	**1.09 (1.03, 1.16)**	1.05 (0.99, 1.12)
MP+CN	**1.22 (1.13, 1.32)**	**1.19 (1.10, 1.28)**	**1.13 (1.04, 1.22)**	**1.22 (1.13, 1.32)**	**1.14 (1.05, 1.23)**
STI Non-Testing	0.95 (0.89, 1.02)	**0.93 (0.87, 0.99)**	1.03 (0.97, 1.10)	**0.93 (0.87, 0.99)**	**0.91 (0.85, 0.97)**
MP+CN+NT	**1.26 (1.12, 1.41)**	**1.17 (1.04, 1.32)**	**1.27 (1.13, 1.43)**	**1.24 (1.11, 1.39)**	1.13 (1.00, 1.27)
Contraception Non-Use	**1.33 (1.19, 1.48)**	**1.27 (1.13, 1.43)**	**1.28 (1.13, 1.45)**	**1.28 (1.15, 1.41)**	**1.28 (1.10, 1.21)**
			Adjusted (Each Scale With Controls)		
> 1 Partner	**1.13 (1.06, 1.21)**	**1.13 (1.06, 1.21)**	**1.08 (1.01, 1.16)**	**1.11 (1.04, 1.19)**	**1.12 (1.05, 1.20)**
Condom Non-Use	**1.12 (1.05, 1.19)**	**1.09 (1.02, 1.16)**	**1.11 (1.04, 1.18)**	**1.11 (1.04, 1.18)**	1.05 (0.99, 1.12)
MP+CN	**1.19 (1.10, 1.29)**	**1.16 (1.07, 1.25)**	**1.14 (1.04, 1.23)**	**1.19 (1.10, 1.28)**	**1.13 (1.04, 1.22)**
STI Non-Testing	0.96 (0.89, 1.03)	**0.93 (0.87, 1.00)**	1.06 (0.99, 1.14)	**0.92 (0.86, 0.98)**	**0.93 (0.87, 1.00)**
MP+CN+NT	**1.23 (1.10, 1.39)**	**1.14 (1.00, 1.29)**	**1.29 (1.14, 1.46)**	**1.20 (1.06, 1.35)**	1.12 (1.00, 1.27)
Contraception Non-Use	**1.28 (1.15, 1.43)**	**1.22 (1.09, 1.36)**	**1.22 (1.09, 1.37)**	**1.26 (1.13, 1.40)**	**1.20 (1.08, 1.34)**
			Adjusted (All Scales, No Controls)		
> 1 Partner	**1.16 (1.09, 1.23)**	**1.20 (1.06, 1.37)**	0.96 (0.90, 1.04)	**1.09 (1.01, 1.18)**	0.93 (0.82, 1.04)
Condom Non-Use	**1.10 (1.03, 1.17)**	1.02 (0.90, 1.15)	**1.09 (1.01, 1.17)**	1.07 (0.99, 1.15)	0.96 (0.85, 1.08)
MP+CN	**1.22 (1.13, 1.32)**	1.17 (1.00, 1.38)	1.02 (0.92, 1.13)	**1.17 (1.06, 1.28)**	0.90 (0.77, 1.05)
STI Non-Testing	0.95 (0.89, 1.02)	1.03 (0.91, 1.18)	**1.14 (1.05, 1.23)**	0.94 (0.87, 1.02)	**0.85 (0.75, 0.96)**
MP+CN+NT	**1.26 (1.12, 1.41)**	1.07 (0.84, 1.36)	**1.24 (1.07, 1.45)**	**1.19 (1.03, 1.36)**	0.86 (0.69, 1.08)
Contraception Non-Use	**1.33 (1.19, 1.48)**	0.98 (0.78, 1.22)	1.14 (1.00, 1.31)	1.13 (0.99, 1.30)	1.14 (0.93, 1.39)
			Full Model		
> 1 Partner	**1.13 (1.06, 1.21)**	1.07 (0.92, 1.24)	1.01 (0.92, 1.10)	1.05 (0.96, 1.14)	1.03 (0.90, 1.18)
Condom Non-Use	**1.12 (1.05, 1.19)**	1.09 (0.96, 1.27)	**1.09 (1.01, 1.17)**	1.08 (1.00, 1.16)	0.90 (0.79, 1.01)
MP+CN	**1.19 (1.10, 1.29)**	1.09 (0.91, 1.30)	1.06 (0.96, 1.17)	**1.13 (1.02, 1.25)**	0.95 (0.81, 1.13)
STI Non-Testing	0.96 (0.89, 1.03)	0.94 (0.82, 1.08)	**1.17 (1.08, 1.27)**	0.92 (0.85, 1.00)	0.94 (0.83, 1.07)
MP+CN+NT	**1.23 (1.10, 1.39)**	0.96 (0.75, 1.23)	**1.29 (1.11, 1.50)**	1.14 (0.99, 1.30)	0.96 (0.77, 1.19)
Contraception Non-Use	**1.28 (1.15, 1.43)**	1.04 (0.82, 1.32)	1.12 (0.97, 1.33)	**1.16 (1.02, 1.33)**	1.01 (0.82, 1.25)

Notes: Bolded values are statistically significant ($p < 0.05$). Controls include: age, ethnicity, socioeconomic status, current living situation, marijuana use and binge drinking in the past 30 days, experience of forced sex while at university, and sexual orientation.

Table 8. Weighted descriptive statistics for male students by depressive symptom cluster (N = 1,982).

	Low Depressive Symptoms (73.7%)	Elevated Depressive Symptoms (26.3%)
Depression Score (z-score)*	-0.5 (0.4)	1.4 (0.6)
Negative Affect (z-score)*	-0.5 (0.4)	1.35 (0.8)
Anhedonia (z-score)*	-0.4 (0.6)	1.1 (0.7)
Somatic Symptoms (z-score)*	-0.4 (0.6)	1.0 (0.7)
Interpersonal Problems (z-score)*	-0.5 (0.4)	1.3 (0.8)
Age (years)	21.3 (2.1)	21.8 (2.4)
Ethnicity		
White	74.4%	25.6%
African	78.0%	22.0%
Aboriginal	69.1%	30.9%
Asian	70.2%	29.8%
Middle Eastern	57.1%	42.9%
Other	69.7%	30.3%
Multiple	68.6%	31.4%
Socioeconomic Status*		
Not at all Wealthy	52.5%	47.5%
Not so Wealthy	67.1%	32.9%
Average	75.7%	24.3%
Quite Wealthy	76.4%	23.6%
Very Wealthy	86.3%	13.7%
Living Situation		
Alone	69.8%	30.2%
With Parent(s)	74.6%	25.4%
With Romantic Partner	71.8%	28.2%
With a Roommate	75.6%	24.4%
Marijuana Use (past month)*		
0-2 Times	76.2%	23.8%
> 2 Times	65.3%	34.7%
Binge Drinking (post month)		
0 times	71.0%	29.0%
1-2 Times	74.5%	25.5%
> 2 Times	74.6%	25.4%
Experienced Forced Sex*		
No	74.2%	25.8%
Yes	53.4%	46.6%
Sexual Orientation		
Heterosexual	74.0%	26.1%
Bisexual	70.3%	29.7%
Gay	68.2%	31.8%
> 1 Partner (N = 1,982)		
No	72.6%	27.4%
Yes	75.5%	24.5%
Condom Non-Use (N = 1,971)*		
No	75.8%	24.2%
Yes	70.5%	29.5%
MP+CN (N = 1,971)		
No	73.5%	26.5%
Yes	74.5%	25.5%
No STI-Testing (N = 1,870)		
No	72.3%	27.7%
Yes	74.6%	25.4%
MP+CN+NT (N = 1,861)		
No	74.1%	25.9%
Yes	72.4%	27.7%

Variables that differ significantly across clusters are marked by (*)

Table 9. Weighted distribution of depressive symptom cluster membership relative to the established cut-off score for the CES-D-12 for male (N = 1,982) and female (N= 5,183) students.

		Low Depressive Symptoms	Elevated Depressive Symptoms
	CES-D-12 ≥ 12		
Male Students	No	97.8%	2.2%
	Yes	11.5%	88.5%
	CES-D-12 ≥ 12		
Female Students	No	99.1%	0.9%
	Yes	20.9%	79.1%

Table 10. Unadjusted and adjusted logistic regressions between cluster membership and sexual health risk behaviours among male students (ORs and 95% confidence intervals).

	Low Depressive Symptoms	Elevated Depressive Symptoms
	Unadjusted	
> 1 Partner	1.00	0.86 (0.68, 1.08)
Condom Non-Use	1.00	**1.31 (1.04, 1.64)**
MP+CN	1.00	0.95 (0.71, 1.28)
STI Non-Testing	1.00	0.89 (0.69, 1.15)
MP+CN+NT	1.00	1.09 (0.74, 1.61)
	Adjusted	
> 1 Partner	1.00	0.83 (0.64, 1.07)
Condom Non-Use	1.00	1.23 (0.97, 1.18)
MP+CN	1.00	0.91 (0.66, 1.26)
STI Non-Testing	1.00	0.96 (0.72, 1.27)
MP+CN+NT	1.00	1.15 (0.78, 1.70)

Notes: Bolded values are statistically significant ($p < 0.05$). Controls include: age, ethnicity, socioeconomic status, current living situation, marijuana use and binge drinking in the past 30 days, experience of forced sex while at university, and sexual orientation.

Table 11. Weighted descriptive statistics for female students by depressive symptom cluster (N = 5,183).

	Low Depressive Symptoms (70.6%)	Elevated Depressive Symptoms (29.4%)
Depression Score (z-score)*	-0.5 (0.6)	1.3 (0.8)
Negative Affect (z-score)*	-0.5 (0.5)	1.2 (1.0)
Anhedonia (z-score)*	-0.4 (0.9)	1.0 (1.0)
Somatic Symptoms (z-score)*	-0.4 (0.9)	0.9 (1.0)
Interpersonal Problems (z-score)*	-0.50 (0.5)	1.2 (1.0)
Age (years)	21.1 (2.9)	21.0 (2.9)
Ethnicity		
White	71.2%	28.8%
African	61.4%	38.6%
Aboriginal	61.2%	38.8%
Asian	66.7%	33.3%
Middle Eastern	72.5%	27.5%
Other	68.3%	31.7%
Multiple	66.5%	33.5%
Socioeconomic Status*		
Not at all Wealthy	58.5%	41.5%
Not so Wealthy	62.0%	38.0%
Average	72.0%	28.0%
Quite Wealthy	75.9%	24.1%
Very Wealthy	75.5%	24.5%
Living Situation		
Alone	69.2%	30.8%
With Parent(s)	69.2%	30.3%
With Romantic Partner	72.0%	28.0%
With a Roommate	71.1%	29.0%
Marijuana Use (past month)*		
0-2 Times	72.0%	28.1%
> 2 Times	63.3%	36.7%
Binge Drinking (post month)		
0 times	69.2%	30.8%
1-2 Times	71.7%	28.3%
> 2 Times	70.8%	29.3%
Experienced Forced Sex*		
No	72.3%	27.7%
Yes	50.7%	49.3%
Sexual Orientation*		
Heterosexual	71.8%	28.2%
Bisexual	52.7%	47.3%
Gay	59.0%	41.0%
> 1 Partner (N = 5,183)*		
No	72.9%	27.1%
Yes	66.8%	33.2%
Condom Non-Use (N = 5,163)*		
No	71.9%	28.1%
Yes	69.0%	31.0%
MP+CN (N = 5,163)*		
No	71.7%	28.3%
Yes	65.2%	34.8%
No STI-Testing (N = 4,730)*		
No	68.8%	31.2%
Yes	71.8%	28.2%
MP+CN+NT (N = 4,713)		
No	70.9%	29.1%
Yes	63.7%	36.4%
Effective Contraception Non-Use (N = 5,170)*		
No	70.9%	29.1%
Yes	63.7%	36.4%

Variables that differ significantly across clusters are marked by (*)

Table 12. Unadjusted and adjusted logistic regressions between cluster membership and sexual health risk behaviours among female students.

	Low Depressive Symptoms	Elevated Depressive Symptoms
	Unadjusted	
> 1 Partner	1.00	**1.33 (1.17, 1.53)**
Condom Non-Use	1.00	**1.15 (1.01, 1.31)**
MP+CN	1.00	**1.36 (1.14, 1.61)**
STI Non-Testing	1.00	**0.87 (0.75, 1.00)**
MP+CN+NT	1.00	**1.39 (1.08, 1.80)**
Contraception Non-Use	1.00	**1.65 (1.30, 2.09)**
	Adjusted	
> 1 Partner	1.00	**1.28 (1.10, 1.49)**
Condom Non-Use	1.00	**1.16 (1.01, 1.33)**
MP+CN	1.00	**1.27 (1.07, 1.52)**
STI Non-Testing	1.00	0.91 (0.78, 1.05)
MP+CN+NT	1.00	**1.32 (1.01, 1.72)**
Contraception Non-Use	1.00	**1.50 (1.19, 1.90)**

Notes: Bolded values are statistically significant ($p < 0.05$). Controls include: age, ethnicity, socioeconomic status, current living situation, marijuana use and binge drinking in the past 30 days, experience of forced sex while at university, and sexual orientation.

APPENDIX B: FIGURES

Figure 1. Path diagram of the four-factor model applied to the CES-D-12.

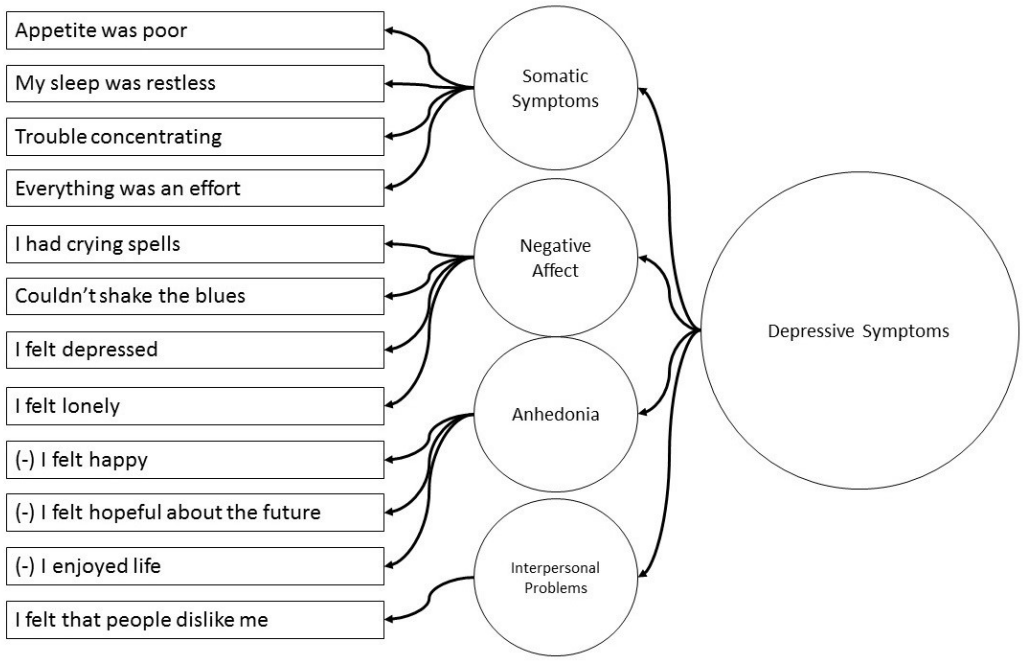


Figure 2. An example of a two-stage cluster analysis procedure.

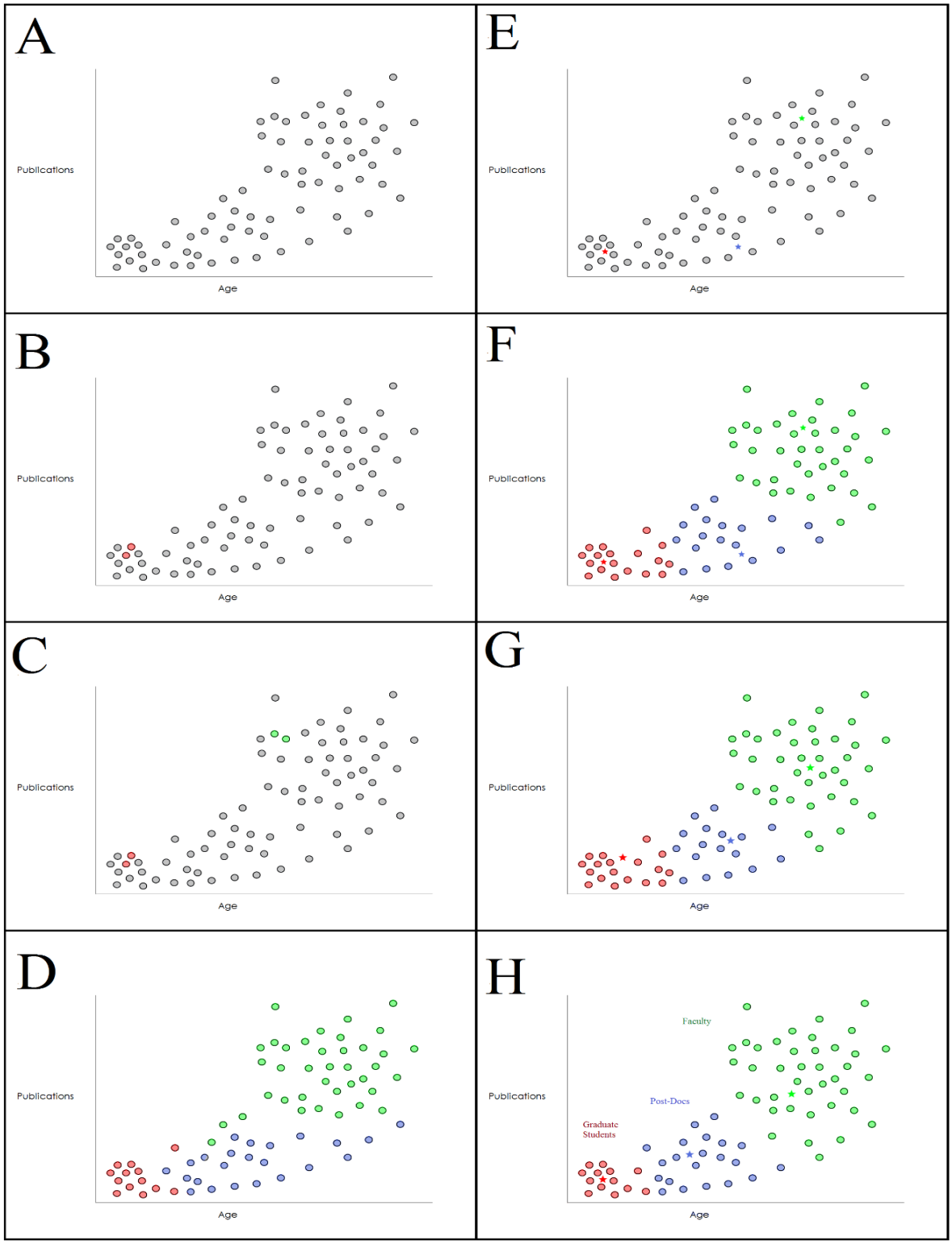


Figure 3: Scree plot for male students

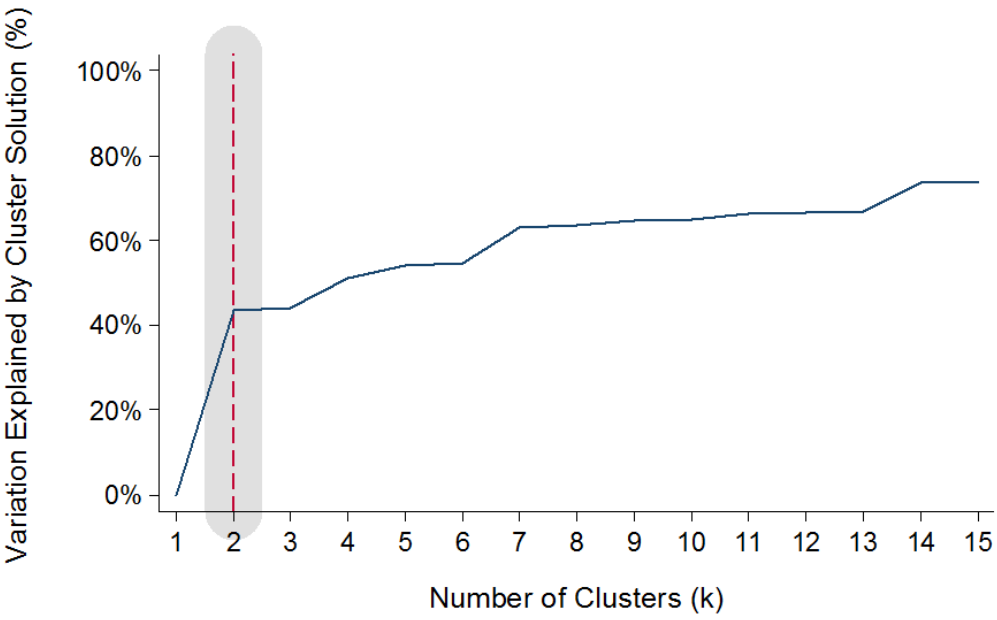


Figure 4: Clustering profile plot for male students

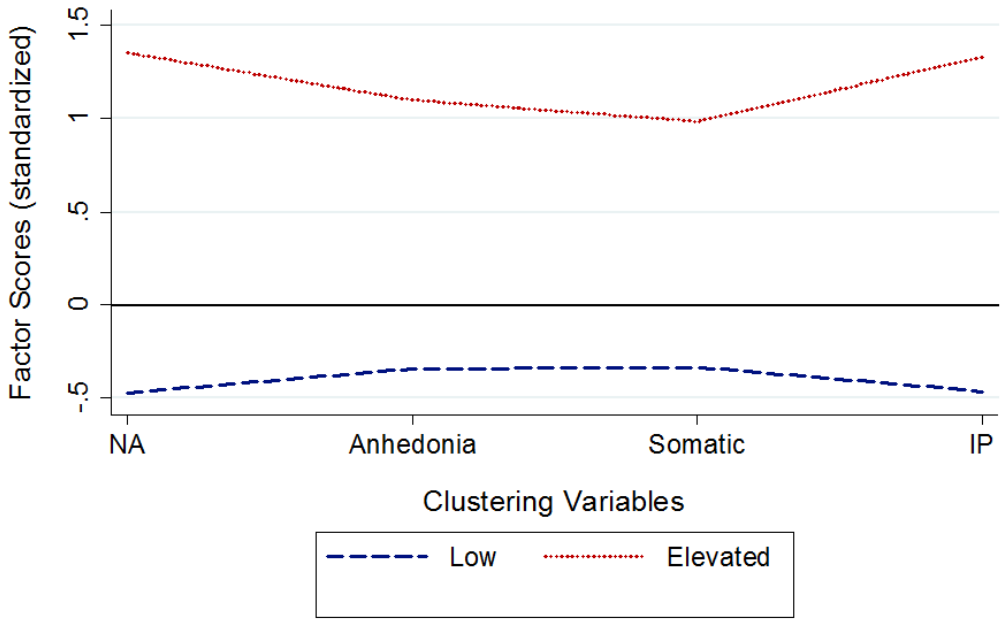


Figure 5: Scree plot for female students

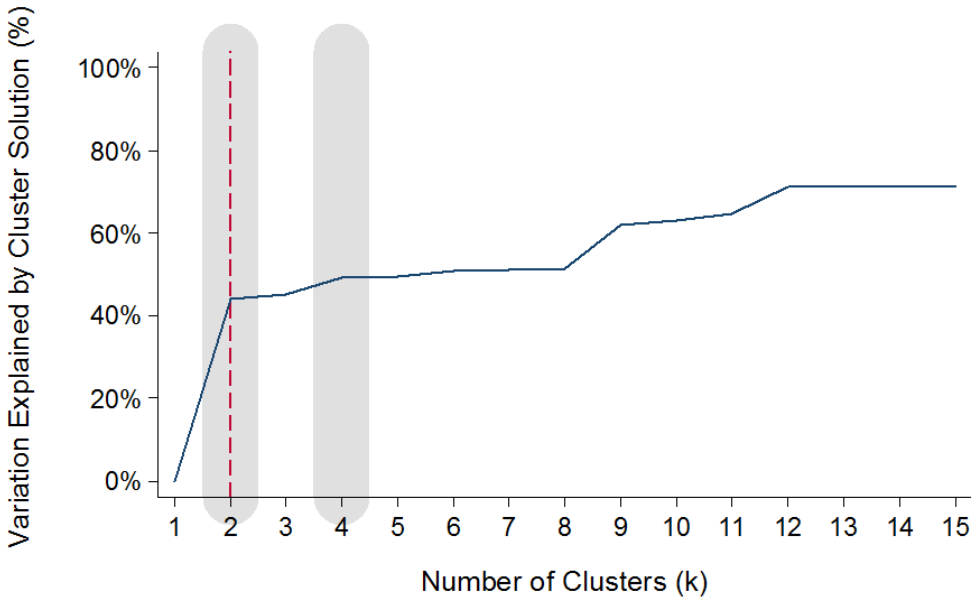


Figure 6: Clustering profile plot for female students

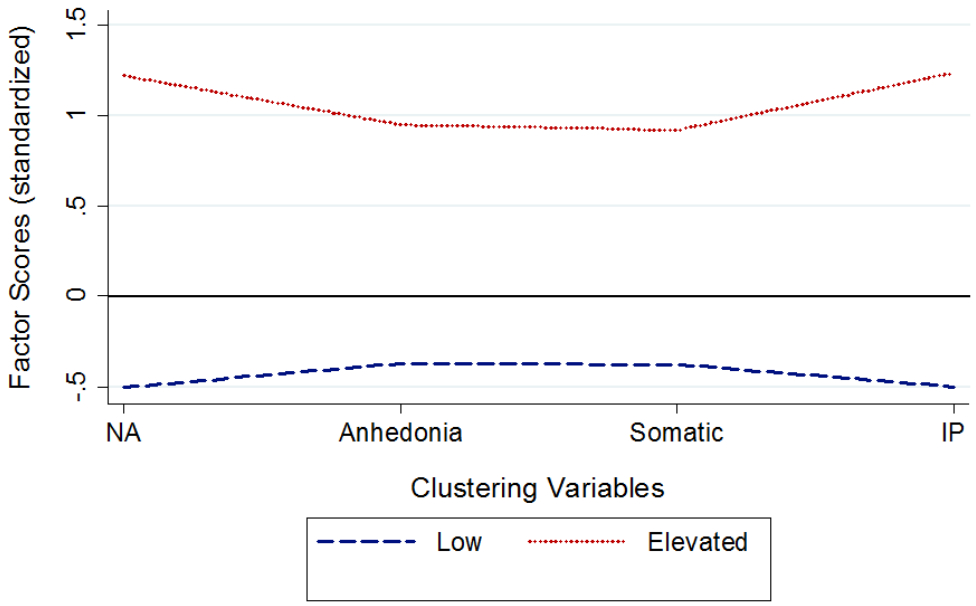
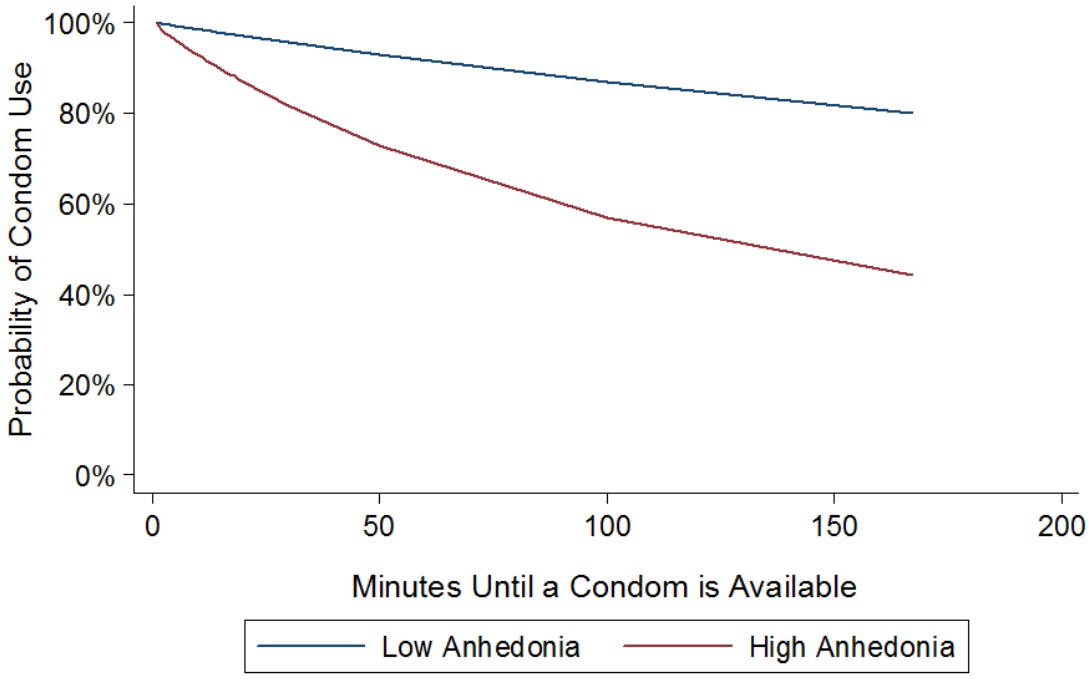


Figure 7: Sexual health delay discounting example.



APPENDIX C: MARITIME STUDENT SEXUAL HEALTH SURVEY

SECTION A – DEMOGRAPHICS

The following questions are about you and your family. For each question please indicate your answer by checking the appropriate box or by answering on the response lines provided for some of the questions. Please note, all these questions are confidential and anonymous and you can skip any question you are not comfortable with.

1. What is your age in years? _____
2. What ethnic/racial background do you consider yourself to be? (*Check all that apply.)*

   □ White (Caucasian)

   □ African descent
   □ Aboriginal (*specify*) _____

   □ Asian

   □ Middle Eastern
   □ Other (*describe*) _____

3. Are you employed for money during the university year?

   □ No

   □ Yes (*If yes, specify how many hours you work each week*)
_____ (*hrs/wk*)

4. What year of your undergraduate program are you in?

   □ First

   □ Second

   □ Third

   □ Fourth

   □ Other (*explain*)
   _____

5. What was the last GPA you received on your University record? If you are in your first year of university, please provide the average grade of your last high school year instead.

    □ My last GPA at University was _____

    OR □ My last high school average grade was _____

6. Who do you live with?

    □ I live alone

    □ I live with one or both of my parent(s)

    □ I live with my partner (i.e., sexual or romantic partner, spouse or girlfriend/boyfriend)

    □ I live with a roommate(s) (not a sexual or romantic partner)

7. What are your living arrangements?

    □ I live off-campus

    □ I live on campus in student residence/housing

8. How important would you say religion is to you?

    □ Not important at all

    □ Not very important

    □ Fairly important

    □ Very important

9. How wealthy do you see your family as being?

    □ Very wealthy

    □ Quite wealthy

    □ Average

    □ Not so wealthy

    □ Not wealthy at all

10. What is your sex?

- □ Male
- □ Female
- □ Transgendered
- □ Other (*describe*) _____

11. People have different feelings about themselves when it comes to questions of being attracted to other people. Which of the following best describes your feelings?

- □ 100% heterosexual (attracted to persons of the opposite sex)
- □ Mostly heterosexual
- □ Bisexual (attracted to both males and females)
- □ Mostly homosexual
- □ 100% homosexual (gay/lesbian, attracted to persons of the same sex)
- □ Transgendered
- □ Not sure

SECTION B – Your Health, Health Knowledge and Social Well Being

The next section asks questions about your health and about your knowledge of sexual health issues. It also asks how you feel about yourself and others. Please remember that all of your answers are anonymous and confidential and you can skip any question you are not comfortable with.

12. In general, would you say that your health is? (C*heck one.*)

- ☐ Excellent
- ☐ Very good
- ☐ Good
- ☐ Fair
- ☐ Poor

13. Please indicate how much you disagree or agree with the following statements by checking the appropriate number on the 5 point scale, *where 1 = "Strongly disagree" and 5 = "Strongly agree*".

	1	2	3	4	5
My friends don't think being in a relationship with one person at a time is cool	☐	☐	☐	☐	☐
My friends mostly have sex for recreation	☐	☐	☐	☐	☐
My friends believe love is not necessary for sex	☐	☐	☐	☐	☐
My friends do not believe in having sex with someone that looks respectable	☐	☐	☐	☐	☐
My friends are not in steady relationships with one person at a time	☐	☐	☐	☐	☐
Many of my friends have sex under the influence of drugs and/or alcohol	☐	☐	☐	☐	☐
My friends show little concern for sex education	☐	☐	☐	☐	☐
My friends don't know/practice safe sex	☐	☐	☐	☐	☐
My friends don't think safe sex is important	☐	☐	☐	☐	☐

14. Please indicate whether you believe each of the following statements are true or false by checking the appropriate response. If you do not know the answer, please do not guess, but answer “Don’t Know”.

	True	False	Don’t Know
If you know a person’s sexual history and lifestyle before you have sex with them, you don’t need to use condoms	☐	☐	☐
Men with chlamydia always have symptoms	☐	☐	☐
Women with chlamydia always have symptoms	☐	☐	☐
Chlamydia infection in women can result in being unable to have children	☐	☐	☐
If a guy or girl aged 18 – 24 gets chlamydia and is treated properly, he or she can never get chlamydia again	☐	☐	☐
If both are used properly, condoms are just as effective as birth control pills in preventing pregnancy	☐	☐	☐
Emergency contraceptive pills are available at pharmacies	☐	☐	☐
Emergency contraceptive pills always prevent pregnancies	☐	☐	☐
To be effective, emergency contraceptive pills must be taken within 12 hours of unprotected sex	☐	☐	☐
Emergency contraceptive pills are more effective the earlier they are taken after unprotected sex	☐	☐	☐
Doctors will always test for STIs when they do a PAP test	☐	☐	☐
The time in the monthly menstrual cycle during which a female is most likely to become pregnant is about two weeks before her period begins	☐	☐	☐

15. We would like to know how you have been feeling about yourself and your life generally. Below is a list of the ways you might have felt or behaved. Please indicate how much of the time you felt this way during the past week checking the appropriate response.

During the past week:	Rarely or none of the time (less than 1 day)	Some or a little of the time (1–2 days)	Occasionally or a moderate amount of the time (3-4 days)	Most or all of the time (5–7 days)
I did not feel like eating: my appetite was poor	□	□	□	□
I felt that I could not shake off the blues even with help from my family or friends	□	□	□	□
I had trouble keeping my mind on what I was doing	□	□	□	□
I felt depressed	□	□	□	□
I felt like I was too tired to do things	□	□	□	□
I felt hopeful about the future	□	□	□	□
My sleep was restless	□	□	□	□
I was happy	□	□	□	□
I felt lonely	□	□	□	□
I enjoyed life	□	□	□	□
I had crying spells	□	□	□	□
I felt that people disliked me	□	□	□	□

16. Please indicate how much you disagree or agree with the following statements by checking the appropriate number on the 5 point scale, where 1 = “Strongly disagree” and 5 = “Strongly agree”.

	1	2	3	4	5
I would think less of myself for needing help	□	□	□	□	□
I don’t like other people telling me what to do	□	□	□	□	□
Nobody knows more about my problems than I do	□	□	□	□	□
I’d feel better about myself knowing I didn’t need help from others	□	□	□	□	□
I don’t like feeling controlled by other people	□	□	□	□	□
It would seem weak to ask for help	□	□	□	□	□
I like to make my own decision and not be too influenced by others	□	□	□	□	□
Asking for help is like surrendering authority over my life	□	□	□	□	□

17. Please describe how true you believe each of the following statements about your social relationships and support networks, where 1 = not at all true and 5 = completely true

	1	2	3	4	5
I participate in volunteer/service projects	□	□	□	□	□
I have meaningful conversations with my parents and or/siblings	□	□	□	□	□
I have a mentor(s) in my life I can go to for support/advice	□	□	□	□	□
I seldom invite others to join me in my social and or/recreational activities	□	□	□	□	□
There is at least one person I feel a strong emotional tie with	□	□	□	□	□
There is no one I can trust to help solve my problems	□	□	□	□	□
I take time to visit my neighbours	□	□	□	□	□
If a crisis arose in my life, I would have the support I need from family and/or friends	□	□	□	□	□
I belong to a club (e.g., sports, hobbies, support group, special interests)	□	□	□	□	□
I have friends from work that I see socially (movie, dinner, sports etc)	□	□	□	□	□
I have friendships that are mutually fulfilling	□	□	□	□	□
There is no one I can talk to when making important decisions in my life	□	□	□	□	□
I make an effort to keep in touch with friends	□	□	□	□	□
My friends and family feel comfortable asking me for help	□	□	□	□	□
I find it difficult to make new friends	□	□	□	□	□
I look for opportunities to help and support others	□	□	□	□	□
I have a close friend(s) who I feel comfortable sharing deeply about myself	□	□	□	□	□
I seldom get invited to do things with others	□	□	□	□	□
I feel well supported by my friends and/or family	□	□	□	□	□

I wish I had more people in my life that enjoy the same interests and activities as I do	□	□	□	□	□
There is no one that shares my beliefs and attitudes	□	□	□	□	□

18. The following are some statements about Emergency Contraception (EC). Please rate whether you agree or disagree with the statements, where 1 = "I completely disagree" and 5= "I completely agree".

	1	**2**	**3**	**4**	**5**
My partner or I could get EC if we needed it	□	□	□	□	□
I could get EC at my university health centre if I wanted to	□	□	□	□	□
I would prefer to go to a pharmacy to obtain EC pills if I or	□	□	□	□	□

SECTION C – HEALTH BEHAVIOURS

The next section asks questions about sexual activity and other health behaviours, and your opinions and feelings about sexuality issues. Please remember that all of your answers are anonymous and confidential and you have the right to skip any question you are not comfortable with.

19. During the past 30 days, how many times did you use marijuana?

□ 0 times

□ 1 or 2 times

□ 3 to 9 times

□ 10 to 19 times

□ 20 to 39 times

□ 40 or more times

20. During the past 30 days, on how many days did you have 5 or more drinks of alcohol in a row, that is, within a couple of hours?

□ 0 days

□ 1 day

□ 2 days

□ 3 to 5 days

□ 6 to 9 days

□ 10 to 19 days

□ 20 or more days

The following questions; Q.s21 (a-e) and 22 (a-d) pertain to heterosexual vaginal intercourse and anal sex (male to male or male to female).

21. Read the following definition of heterosexual vaginal **i**ntercourse and then answer the question below. "Heterosexual vaginal intercourse occurs when a male's penis enters a female's vagina. When this happens, both people are having vaginal intercourse."

Have you **ever** had heterosexual vaginal intercourse? (*Check one.*)

□ I prefer not to answer *[Skip to Question 26(a)]*
□ No *[Skip to Question 26(a)]*
□ Yes

22. How old were you **the last time** you had heterosexual vaginal intercourse? _____ (*Specify your age in years.*)

23. Did you or your partner use a condom the last time you had heterosexual vaginal intercourse?

□ No
□ Yes

24. In the **past 12 months**, with how many people have you had heterosexual vaginal intercourse? _____ person/people (*Please fill in number.*)

25. Which of the following forms of contraception did you and/or your partner use the last time you had heterosexual vaginal intercourse? *(Check all the boxes that apply.)*?

□ Oral contraception (the pill)

□ Intrauterine device (IUD)

□ Depo-Provera (the needle)

□ Contraceptive patch

□ Condom

□ Withdrawal

□ Don't know/Can't remember

□ Other (specify) _____

□ No contraception was used

26. Please read the following definition of anal sex and then answer the question below. "Anal sex occurs when a male's penis enters another person's (male or

female) anus or rectum (their behind). When this happens, both people are having anal sex."

Have you ever had anal sex? (*Check one.*)

- ☐ I prefer not to answer (*Skip to Question 27)*
- ☐ No (*Skip to Question 27*)
- ☐ Yes

27. How old were you **the first time** you had anal sex?

28. Did you use a condom the last time you had anal sex?

- ☐ No
- ☐ Yes

29. In the **past 12 months**, how many people have you had anal sex with?

_____ person/people (*Please fill in number.*)

30. Do you or did you have a steady relationship with the last person you had vaginal or anal sex with?

- ☐ No
- ☐ Yes (S*pecify length of your relationship)* _____*(years)* _____*(months)*

31. In the **past 12 months** have you had a sexual encounter; either vaginal or anal, when you did not plan to because you were under the influence of alcohol or drugs?

- ☐ Yes
- ☐ No

If yes, please specify:

- ☐ Alcohol
- ☐ Drugs
- ☐ Both

32. Have you ever had a sexually transmitted infection (STI) which was diagnosed by a health professional?

- ☐ No
- ☐ Yes (*Specify which STI(s)*)_____

33. With your present sexual lifestyle, how much at risk do you personally feel of becoming infected with a sexually transmitted infection (STI)? *(Check one box only.)*

- ☐ Greatly at risk
- ☐ Quite a lot at risk

□ Not very much at risk

□ Not at all at risk

34. Since you have been at university, have you ever been forced to have sex of any type against your will?

□ No

□ Yes

SECTION D– Use of Health Care Services

This section asks about the health care services provided by your university health centre, both in general and concerning your use of sexual health services. Please remember that all of your answers are anonymous and confidential. You have the right to refuse to answer any of these questions.

35. Have you visited your student health centre in the past 12 months to pick up written material such as pamphlets or brochures about sexual health concerns or other health related issues?

□ No

□ Yes

36. Have you ever seen a doctor or a nurse at your university health centre for any reason?

□ No *(Skip to Question 42.)*

□ Yes

(R*eason for last visit*) _____

37. In the past 12 months, about how often did you see your doctor or nurse at your university health centre? If this is your first year at university, please indicate how often you have seen your doctor or nurse at your university health centre since you first arrived.

□ More than once per month

□ About once per month

□ Less than once per month

38. Please indicate if any of the following is a reason for your using your university health centre (*Check all that apply*)

□ I am more comfortable at my university health centre than I am with my family doctor

□ The staff at my university health centre are friendly and approachable

□ It's confidential – the reason for my visit will be kept secret from other people

□ The university health centre provides the information that I need in a way that I can understand

□ The university health centre is convenient to use because it is on campus

□ I don't get judged for going there.

□ It's the only option I have available when I have a concern

39. Have you continued to use your university health centre since your first visit?

□ No

□ Yes ⟶ If "Yes" go to the next Question

If "No" why have you not continued to use your university health centre? (Check all that apply.)

□ I felt that I was judged by the nurse/doctor during my last visit

□ I did not find it easy to discuss my needs or concerns with the doctor/nurse

□ The hours and location are inconvenient

□ There was no reason for me to go to my university health centre more than once

□ Other (*specify)* _____

40. Please rate your level of satisfaction with the sexual health service(s) you have received at your university health centre by checking the appropriate number on the 5 point scale, where 1 = “not at all satisfied” and 5 = “very satisfied”. Please check N/A (not applicable) if you have never accessed such services.

Type of service	1	2	3	4	5	N/A
Counselling about use of condoms	□	□	□	□	□	□
Counselling about sexually transmitted infections	□	□	□	□	□	□
Testing for sexually transmitted infections	□	□	□	□	□	□
Counselling about violence/abuse in relationships	□	□	□	□	□	□
Discussing issues related to sexual orientation	□	□	□	□	□	□
Discussing other sexual health issues	□	□	□	□	□	□
Pregnancy testing	□	□	□	□	□	□
Provision of educational pamphlets and brochures about sexual health	□	□	□	□	□	□
Referral to another health care provider about sexual health	□	□	□	□	□	□
Provision of emergency contraception	□	□	□	□	□	□
Counselling about or prescription for birth control	□	□	□	□	□	□
Pap testing	□	□	□	□	□	□

41. Please rate the following characteristics of your university health centre staff with respect to any sexual health services you have received from them (counselling about relationships, preventing sexually transmitted infections, etc.), where 1 = “poor service ” and 5 = “excellent service”. If you have not received any sexual health services, or the question does not apply to your experiences, please check N/A (not applicable).

Characteristics of care:	1	2	3	4	5	NA
They are not judgmental about my sexual activity	□	□	□	□	□	□
They take time to explain things about sexual health	□	□	□	□	□	□
They address the sexual health issues for which I come to the health service very well	□	□	□	□	□	□
They let me stay in control of available options during visits about sexual health	□	□	□	□	□	□
The same person sees me on every visit that I have about sexual health	□	□	□	□	□	□

THE FOLLOWING QUESTIONS ARE FOR <u>EVERYONE</u> - BOTH THOSE WHO HAVE USED THEIR UNIVERSITY HEALTH SERVICES AND THOSE WHO HAVE NOT USED THEM

42. How important would you say the following features of a university health centre are in general, where 1 = “not at all important” and 5 = “extremely important”?

Features	**1**	**2**	**3**	**4**	**5**
The range of services available	□	□	□	□	□
The atmosphere of the waiting area	□	□	□	□	□
The privacy of the reception area	□	□	□	□	□
The friendliness of the people working there	□	□	□	□	□
Confidentiality about students’ health information is	□	□	□	□	□
Hours of operation	□	□	□	□	□
Transportation to the university health centre	□	□	□	□	□
Length of time you have to wait to be seen	□	□	□	□	□
The location of the university health centre	□	□	□	□	□

43. How applicable to students’ needs would you say the following services, which can be provided by a university health centre, are where 1 = “not applicable to students’ health needs” and 5 = “very applicable to students’ health needs”.

Type of service	1	2	3	4	5
Counselling about birth control and/or free condoms	□	□	□	□	□
Counselling about having sex for the first time	□	□	□	□	□
Counselling about sexually transmitted infections	□	□	□	□	□
Counselling about HIV/AIDS	□	□	□	□	□
Discussing issues related to my sexual orientation	□	□	□	□	□
Counselling about other sexual health issues	□	□	□	□	□
Counselling about other worries to do with sex and sexuality	□	□	□	□	□
Pregnancy testing	□	□	□	□	□
Emergency contraception (sometimes called the morning after	□	□	□	□	□
Educational pamphlets and brochures about sexual health	□	□	□	□	□
Referral to another health care provider about sexual health	□	□	□	□	□

The following questions concern your preferences for accessing sexual health services at your university health centre

44. When would it be convenient for you to visit your university health centre? (*Check all that apply.*)

    - ☐ In the morning before classes
    - ☐ Lunchtime
    - ☐ Afternoon
    - ☐ Evenings
    - ☐ Saturday

45. What do you think would be the best way for us to tell students about the university health centre? (*Check only one*)

    - ☐ University admission letter
    - ☐ Visit to the clinic during student orientation
    - ☐ Visit to first year classes by health centre staff
    - ☐ Posters on student information boards
    - ☐ Leaflets around campus
    - ☐ Internet (e.g. a web site, email newsletters, etc.)
    - ☐ Other (*specify*)

      _____

46. If you had a choice of the sex of the doctor/nurse that you see at your university health centre which would you choose? (*Check only one*)

    - ☐ I would like to be seen by a female doctor/nurse
    - ☐ I would like to be seen by a male doctor/nurse
    - ☐ It's not important

47. Have you ever seen a health professional in order to obtain the following services? If you answer 'Yes' for a particular service, please indicate the location where you access that service.

Service:	Accessed?		If yes, please indicate location	
	Yes	**No**	**University health centre**	**Other**
STI testing	☐	☐	☐	☐
PAP testing	☐	☐	☐	☐
HIV/AIDS testing	☐	☐	☐	☐
Pregnancy testing	☐	☐	☐	☐

48. If you have never been to your university health centre please indicate below why you did not go. (*Check all that apply.*)

☐ I haven't had any health concerns

☐ I don't think a nurse/doctor can help me with my concerns

☐ I don't think a nurse/doctor will understand gay, lesbian or bisexual issues

☐ The university health centre was not open when I wanted to use it

☐ I don't trust the university health centre to keep my health information confidential

☐ I went elsewhere with my health concerns over the past year (If so, please indicate where)

_____

☐ Other reasons (*specify*)

_____

49. Do you have any suggestions on how to improve the overall health services provided at the university health centre?

_____

_____

50. Do you have any suggestions on how to improve the sexual health services and or information provided at the university health centre?

_____

_____

51. How did you find out about this study? (Check all that apply)

- ☐ Email
- ☐ Facebook/Twitter
- ☐ University news (e.g. newsletter, web page, etc.)
- ☐ Poster
- ☐ Student told me
- ☐ Professor told me
- ☐ Other (specify) _____

Thank you for participating in our survey. This information will be used to help improve student health services.

APPENDIX D: CLUSTER ELBOW PROGRAM CODE

```
capture program drop cluster_elbow

program define cluster_elbow
        version 13.1
        syntax [anything(name=clname)] [, K(numlist integer min=1) * ]

        cluster query
        local clname `r(names)'

        qui {
                cluster query `clname'
                        local cluslist `r(o2_val)'

                forvalues i = 1/`k' {
                        cluster generate `clname'_grp = groups(1/`k'), name(`clname')
                        centroid `cluslist', group(`clname'_grp`i')
                        generate average_dist`i' = .
                        quietly summarize `clname'_grp`i', meanonly
                        forvalues p = 1/`r(max)' {
                                replace average_dist`i' = DIST`p'^2 if `clname'_grp`i' == `p'
                        }
                        *
                        egen total_dist`i' = total(average_dist`i')
                        generate percentvar`i' = (1 - (total_dist`i'/total_dist1))*100
                        drop DIST* average_dist* `clname'_grp*
                }
                *

                generate tempv = 1
                profileplot percentvar*, ///
                by(tempv) graphregion(color(white)) ///
                ylabel(0 "0%" 20 "20%" 40 "40%" 60 "60%" 80 "80%" 100 "100%", nogrid angle(0)) ///
                xlabel(1 "1") ///
                xtitle("Number of Clusters (k)", height(+7.5) size(medium)) ///
                ytitle("Variation Explained by Cluster Solution (%)", height(+7.5) size(medium)) ///
                yscale(range(0 100)) msymbol(i) legend(off) ///
                title("Elbow Plot" " ", linegap(10) bexpand ///
                size(medium) color(black) justification(left) span)

                drop tempv total_dist* percent*
        }
        *
end
```