Bachelor of Science

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Associations of Perceived Stress, Depressive Symptomatology and Cannabis Use among Students at the University of Twente

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Abstract

Background: Previous research in terms of cross-sectional or longitudinal studies aimed to explain the relationships between perceived stress, mental health of adolescents and substance use. Yet, the concepts have only been solitarily associated with each other. It is not fully understood how all these concepts are associated among one another. Neither is clear whether significant differences between cannabis users and non-users in relation to the experience of perceived stress and depressive symptomatology exist.

Aim: This study aimed to identify the prevalence of perceived stress, depressive symptomatology and cannabis use among students at the University of Twente. Additionally, this research aimed to test for significant differences between two groups, cannabis users and non-users in relation to perceived stress and depressive symptomatology. Further, this researched aimed to check for significant correlations among the concepts mentioned, and to control for depressive symptomatology as possible mediator in the relationship between perceived stress and cannabis use.

Methods: This study (N = 1429) used a cross-sectional online survey-based design. Frequency analyses were used to identify the prevalence of perceived stress, depressive symptomatology and cannabis use among students. An independent samples t-test was used to test for differences between groups. Pearson Correlation was used to analyse associations between the concepts and multiple linear regression analyses were used to identify depressive symptomatology as possible mediator between perceived stress and cannabis use.

Results: Perceived stress appeared to be moderate. A considerable amount of the population was identified with either mild, moderate or severe depressive symptomatology and the prevalence of cannabis use among students was heightened. It could be shown that cannabis users and non-users differ significantly in the experience of depressive symptomatology but not in levels of perceived stress. Perceived stress could not be shown to be correlated with cannabis use, yet, perceived stress was correlated with depressive symptomatology and depressive symptomatology with cannabis use. Depressive symptomatology could not be proven to function as mediator in the relationship between perceived stress and cannabis use.

Conclusion: The results found underline the importance of preventing high levels of perceived stress and depressive symptomatology among students. Further research is needed to assess and evaluate appropriate means to handle student stress and well-being.

Keywords: Perceived Stress, Depression, Substance Use, Cannabis

Introduction

Stress is a frequently used term in our society to describe the response of an individual to challenging experiences in social, academic and employment settings. The transition to university can yield major life changes for an individual that may be experienced as stress in everyday life. Fisher & Hood (1987) investigated the effects of university transition and found that all first-year students showed increased psychological distress following the transition to university. This heightened psychological distress may be explained by different facets that accumulate to the experienced stress level of the individual. It has been shown that daily life hassles, such as academic performance pressure as well as social relations and financial burdens, were significantly correlated with psychological symptoms (Lu, 1994; Tavloacci, 2013). Furthermore, research has shown that the demands of modern life often predicted the onset of somatic complaints in adolescents. Subjectively experienced internal and external academic or social demands interact to collaboratively negatively affect students' academic performance and achievement (Lu, 1994; Ribeiro et al., 2018). The study of D'Angelo & Wierzbicki (2003) has shown that combined effects of daily stressors are significant predictors for the occurrence of depressive symptoms and symptoms of anxiety. This comes as no surprise as the most common psychological problems of adolescence have been found to be depression and anxiety and that these symptoms are significantly correlated with the experienced stress level of the individual (Al-Qaisy, 2011; Wei & Sha, 2003).

Circumstances at today's universities bear tremendous amounts of stress for their students with significant negative implications in domains of mental well-being. In our nowadays highly competitive academic environments, students experience more stress than ever (Sreeramareddy et al., 2007).

Coping with Stress

To cope with stress in everyday life as well as mental health problems, coping strategies such as emotional regulation, thought process and/or behavioural strategies are used. It is believed that 'coping is founded in an individual's psychological response to stress, their appraisals of events of, their attention and their goals or outcomes they desire.' (Pierceall & Keim, 2007, p.41). It is increasingly recognized in today's literature that 'how individuals cope' with certain stressing situations is the most influencing and mediating factor for consequences that may arise through stress (Pierceall & Keim, 2007).

One coping strategy individuals have reported to engage in, when dealing with stress, is substance use (Chiong, 2008). Since coping strategies rely on the social context as well as the

individual's appraisal of a certain situation, coping styles may function as an influence on one's risk appraisal for engaging in substance use (Chiong, 2008; Cohen & McKay, 1984). Individuals, who most often rely on dysfunctional coping strategies to handle everyday life, may experience more unpleasant emotions such as anger, frustration, sadness or unresolved problems. If an individual comes to experience these negative feelings on a regular basis, if not chronically, these feelings may incline an individual to reappraise the use of specific substances. Consequently, the individual might show greater acknowledgement for potential positive effects of substance use while also minimizing possible negative effects. Individuals, who continuously rely on dysfunctional coping strategies as means to cope with stressful situations, then may mistakenly perceive harm from substance use as progressively insignificant, while simultaneously increasing one's positive expectancies regarding the substances being used (Chiong, 2008).

Among young adults, the most common substances used are alcohol, tobacco and cannabis (Tavolacci, 2013). Worldwide, cannabis counts as the most frequently used illegal substance, whereas in some countries (e.g. Uruguay, Canada, Netherlands) cannabis does not possess the status of an illegal substance. While approximately 80.5 million Europeans (15-64 years of age) reported to have used cannabis at least once in their life, the lifetime prevalence estimates for cannabis use are between 10 - 30% for the adult population (Karila et al, 2014). In the Netherlands, in 2016, 15,7% of the population of young adults (15-34 years of age) reported to have used cannabis in the last year whereas for adolescents (15-24 years of age) alone, this percentage is increased to 17.7% (EMCDDA, 2018).

Stress, Depression and Cannabis Use

Common stressful life events are not only associated with distressing mental health symptoms such as depression and anxiety, they are also associated with substance use in young adolescents (Tavolacci, 2013). The study of Davis, Uezato, Newell & Frazier (2008) showed that almost one-third of individuals identified with major depressive disorder (MDD) also showed symptoms of comorbid substance use disorders. This comorbidity between MDD and substance use has been shown to bear increased risk for suicidal behaviour as well as elevated social and personal impairment (Danielson, Overholser & Butt, 2003; Davis et al., 2008).

Mental health and substance use disorders have been frequently discussed in previous literature. Prevalence rates for depression and substance misuse in adolescents, based on population-based surveys, are estimated to be as high as 15% for depression and 10% for substance misuse (Low, 2012). Frighteningly, both these disorders have also been shown to be

associated with severe co-morbidities such as anxiety disorders (Merkangas, 1998), underachievement in age-appropriate social skills, delinquency and increased suicidal behaviour (Low, 2012; Danielson et al., 2003; Davis et al., 2008).

The study of Saban et al. (2014) found that mood and anxiety disorders were significantly associated with substance use, while a particular strong relationship between cannabis use and mental disorders could be observed. Horwood et al. (2012) added to this observed relationship between cannabis use and mental disorders as their study showed that more frequent cannabis use is associated with increased depressive symptoms in adolescents (Howood et al., 2012).

The authors Vargas and Trujillo (2012) see stress as a possible risk factor for individuals to indulge in cannabis use. The authors argue that individuals, on a psychological level, might seek for a temporary escape from their environment, thus using negative reinforcement mechanism by using cannabis. Studies on the topic of psychological stressors and consumption of drugs underline this hypothesis by providing associations between psychological distress, social anxiety, perceived stress and/or negative life events and drug use as well as cannabis use in the context of coping with emotional pain (Beck et al., 2009; Hyman & Sinha, 2009; Vargas & Tujillo, 2012).

However, cannabis has not only been associated with mood and anxiety disorders. On the contrary, the acute negative consequences of cannabis use range from impaired coordination and performance to anxiety and psychotic symptoms. Studies suggest that frequent and continuous use of cannabis can have adverse effects on both mental and physical health (Karila et al., 2014). More than that, chronic effects of cannabis use include mood disorders, exacerbation of psychotic disorders in vulnerable people, cannabis use disorders, withdrawal syndrome and neurocognitive impairments (Karila et al., 2014).

Aim of this Study

Despite various cross-sectional and longitudinal studies that aimed to explain the relationships between perceived stress, mental health of adolescents and substance use, these concepts are not yet fully understood. Previous research has solitarily investigated the relationship between the concepts of perceived stress and depressive symptomatology, perceived stress and cannabis use as well as depressive symptomatology and cannabis use. However, it is not fully understood how all these concepts stand in relation to each other.

Further, it has not been investigated whether cannabis users and non-users differ in the experience of perceived stress or depressive symptomatology. Cannabis use could be shown to

function as coping mechanism for perceived stress and that more frequent cannabis use has been shown to be associated with elevated depressive symptomatology (Hyman & Sinha, 2009; Howood et al., 2012). Hence, it is believed that cannabis users show decreased levels of perceived stress but increased depressive symptomatology in comparison to non-users. It is therefore increasingly interesting if perceived stress and depressive symptomatology are significantly correlated in both groups and whether the two groups differ in the experience of perceived stress and depressive symptomatology.

Although significant relationships between all three concepts have been proven to exist, it has not yet been investigated what role depressive symptomatology plays in the relationship between perceived stress and cannabis use or if depressive symptomatology may function as a possible mediator between the two.

Clark (2014) showed that depression functioned as full mediator between perceived discrimination and recent cannabis use. Since perceived discrimination can be argued to contribute towards the perceived stress level of an individual, it seems reasonable to assume that depressive symptomatology may function as mediator between the overall perceived stress level of an individual and recent cannabis use. Further, it could be shown that emotional pain is one of the main factors for individuals to engage in cannabis use (Beck et al., 2009). Moreover, stress could be shown to negatively affect an individuals' ability to appropriately execute prosocial decisions and behaviour, similar to depression, which in turn may result in cannabis use as means to cope with perceived stress (Fischbein et al., 2009; Hyman & Sinha, 2009;Vargas & Tujillo, 2012). Consequently, it seems reasonable to assume that depressive symptomatology may mediate the possible relationship between perceived stress and cannabis use.

This research may not fully explain these relationships or provide details about the causation of these relationships, but aims to illuminate the associations between perceived stress and cannabis use, perceived stress and depressive symptomatology as well as depressive symptomatology and cannabis use. This research also intends to test for and illuminate differences between cannabis using students and students who do not use cannabis, so that the effect of cannabis on the well-being of students can be better understood. Additionally, this study aims to clarify the role of depressive symptomatology as possible mediator between the possible relationship of perceived stress and cannabis use in a population of students at the University of Twente, in the Netherlands. This means that this research tries to explain the relationship between perceived stress and cannabis use by identifying depressive

symptomatology as one underlying factor for this relationship. Subsequently, the research questions for this research can be formulated as follows:

- What is the prevalence of perceived stress, depressive symptomatology and cannabis use among students at the University of Twente?
- Are students who used cannabis in the last year and those who did not significantly different from each other in terms of perceived stress and depressive symptoms?
- Is there a significant correlation between perceived stress and depressive symptoms among students?
    - Is there a significant correlation between perceived stress and depressive symptoms among students who used cannabis in the last year?
    - Is there a significant correlation between perceived stress and depressive symptoms among students who did not use cannabis in the last year?
- Is there a significant correlation between perceived stress and cannabis use?
- Is there a significant correlation between depressive symptoms and cannabis use?
- Do depressive symptoms mediate the possible relationship between perceived stress and cannabis use?

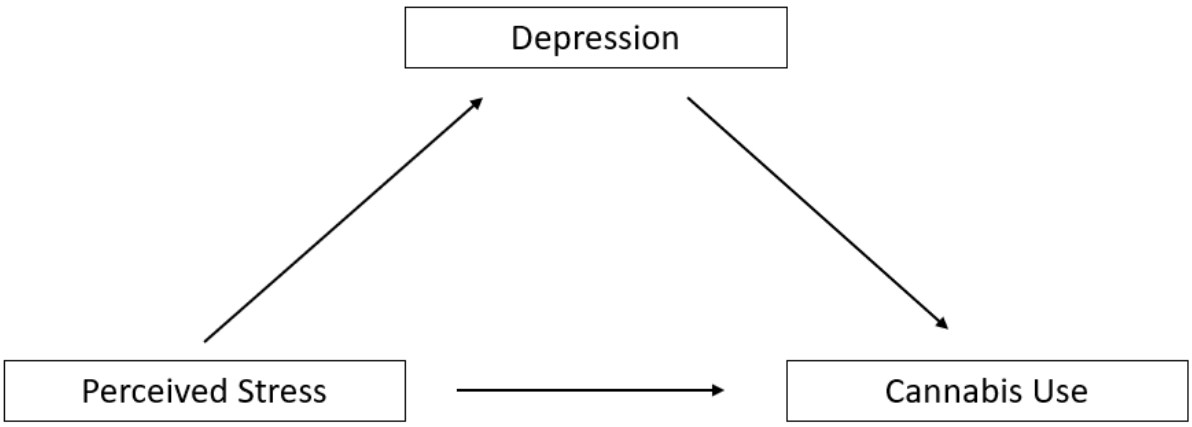

Figure 1. Hypothesised model for the mediation of depression between perceived stress and cannabis use

Hypotheses

Cannabis use as been identified as coping mechanism for perceived stress (Hyman & Sinha, 2009). A significant strong relationship between cannabis use and mood and anxiety disorders could be proven to exist (Saban et al., 2014). Daily stressors are significant predictors for the occurrence of depressive symptoms and more frequent cannabis use is associated with elevated depressive symptomatology in adolescents (Horwood et al., 2012; D'Angelo & Wierzbicki, 2003). Hence, the following is hypothesized:

Hypothesis 1a *(H1a)* There is a significant difference between 'Cannabis Users' and 'Cannabis Non-Users' regarding self-reported levels of perceived stress.

Hypothesis 1b *(H1b)* There is a significant difference between 'Cannabis Users' and 'Cannabis Non-Users' regarding self-reported levels of depressive symptoms.

Hypothesis 2a *(H2a)* There is a significant correlation between 'Perceived Stress' and 'Depressive Symptoms'.

Hypothesis 2b (*H2b*) There is significant correlation between 'Perceived Stress' and 'Depressive Symptoms' among 'Cannabis Users'.

Hypothesis 2c (*H2c*) There is significant correlation between 'Perceived Stress' and 'Depressive Symptoms' among 'Cannabis Non-Users'.

Since perceived stress is associated with substance use in adolescents and that one third of individuals diagnosed with MDD also show symptoms of secondary substance use disorders (Davis et al., 2008; Tavolacci, 2013), it is hypothesized that:

Hypothesis 3 *(H3)* There is a significant correlation between 'Perceived Stress' and 'Cannabis Use'.

Hypothesis 4 *(H4)* There is a significant correlation between 'Depressive Symptoms' and 'Cannabis Use'.

Cannabis use has been shown to be consistently related to depression in the context of coping with emotional pain (Beck et al., 2009). Stress could be shown to negatively impact an individuals' ability to effectively generate and execute prosocial decisions and behaviour, similar to depression (Fischbein et al., 2009). This may consequently lead an individual to engage in cannabis use as means to cope with either perceived stress or emotional pain. Depression has also been shown to fully mediate the relationship between perceived discrimination and recent cannabis use (Clark, 2014). Since perceived discrimination can be argued to function as a source of stress for the individual in question, it seems reasonable to assume that depressive symptomatology may also function as full mediator between more general perceived stress and cannabis use. Therefore, it is hypothesized that:

Hypothesis 5 *(H4)* 'Depressive Symptoms' fully mediates the possible relationship between 'Perceived Stress' and 'Cannabis Use'.

Methods

Design

For this research, a cross-sectional online survey-based design was used to measure perceived stress levels, mental well-being (positive and negative facets) as well as substance use prevalence among a student population at the University of Twente, in the Netherlands. A questionnaire was employed to examine the variables 'Perceived Stress', 'Depressive Symptoms' and 'Cannabis Use'. Additionally, this research focuses on differences between two groups, cannabis users and non-users in relation to perceived stress and depressive symptomatology. Lastly, the possible mediating role of 'Depressive Symptoms' between the variables 'Perceived Stress' and 'Cannabis Use' was investigated.

Participants

To be included in this research, participants had to be full-time enrolled in any study program offered by the university. Participants were asked to participate in this study via an e-mail that was sent to every student, who was enrolled in any study program at the University of Twente at the given time. Participants had to have filled in more than 50% of the questionnaire and range in age between 18 and 80. To analyse the validation or falsification of the hypothesis H5, participants had to have used cannabis at least once during the last year and completed all three subscales regarding perceived stress, depressive symptomatology and cannabis use.

Respondents were excluded from this research or further analysis if they did not meet these criteria.

Altogether, 2057 responses have been collected. After the exclusion of participants that did not meet the inclusion criteria, the first group that filled out the 'Perceived Stress' scale consisted of 1347 individuals, the second group 'Depressive Symptoms' included 1360 individuals and the third group 'Cannabis Use' consisted of 1285 individuals. The group of participants that filled in all three questionnaires and indicated that they used cannabis in the last year, consisted of 439 individuals. Respondents ranged from 18 to 48 years of age, with an average age of 22 years (SD=3). More detailed information about participants is displayed in Table 1.

Table 1

Demographic Characteristics of Participants

Characteristics	Frequency	Percent
All Valid Participants	1429	100%
Perceived Stress	1347	94,26%
Depressive Sym.	1360	95,17%
Cannabis Use	1285	89,92%
Cannabis Users	439	34,16%
Cannabis Non-Users	846	65,84%
Gender		
Male	759	53,1%
Female	660	46,2%
Other	10	0.7%
Age		
Mean	22.17	
Median	22	
Nationality		
Dutch	1033	72,3%
German	152	10,6%
Other	244	17,1%
Current Study Year		
Year 1	303	21,2%
Year 2	252	17,6%
Year 3	286	20%
Pre-Master	27	1,9%
Master	561	39,3%

Materials

The questionnaire used for this research consisted of 40 items. It was estimated that the duration for the completion of the whole questionnaire would take approximately 20 minutes. For assessing the demographics of participants, 16 items were used that included questions about age, gender, nationality and enrolled study program. This research, however, only used two subscales, namely the 14-item 'Perceived Stress Scale' (PSS-14), which assess the subjectively experienced stress level of individuals and the nine-item 'Brief Patient Health Questionnaire Mood Scale (PHQ-9), which measures symptoms of depression. To assess substance use among students at the university, one question was included where participants could indicate their prevalence of substance use for the most common substances (Alcohol, Nicotine, Cannabis/Marijuana, MDMA, Cocaine etc.). Participants were asked to report on their substance use over the course of the last year, ranging on a nine-point Likert-scale from 'Never' to 'Daily'.

The 'Perceived Stress Scale' (PSS-14) has been used in this research due to appropriate psychometric properties. To assess internal consistency reliability, Cronbach's alpha is most commonly used and a value of >.70 is seen as the minimum measure of internal consistency (Lee, 2012). Cronbach's alpha for the PSS-14 has been found to have a value of >.70 in 11 out of 12 studies, thus indicating appropriate internal consistency reliability (Lee, 2012). In this study, Cronbach's alpha for the PSS-14 had a value of .864, indicating excellent reliability. Additionally, test-retest reliability has been considered and evaluated by using correlation coefficients from other studies. Here, Pearson's, Spearman's and the intraclass correlation (ICC) have been used for which value of >.70 again is recommended. The PSS-14 showed a coefficient value of >.70 in two out of three studies (Lee, 2012), which show appropriate test-retest reliability for the admission in this questionnaire.

Moreover, the 'Brief Patient Health Questionnaire Mood Scale (PHQ-9) was administered in the present study due to excellent psychometric properties. Cronbach's alpha for the PHQ-9 could be shown to be as high as 0.89, whereas the test retest reliability in one study was found to be as high as 0.84 (Kroenke, Spitzer & Williams, 2001). Cronbach's alpha for the PHQ-9, in this study, had a value of 0.84, consequently indicating sufficient and favourable reliability.

Procedure

Previous to the publication, the study has been approved by the Ethical Committee of the University of Twente where the research was conducted. The researchers then proceeded with the recruitment of participants. An email, which was signed by the rector of the University of

Twente, was sent to every student enrolled in any study program at the University of Twente, at the given time. The email contained the hyperlink to the Research & Experience-platform Qualtrics, where the questionnaire could be found and completed. Before filling in the questionnaire, participants were welcomed to the study and introduced to the background of the researchers who were conducting the study. The participants were informed about the research and about a timeframe of 20-25 minutes duration for the completion of the questionnaire. An informed consent was provided to each participant (Appendix 1) which assured that it can be withdrawn from the study at any time without further consequences. Furthermore, the participants were informed about the anonymization and the confidentiality of their data. The participants had to indicate that they agree to participate and, thus, also agreed to the informed consent. The participants were then led to the next page and could proceed to complete the questionnaire. Since a well distributed dataset was hoped for, the order of the various subscales and items was random. The data was collected over a period of 6 weeks, starting at the 01st of April 2019 and ending at the 14th of May 2019.

Data analysis

After the initial data collection period, the raw data set was obtained via 'Qualtrics'. The dataset was then screened for invalid responses. Participants have been excluded from the research if they took less than ten minutes to complete the questionnaire, were younger than 18, older than 80 or filled in less than 50% of the questionnaire. For further analyses regarding the validation or falsification of the hypotheses, two subsets of the variable 'Cannabis Use' were used. 'Cannabis Use' resembled all individuals that answered this question. 'Cannabis Users' included only participants that answered to have used cannabis at least once in the last year and 'Cannabis Non-Users' contained all individuals that never used cannabis, or not in the last year. After screening the data, missing values have been calculated using SPSS Statistics v24. It could be shown that for the PHQ scale approximately 4,8% were missing. For the PSS scale approximately 5,7% of data was missing and for the question regarding cannabis use approximately 10,1%. For the variables (IV = 'Perceived Stress') and (DV = 'Depressive symptoms') mean scores, standard deviations, Cronbach's alpha as well as Skewness and Kurtosis were calculated (see Table 1). For the variable 'Cannabis Use' and the subsets 'Cannabis Users' and 'Cannabis Non-Users' only Skewness and Kurtosis were calculated.

Since the sample size of each subscale and the subsets of 'Cannabis Use' exceeded 300, an absolute skew value of 2 or smaller and an absolute kurtosis value of 7 or smaller were used as cut-off scores to validate the statistical analyses (Kim, 2013). The calculations showed that

'Perceived Stress' is normally distributed with skewness of -.069 (SE = .067) and kurtosis of -.380 (SE = .133). 'Depressive Symptoms' showed normal distribution as well with skewness of .687 (SE = .066) and kurtosis of -.074 (SE = .133). 'Cannabis Use' was slightly left skewed with a skewness of 1.329 (SE = .068) and kurtosis of .684 (SE = .136), nevertheless, being between the cut-offs scores and thus validating the statistical analyses. 'Cannabis Users' could be shown to have a skewness of .602 (SE = .117) and kurtosis of -.664 (SE = .233) indicating normal distribution, whereas 'Cannabis Non-Users' was also normally distributed with skewness of 1.937 (SE = .084) and kurtosis of 1.755 (SE = .168). Consequently, the calculations showed that all statistical analyses could be validated regarding normality of the data.

In order to answer research question 1 '*What is the prevalence of perceived stress, depressive symptomatology and cannabis use among students at the University of Twente?*', frequency analyses for the variables 'Perceived Stress', 'Depressive Symptoms' and 'Cannabis Use' were administered. To answer H1a&b, an independent samples *t*-test was performed to check for significant differences in means between 'Cannabis Users' and 'Cannabis Non-Users' regarding mean scores for 'Perceived Stress' and 'Depressive Symptoms'. Further, Pearson Correlation was used to check for significant correlations between the variables in the whole data set, in order to answer the hypotheses H2a, H3 and H4. To validate or falsify the hypotheses H2b and H2c, Pearson Correlation was used again but only between the variables in the subsets. Additionally, multiple linear regression analysis between the variables 'Perceived Stress' and 'Cannabis Use', 'Perceived Stress' and 'Depressive Symptoms' as well as 'Depressive Symptoms' and 'Cannabis Use' have been performed to identify 'Depressive Symptoms' as possible mediator in the relationship between 'Perceived Stress' and 'Cannabis Use' and to answer hypothesis H5. For the independent samples *t*-test analysis a significance level of $p < 0.05$ was used whereas for the Pearson Correlation a significance level of $p < 0.01$ was used.

Results

Descriptive Statistics

The first goal of this research was to investigate the prevalence of perceived stress, depressive symptomatology and cannabis use among students at the University of Twente. The variable 'Perceived Stress' showed to have a mean of 27,84 with a standard deviation of 7.17. Since the PSS-scale is not a diagnostic tool, norm tables do not exist for this scale meaning that the results can only be used to compare participants within the sample. Nevertheless, as the maximum score an individual can indicate on the scale is 56 and the minimum is 0, a mean of 27,84 can be interpreted to indicate moderate perceived stress among students.

The variable 'Depressive Symptoms' could be displayed with a mean of 8,72 with a standard deviation of 5,51. This mean demonstrates modest findings regarding depressive symptoms among students as a mean of 10 or above is associated with mild, moderate or severe depression (Kroenke et. al, 2016). However, out of 1360 individuals, 516 (37.94%) could be identified with mean of over 10, indicating mild, moderate or severe depressive symptomatology for these individuals.

Out of 1285 participants that completed the question regarding cannabis use, 846 individuals expressed that they have never used cannabis before, or that they have not used cannabis in the last year. In contrast to this, 439 individuals indicated that they used cannabis in the last year. The prevalence and more detailed information about cannabis use of students at the University of Twente is displayed in Table 2.

Table 2

Frequency of Cannabis Use among Students at the University of Twente

Cannabis Use, Cannabis Non-Users & Cannabis Users			
	Frequency	Percentage for Whole Population	Percentage for Cannabis-Users
Never	717	55,8%	
I have used it, but not in the last year	129	10%	
Once	89	6,9%	20,3%
2 or 3 times	116	9%	46,4%
4 to 11 times	75	5,8%	17,1%
Once a month	64	5%	14,6%
Once a week	38	3%	8,7%
Several times a week	42	3,3%	9,6%
Daily	15	1,2%	3,4%
Total N	1285		

Differences between Cannabis-Users and Cannabis Non-Users

The second objective of this study was to examine whether significant differences in means scores between 'Cannabis Users' (H1a) and 'Cannabis Non-Users' (H1b) could be observed regarding 'Perceived Stress' and 'Depressive Symptoms'. The results show that the mean score on perceived stress of 'Cannabis Users' (M = 28.11, SD = 7.14) is not significantly different from 'Cannabis Non-Users' (M = 27.71, SD = 7.23), p = 0.352. These results indicate to give reason to falsify hypothesis 1a and demonstrate that individuals who do not use cannabis do not experience greater stress than individuals who do. Nonetheless, the results also indicate that the mean score on depressive symptoms of 'Cannabis Users' (M = 9.24, SD = 5.49) is statistically greater than the mean score of 'Cannabis Non-Users' (M = 8.44, SD = 5.47), p = 0.013. Consequently, hypothesis 1b can be validated. This means that individuals who use cannabis experience greater depressive symptomatology than individuals who do not use cannabis. Further information is displayed in Table 3.

Table 3

Descriptive Statistics for Cannabis Users and Cannabis Non-users in Relation to Perceived Stress and Depressive Symptoms

	Cannabis Groups	N	Mean	SD	t	df	Sig. (2-tailed
Perceived Stress	Non-Users	846	27.71	7.23	-.931	1283	.352
	Users	439	28.11	7.14			
Depressive Symp.	Non-Users	846	8.44	5.47	-2.481	1283	.013*
	Users	439	9.24	5.49			

*p<.05.

Correlations

The third purpose of this research was to investigate whether 'Perceived Stress' is significantly correlated with 'Depressive Symptoms' in the total population (H2a) and whether this is true for the subsets, 'Cannabis Users' (H2b) and 'Cannabis Non-Users' (H2c), as well. The Pearson Correlation analyses showed that 'Perceived Stress' is indeed significantly correlated with 'Depressive Symptoms' in the total population, r = .709, n = 1324, p < 0.01, as well as for 'Cannabis Users', r = .692, n = 439, p < 0.01, and 'Cannabis Non-Users', r = .717, n = 846, p < 0.01. Consequently, the hypotheses (H1a-c) can be validated. This indicates that if either experienced stress or depressive symptomatology increases, so does the other. This is

also true whether participants used cannabis in the last year or not.

The fourth purpose of this research was to explore whether ‘Perceived Stress’ is significantly correlated with ‘Cannabis Use’ of the total population (H3). No significant relationship between the frequency of ‘Cannabis Use’, r = .049, n = 1285, p = .081, and ‘Perceived Stress’ could be shown. Therefore, the hypothesis H3 can be falsified. Consequently, there is no proof that if perceived stress increases cannabis use increases as well.

The fifth intention of this research was to explore whether ‘Depressive symptoms’ is significantly correlated with ‘Cannabis Use’ (H4). In the total population, the correlation between the frequency of cannabis use and depressive symptomatology was significant, r =.079, n = 1285, p =.004. Hence, hypothesis H4 can be validated. This indicates that if depressive symptomatology increases, so does cannabis use and vice versa.

The sixth goal of this research was to answer the question whether ‘Depressive symptoms’ functions as full mediator between ‘Perceived Stress’ and ‘Cannabis Use’ (H5). Since ‘Perceived Stress’ and ‘Cannabis Use’ are not significantly correlated, but ‘Perceived Stress’ and ‘Depressive Symptoms’ as well as ‘Depressive Symptoms’ and ‘Cannabis Use’ are, this shows that ‘Depressive Symptoms’ may not function as mediator between ‘Perceived Stress’ and ‘Cannabis Use’. More detailed information about the correlations is displayed in Table 4.

Table 4

Correlations for the Variables Perceived Stress, Cannabis Use, Cannabis Users, Cannabis Non-users and Depressive Symptoms in the whole population and the subsets

Correlations						
		Perceived Stress	Cannabis Use	Cannabis Users	Cannabis Non-Users	Depressive Symptoms
Perceived Stress	Pearson Correlation	-				
	Sig. (2-tailed)					
	N	1347				
Cannabis Use	Pearson Correlation	.049	-			
	Sig. (2-tailed)	.081				
	N	1285				
Cannabis Users	Pearson Correlation	.092	-	-		
	Sig. (2-tailed)	.055				
	N	439				
Cannabis Non-Users	Pearson Correlation	.010	-	-	-	
	Sig. (2-tailed)	.781				
	N	846				
Depressive Symptoms	Pearson Correlation	.709**	.079**	.068	.004	-
	Sig. (2-tailed)	.000	.004	.158	.913	
	N	1324	1285	439	846	1360

** Correlation is significant at the 0.01 level (2-tailed)

Discussion

The aim of the present study was to investigate the prevalence of perceived stress, depressive symptomatology and cannabis use among students at the University of Twente.

Further, this research aimed to explore whether significant differences in means between cannabis users and non-users in relation to perceived stress and depressive symptomatology exist. Additionally, this report intended to investigate the relationship between the concepts of perceived stress and depressive symptomatology, perceived stress and cannabis use as well as depressive symptomatology and cannabis use. For the relationship between 'Perceived Stress' and 'Depressive Symptoms', this was tested among the total population of students and two subsets, namely cannabis users and non-users. Lastly, it was aimed to test whether depressive symptomatology may function as full mediator in the relationship between perceived stress and cannabis use.

Prevalence of Perceived Stress, Depressive Symptomatology and Cannabis Use

The mean score of perceived stress in the total population had value of 27.84. Given the fact that the study of Marshall, Allison, Nykamp & Lanke (2002) found that pharmacy students in their sample had a mean of 26.5 and Deckro et al. (2002), who studied the intervention effects on perceived stress, found a mean of 29.86 preintervention, a mean of 27.84 can be interpreted to indicate moderate levels of perceived stress. Since our nowadays highly ambitious academic environments bear more stress than ever for their students, a moderate level of perceived stress among students was to be expected (Sreeramareddy et al., 2007). This moderate level of perceived stress may be explained by different facets that accumulate towards the experienced stress level of the individual (Fisher & Hood, 1987). Subjectively experienced social or academic demands that together affect students' academic performance and achievement negatively may heighten perceived stress (Lu, 1994; Ribeiro et al., 2018).

Depressive symptomatology in this study had mean score of 8,72. However, it could be shown that 516 (37.94%) out of 1360 individuals scored above a value of 10, which indicates that these individuals may be suffering from a mild, moderate or severe depression. Prevalence rates for depression in adolescents are expected to be as high as 15% (Low, 2012). In this sample, however, 37.94% could be identified with a mean over 10, which gives reason to investigate depressive symptomatology among students in further research and if necessary, to design and evaluate appropriate intervention strategies to help struggling students.

Out of 1285 students that indicated an answer regarding their cannabis use in the last year, 846 (65.84%) indicated that they have never used cannabis before or that they have not used in the last year. Nevertheless, 439 (34.16%) students expressed that they have used cannabis in the last year at least once or more frequently, whereas most students in this sample (46,4%) indicated that they used cannabis 2 or 3 times in the last year. If compared to the

national prevalence rate of cannabis use among adolescents in the Netherlands in the last year, which was at 17.7%, a prevalence rate of cannabis use in this sample of 34.16% seems to be quite surprising. This heightened prevalence rate of cannabis use among students may be explained by taking different factors into account. On the one hand, cannabis is depenalised in the Netherlands meaning that a limited number of coffee shops are allowed to openly sell cannabis and that no penalties are imposed for the possession of small amounts of this drug (MacCoun & Reuter, 1997). The fact that cannabis is more easily obtained in the Netherlands whereas no considerable consequences must be feared when obtaining or consuming cannabis may facilitate the use of cannabis in this country. On the other hand, among students, drug use may be more likely to be associated as a socially occurring theme as well as experimentally tried rather than exhibited alone (Beck et al., 2009; Dekker, 2009). Taking together that cannabis is easily accessible in the Netherlands and that among students, cannabis may be socially experimented with, this would serve as an explanation for a heightened prevalence rate of cannabis use in this sample. However, due to the fact that 46,4% out of 439 individuals indicated that they have used cannabis only 2 or 3 times in the last year, this prevalence rate of cannabis use among students does not seem raise red flags. Since harmful substance use, among other criteria, is most importantly classified as the substance use being responsible for (or considerably contributing to) physical or psychological harm, cannabis use of 2 or 3 times per year seems unlikely to result in physical or psychological harm for the individual (WHO, 1993).

Perceived Stress and Depressive Symptomatology

The results show that for all groups, the total population as well as cannabis users and non-users an equally strong significant relationship between perceived stress and depressive symptomatology could be demonstrated. This observation of significant correlations between the concepts is in line with existing literature on the topic. Since the combined effects of daily stressors could be found to be significant predictors for the occurrence of depressive symptoms and depressive symptomatology are significantly correlated with the individually experienced stress level, previous literature seems to support the found results (D'Angelo & Wierzbicki, 2003; Wei & Sha, 2003).

Perceived Stress and Cannabis Use

For the relationship between perceived stress and cannabis use, the results appear to be different. No relationship between perceived stress and cannabis use could be demonstrated. Considering this, the results shown stand in contrast to existing literature on the topic. Literature

showed that common life stressors are associated with substance use in young adolescents (Tavolacci, 2013). Further, it could be shown that cannabis use is used as coping mechanism for experienced stress and that psychological distress and perceived stress are also associated with drug use (Hyman & Sinha, 2009; Vargas & Tujillo, 2012). However, in this sample perceived stress could not be demonstrated to be significantly correlated with cannabis use. This may be explained due to the fact that these correlations were tested among a student population and that in this context drug use may be more likely to be exhibited socially. This assumption would stand in line with existing literature on the topic as the most dominant factors for using cannabis are social facilitation, conviviality and social interaction but also conformity (to avoid social rejection) (Beck et al., 2009; Dekker, 2009). Cannabis use as socially occurring theme would give an explanation for the fact that no significant relationship could be verified between perceived stress and cannabis use. Instead of cannabis, the social context may be used as coping mechanism regarding perceived stress. The fact that social support was shown to enhance well-being and reduce perceived stress in individuals would defend this hypothesis (Cohen & McKay, 1984).

Depressive Symptoms and Cannabis Use

Depressive symptomatology and cannabis use showed to be significantly correlated. This indicates that if either depressive symptomatology or cannabis use increases, so does the other. These findings stand in line with existing literature on the topic as mood and anxiety disorders could be shown to be significantly associated with substance use, especially cannabis use (Saban et al, 2014). Further, since comorbid substance use disorders could be identified in almost one-third of individuals suffering from MDD and that more frequent cannabis use was associated with increased depressive symptomatology in adolescents (Davis et al., 2008; Howood et al, 2012), the found results seem to be supported by existing literature.

Cannabis Users and Non-Users, Perceived Stress and Depressive Symptomatology

Cannabis Users and Cannabis Non-Users did not significantly differ in the experience of perceived stress. These results indicate that cannabis use does not reduce the experienced stress level of an individual as prior hypothesized. It was believed that high levels of perceived stress would evoke more frequent cannabis use in some individuals as cannabis use would be used as coping mechanism to minder experienced stress (Hyman & Sinha, 2009; Vargas & Tujillo, 2012). Individuals would engage in more frequent cannabis use as it would serve them to as a temporary escape from their environment and perceived stress level (Vargas & Tujillo,

2012). The fact that cannabis users and non-user, in this sample, did not significantly differ in levels of perceived stress gives reason to doubt this thought and supports the fact that no relationship between perceived stress and cannabis use could be demonstrated. Nonetheless, cannabis users and non-users could be shown to differ significantly in the experience of depressive symptomatology. These findings stand in line with existing literature since adolescents that use cannabis more frequently showed elevated depressive symptomatology and that cannabis use was especially significantly associated with mood disorders (Horwood et al., 2012; Saban et al., 2014). Further, these findings also underline that cannabis use may worsen depressive symptomatology.

Depressive Symptomatology as Mediator

Despite literature that reports significant relationships between perceived stress and drug use, perceived stress and depressive symptomatology as well as depressive symptomatology and substance use, especially cannabis, this research could not substantiate the findings of a significant relationship between perceived stress and cannabis use (Saban et al, 2014; Vargas & Tujillo, 2012; Wei & Sha, 2003). Therefore, depressive symptomatology may not function as mediator between these concepts.

Strengths and Limitations

As a strength regarding this research, the reliability coefficients (Cronbach's Alpha) for each subscale, except the substance use scale, can be noted. These were representative enough to prove reliability of the questionnaire. Secondly, the screening of the data and exclusion of participants that completed the questionnaire in less than ten minutes and only filled in less than 50% of the questionnaire might have affected the reliability of the dataset positively.

Nevertheless, certain limitations must be mentioned regarding the representation of true values and feelings. First, the research was conducted during exam periods at the university that might have affected the perceived stress level of participants, depressive symptomatology or cannabis use. Therefore, the values reported and found in this research might exceed true values.

Secondly, since no validated scale regarding the measurement of substance use could be found, the researchers developed their own. Flaws in the construction of the scale might have affected the measurement of true values. Further, quantitative research in this domain only indicates the frequency of substance use, yet causation for substance use cannot be accounted for.

Thirdly, due to the fact that an online survey-based design was employed in this research, the research had no control over the environment and motivation of possible participants to fill in the questionnaire purposefully. Conducting research in this area under the control of environmental distractions may help to acquire more reliable data. Nonetheless, the employment of an online survey-based design may have helped to create a greater feeling of anonymity for participants that in turn may have resulted in more honest and self-disclosing answers of participants in regard to depressive symptomatology, perceived stress or drug use. The dataset acquired might therefore be still sufficiently reliable in representing true answers, feelings and values of participants.

Fourthly, the length of the full questionnaire that was administered to possible participants may have affected the motivation of these participants negatively as the duration for the completion of the whole questionnaire was approximately 20 minutes. However, the exclusion of participants that filled in less than 50% of the questionnaire might have resolved this issue in terms of unrepresentative values due to lack of motivation. Further, the random distribution of questions and subscales within the full questionnaire resolved the issue of overrepresentation of certain subscales, which would have biased the data set.

Fifthly, the independent t-test between cannabis users and non-users only showed that a significant difference in means exist for experienced depressive symptomatology but that nothing can be stated about causation between these variables. This limitation underlines that future research in terms of qualitative or longitudinal research should be implemented to understand the causation between depressive symptomatology and cannabis use.

Future Research

The present study can be used to raise awareness for a critical issue in our society and to contribute towards academic literature in this area of research. Additionally, this research may serve as a basis to help understand the associations between perceived stress, depressive symptomatology and cannabis use. It could be shown that perceived stress of individuals is associated with their depressive symptomatology and vice versa. Further, a considerable amount of the population could be identified with either a mild, moderate or severe depression. Consequently, this research may be used to help design and evaluate appropriate intervention strategies that aim at helping and supporting students in domains of academic, social and mental well-being. Designing and executing interventions that target perceived stress or depressive symptomatology of students may be the first step to counteract elevated levels of these concepts among students. Qualitative or longitudinal study designs in this domain could serve to further

understand implications and causations of the interaction between the concepts. It could be further investigated what students perceive to contribute the greatest towards their experienced stress level or depressive symptomatology. Additionally, possible executed interventions could be investigated on their effect to enhance student well-being. Following research about the prevalence of perceived stress and depressive symptomatology among students is recommended to observe future trends and to evaluate about appropriate actions.

Conclusion

This research paper discussed the associations of three concepts among a student population: perceived stress, depressive symptomatology and cannabis use. Cannabis users and non-users could be observed to differ significantly in the perception of depressive symptomatology but not in perceived stress. These findings indicate that cannabis use as coping mechanism for perceived stress may not reduce perceived stress, but that cannabis use, in fact, worsens depressive symptomatology. Further, it could be shown that, despite literature that would have assumed otherwise, perceived stress was not associated with cannabis use in this sample. Yet, perceived stress could be found to be associated with depressive symptomatology and depressive symptomatology, in turn, with cannabis use. Lastly, this research served to clarify the role of depressive symptomatology in the relationship between perceived stress and cannabis use. Depressive symptomatology could not be shown to function as mediator between the two concepts since perceived stress and cannabis use could not be shown to be significantly correlated. The implications of this research seem to be centred around the prevention of high levels of perceived stress and depressive symptomatology among students. However, the results indicate that further research is needed to assess and evaluate means to handle student stress and well-being appropriately.

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Appendix

Appendix 1: Informed Consent

Informed consent

Before you proceed in this questionnaire, please read the informed consent information below. Please be aware that participation in this study is completely voluntary, and that you can stop taking part at any time. You may withdraw from this research at any point until one week after submitting the survey. Under no circumstances will your real name or identifying information be included in the report of this research. Nobody, except the four researchers and the research supervisor, will have access to this anonymized material in its entirety. Your data is treated confidentially, and the research results are published anonymously. Your personal data will not be given to third parties without your expressed permission. If you have any question, you may contact Leonie Reh ([redacted]).

If you have any complaints about this research, please direct them to the secretary of the Ethics Committee of the Faculty of Behavioural Sciences at the University of Twente, Drs. L. Kamphuis-Blikman P.O. Box 217, 7500 AE Enschede (NL), telephone: +31 (0)53 489 3399; email: l.j.m.blikman@utwente.nl).

If you click on proceed, you indicate that you read and understood the informed consent and have been informed in a manner which is clear to you about the nature and method of the research. By proceeding you agree with participating in this study.