Dissertation

The moderating effect of the Dark Triad traits in the relationship between affective disorders and health behaviours

submitted by

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Statutory declaration

I hereby declare that this thesis is my own original work and that I have fully acknowledged by name all of those individuals and organisations that have contributed to the research for this thesis. Due acknowledgement has been made in the text to all other material used. Throughout this thesis and in all related publications I followed the "Standards of Good Scientific Practice and Ombuds Committee at the Medical University of Graz".

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Disclosures

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Table of Contents

Abstract 9
Zusammenfassung 10
1. Introduction 11
1.1 Affective disorders 11
1.1.1 Depressive disorders 13
1.1.2. Manic episodes 13
1.1.3. Bipolar affective disorders 14
1.2. Health behaviours 14
1.2.1. Substance use 16
1.2.2. Diet 17
1.2.3. Participation in medical services 18
1.2.4. Physical activity 18
1.2.5. Sleep quality 19
1.3. Current research on affective disorders and health behaviours 19
1.4. Dark Triad personality traits 21
1.5. Current research on Dark Triad traits, and affective disorders, health behaviours 22
1.5.1. Machiavellianism, affective disorders, and health behaviours 22
1.5.2. Narcissism, affective disorders, and health behaviours 23
1.5.3. Psychopathy, affective disorders, and health behaviours 24
1.6. Relevance and aims of the current study 25
1.7. Research questions and hypotheses 26
2. Method 29
2.1. Sample 29
2.2. Measurements 30
2.2.1. Demographic Questionnaire 30
2.2.2. Multidimensional Health Behaviour Inventory (MHBI) 30
2.2.3. Mediterranean Diet Score (MEDAS) 31
2.2.4. Vaccination Attitude Examination Scale (VAX-Scale) 32
2.2.5. Perceived Sensitivity to Medicines Scale (PSM-Scale) 32
2.2.6. Pittsburgh Sleep Quality Index (PSQI) 32
2.2.7. Patient Health Questionnaire (PHQ-9) 32
2.2.8. Short Dark Triad (SD3) 33
2.2.9. Translation of questionnaires 33

2.3. Procedure 34
2.4. Statistical analyses 34
3. Results 36
3.1. Descriptive analyses 36
3.2. Preliminary analyses 38
3.2.1. Distribution analyses 38
3.2.2. Preliminary correlation analyses 38
3.3. Structural equation model 40
3.4. Moderation analyses 41
3.4.1. Substance use, affective disorders and the Dark Triad traits 42
3.4.2. Diet, affective disorders and the Dark Triad traits 44
3.4.3. Mediterranean diet adherence, affective disorders and the Dark Triad traits 45
3.4.4. Participation in medical services, affective disorders and the Dark Triad traits 47
3.4.5. Physical activity, affective disorders and the Dark Triad traits 50
3.4.6. Sleep quality, affective disorders and the Dark Triad traits 51
3.4.7. Depressive symptom severity, affective disorders and the Dark Triad traits 54
4. Discussion 57
4.1. Associations between health behaviours, affective disorders, and the Dark Triad traits 58
4.1.1. Substance use, affective disorders and the Dark Triad traits 58
4.1.2. Diet, affective disorders and the Dark Triad traits 59
4.1.3. Participation in medical services, affective disorders and the Dark Triad traits 60
4.1.4. Physical activity, affective disorders and the Dark Triad traits 62
4.1.5. Sleep quality, affective disorders and the Dark Triad traits 63
4.1.6. Depressive symptom severity, affective disorders and the Dark Triad traits 64
4.2. Limitations and prospects 67
4.3. Implications 68
4.4. Conclusion 69
5. References 70
6. Appendix 99
6.1. Appendix A: Tables 99
6.2. Appendix B: Test material 102
6.2.1. Appendix B1: Demographic questionnaire (English) 102
6.2.2. Appendix B2: Demographic questionnaire (German) 105
6.2.3. Appendix B3: Translated questionnaire protocols 108
6.2.4. Appendix B4: Pilot study results of translated questionnaires 115

6.2.5. Appendix B5: Standardized instructions (English) 115
6.2.6. Appendix B6: Standardized instructions (German) 116
6.2.7. Appendix B7: Data privacy statement and informed consent (English) 116
6.2.8. Appendix B8: Data privacy statement and informed consent (German) 118
6.3. Appendix C: Pre-registration 120
6.4. Appendix D: Publication 123

List of Figures

Figure 1. Illness courses of affective disorders. 12
Figure 2. Health belief model. 16
Figure 3. Schematic visualization of a structural equation model. 40
Figure 4. Visual representation of the moderation effect of group (individuals with affective disorders (AD) vs. healthy controls (HC)) on substance use by Machiavellianism. 44
Figure 5. Visual representation of the moderation effect of group (individuals with affective disorders (AD) vs. healthy controls (HC)) on Mediterranean diet adherence by Machiavellianism. 47
Figure 6. Visual representation of the moderation effect of group (individuals with affective disorders (AD) vs. healthy controls (HC)) on sleep quality by Machiavellianism. 53
Figure 7. Visual representation of the moderation effect of group (individuals with affective disorders (AD) vs. healthy controls (HC)) on depressive symptom severity by psychopathy. 56

List of Tables

Table 1. Group differences in demographic and psychometric variables between individuals with affective disorders (AD) and healthy controls (HC). 36
Table 2. Spearman- and Pearson correlation analyses between demographic and psychometric variables. 39
Table 3. Factor loadings of the confirmatory factor analysis and equation-based specification tests. 41
Table 4. Linear model of the predictors of substance use. 43
Table 5. Linear model of the predictors of dietary behaviour. 45
Table 6. Linear model of the predictors of Mediterranean diet adherence. 46
Table 7. Linear model of the predictors of participation in medical services. 48
Table 8. Linear model of the predictors of vaccination attitudes 49
Table 9. Linear model of the predictors of perceived medication sensitivity. 50
Table 10. Linear model of the predictors of physical activity. 51
Table 11. Linear model of the predictors of sleep quality. 52
Table 12. Linear model of the predictors of depressive symptom severity. 55

Abstract

Deteriorated health behaviours are a consequence of affective disorders and result in psychological and somatic comorbidities. Since the mechanisms underlying this association remain unclear, factors determining the relationship between affective disorders and health behaviours need to be investigated. In addition to lifestyle and medication use, personality traits should be considered, especially those which are known for their deteriorating impact on health behaviour, such as the Dark Triad personality traits (Machiavellianism, narcissism, psychopathy). This study examined the associations and moderating influences of the Dark Triad traits on the relationship between group affiliation (individuals with affective disorders versus mentally healthy individuals), and health behaviours and parameters (substance use, diet, Mediterranean diet adherence, participation in medical services, vaccination attitudes, medication sensitivity, physical activity, sleep quality, depressive symptom severity). Data from 938 individuals (551 individuals with affective disorders, 387 mentally healthy individuals) were collected in an online survey administering the Multidimensional Health Behaviour Inventory, Mediterranean Diet Score, Vaccination Attitude Examination Scale, Perceived Sensitivity to Medicines Scale, Pittsburgh Sleep Quality Index, Patient Health Questionnaire – 9, and the Short Dark Triad questionnaire. Moderation analyses revealed that Machiavellianism was associated with lower substance use, less adherence to Mediterranean diet, more negative vaccination attitudes, worse sleep quality, and more depressive symptoms. Moreover, Machiavellianism moderated the relationship between group affiliation and substance use, Mediterranean diet adherence, and sleep quality. Narcissism was not associated with any health behaviours. Psychopathy was related to more negative vaccination attitudes, worse sleep quality, and greater depression. This trait had a deteriorating moderation effect on the association between group affiliation and depression. Results indicate that Machiavellianism and psychopathy should be considered when integrating health behaviours for the prevention and treatment of somatic comorbidities in affective disorders. The study contributes a meaningful perspective to biopsychosocial research and highlights the role of personality traits in the aetiopathogenesis of affective disorders.

Keywords: affective disorders, depression, bipolar disorder, health behaviours, Dark Triad, Machiavellianism, narcissism, psychopathy

Zusammenfassung

Verschlechterte Gesundheitsverhaltensweisen sind eine Folge affektiver Erkrankungen und führen zu psychischen und somatischen Komorbiditäten. Da die zugrundliegenden Mechanismen dieses Zusammenhangs unklar sind, müssen Faktoren, die die Beziehung zwischen affektiven Erkrankungen und Gesundheitsverhaltensweisen bestimmen, untersucht werden. Neben dem Lebensstil und der Medikamenteneinnahme sollten auch Persönlichkeitsmerkmale berücksichtigt werden, insbesondere die, die für ihre negativen Auswirkungen auf das Gesundheitsverhalten bekannt sind, wie die Persönlichkeitsmerkmale der Dunklen Triade (Machiavellismus, Narzissmus, Psychopathie). In dieser Studie wurden die Zusammenhänge und moderierenden Einflüsse der Dunklen Triade auf die Beziehung zwischen Gruppenzugehörigkeit (Personen mit affektiven Störungen versus psychisch Gesunde) und Gesundheitsverhaltensweisen und -parametern (Substanzgebrauch, Ernährung, Adhärenz zur mediterranen Diät, Inanspruchnahme medizinischer Dienstleistungen, Impfeinstellungen, Medikamentensensitivität, körperliche Aktivität, Schlafqualität, Schweregrad depressiver Symptome) untersucht. Daten von 938 Personen (551 Personen mit affektiven Erkrankungen, 387 psychisch Gesunde) wurden in einer Online-Umfrage erhoben, in der der Multidimensional Health Behaviour Inventory, Mediterranean Diet Score, Vaccination Attitude Examination Scale, Perceived Sensitivity to Medicines Scale, Pittsburgh Sleep Quality Index, Patient Health Questionnaire - 9 und Short Dark Triad-Fragebogen eingesetzt wurden. Moderationsanalysen ergaben, dass Machiavellismus mit geringerem Substanzgebrauch, geringerer Adhärenz zur mediterranen Diät, negativeren Impfeinstellungen, schlechterer Schlafqualität und mehr depressiven Symptomen verbunden war. Darüber hinaus moderierte Machiavellismus die Beziehung zwischen Gruppenzugehörigkeit und Substanzgebrauch, Adhärenz zur mediterranen Diät und Schlafqualität. Narzissmus war mit keiner Gesundheitsverhaltensweise verbunden. Psychopathie hingegen war mit negativeren Impfeinstellungen, schlechterer Schlafqualität und stärkerer Depression assoziiert. Dieses Merkmal hatte einen verschlechternden Moderationseffekt auf die Beziehung zwischen Gruppenzugehörigkeit und Depression. Die Ergebnisse zeigen, dass Machiavellismus und Psychopathie bei der Integration von Gesundheitsverhaltensweisen zur Prävention und Behandlung somatischer Komorbiditäten bei affektiven Störungen berücksichtigt werden sollten. Die Studie trägt eine bedeutungsvolle Perspektive zur biopsychosozialen Forschung bei und betont die Rolle von Persönlichkeitsmerkmalen in der Ätiopathogenese affektiver Erkrankungen.

Schlüsselwörter: Affektive Erkrankungen, Depression, Bipolare Störung, Gesundheitsverhalten, Dunkle Triade, Machiavellismus, Narzissmus, Psychopathie

1. Introduction

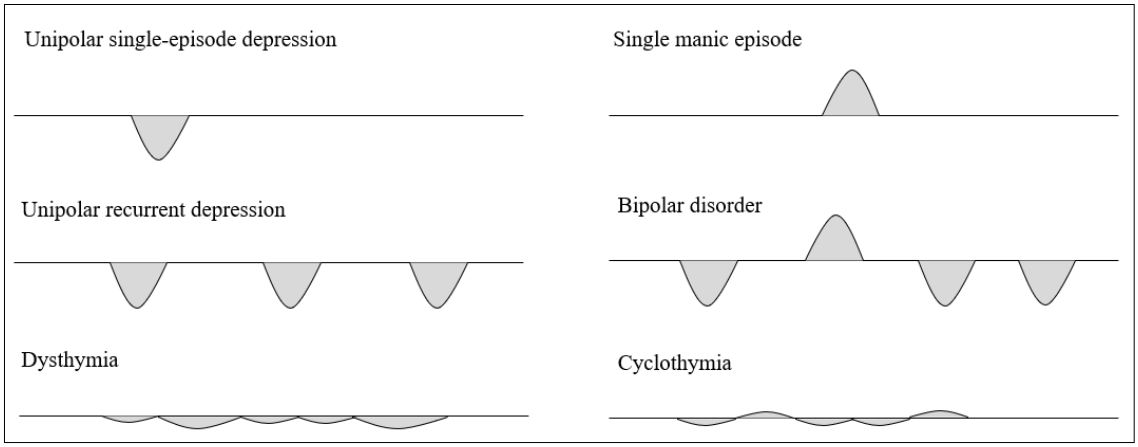
Since the introduction of Engel's biopsychosocial model of health, the intertwined relationship between physical, psychological, and social aspects of health has been acknowledged in research and practice (Engel, 1977). In individuals with affective disorders, the bidirectional interactions of these aspects are very evident and well-researched (e.g., Baranyi *et al.*, 2013, 2017). For instance, it is known that individuals with affective disorders are more likely to suffer from physical and cognitive impairments, as well as social function disabilities, which further deteriorates their physical and psychological health (Liu *et al.*, 2021). In fact, 20–60% of individuals with affective disorders suffer from somatic comorbidities, which frequently involve the circular, neurological, endocrine, metabolic, and musculoskeletal areas (Steffen *et al.*, 2020). Moreover, the increased risk for somatic diseases in individuals with affective disorders heightens the risk of amplifying mental illness symptoms and increase service utilization, medical costs, and premature mortality rates unrelated to suicide (Reininghaus *et al.*, 2019; Steffen *et al.*, 2020). It has thus been of great interest to determine the factors, which drive the relationship between affective disorders and somatic comorbidities. Until now, this relationship was often explained by side effects of psychopharmacological medication, pre-existing metabolic disorders, or health-deteriorating behaviours (e.g., excessive smoking, unhealthy dietary habits, lack of physical activity; Reininghaus *et al.*, 2019). Specifically, modifiable health behaviours were found to be one of the most crucial factors being associated with both affective disorders and somatic comorbidities (Mavrides and Nemeroff, 2015; Romain, Marleau and Baillot, 2018). Nevertheless, it is not yet fully understood, which factors determine the relationship between affective disorders and health behaviours. Personality traits like the Dark Triad traits could possibly contribute to this association but have not been investigated within the context of affective disorders and health behaviours. To fill this knowledge gap, this study will examine the effect of the Dark Triad traits on the relationship between affective disorders and health behaviours, with all constructs being further elaborated in the following chapters.

1.1 Affective disorders

Affective disorders are among the most frequent psychiatric disorders (World Health Organization, 2022a) and remain one of the leading causes of disability worldwide (Institute of Health Metrics and Evaluation, 2020). According to the criteria of the International Classification of Diseases (ICD-10; Dilling and Freyberger, 2019), affective disorders share the common main symptoms of alterations in mood and activity levels. Most secondary symptoms

are related to these changes and many affective disorders are characterized by recurrent episodes (Dilling and Freyberger, 2019). While the beginning of the respective episodes is oftentimes initialized by stressful events, the aetiopathogenesis of affective disorders is multifaceted. Possible causes for the development of affective disorders are genetic factors, disturbances in neurotransmission (e.g., alterations in serotonin levels), neuroendocrinological disturbances (e.g., disorders of the hypothalamic-pituitary-adrenal axis), chronobiological factors, psychosocial factors, personality traits, or somatic factors (e.g., somatic illnesses, medication). Affective disorders can be differentiated according to their mood polarity, time criteria, symptom severity, and illness course. In general, there are three types of affective disorders: unipolar depressive disorders (i.e., single-episode and recurrent depressive disorders), single-episode manic disorders, and bipolar affective disorders (depressive and manic episodes; Rothenhäusler and Täschner, 2012). Notably, recurrent manic episodes are classified within bipolar affective disorders according to the ICD-10 criteria. These types of affective disorders also appear in subtle but persistent episodes which can last up to many years. Persistent affective disorders are characterized by consistent and commonly fluctuating mood disturbances, however, the respective episodes are not severe enough to be considered as hypomanic or mild depressive episodes. Among others, cyclothymia (multiple periods of subtle depressive and elevated mood) and dysthymia (subtle chronic depressive mood) are classified as persistent affective disorders (Dilling and Freyberger, 2019). Out of the different courses of affective disorders, 65% are unipolar depressive disorders, 30% are bipolar illness courses, and about 5% are exclusively manic episodes (Rothenhäusler and Täschner, 2012). Figure 1 illustrates the different courses of affective disorders. The following chapters will elaborate the depressive and bipolar disorders as main differentiations of affective disorders.

Figure 1. Illness courses of affective disorders.



Note. The graphical representation was created by the author of this thesis.

1.1.1 Depressive disorders

Depressive disorders (i.e., single episode or recurrent depressive disorder) are characterized by the main criteria of depressed mood, diminished interest or pleasure in almost all activities, and loss of energy or fatigue. Moreover, secondary symptoms of depressive disorders are, for instance, a deteriorated ability to concentrate, sleep disturbances, changes in appetite, feelings of worthlessness and/or guilt, recurrent thoughts of death, suicide, and/or suicidal behaviour, as well as "somatic" symptoms (e.g., early awakening, psychomotor agitation or inhibition). To fulfill the diagnostic criteria for depressive disorders, the aforementioned symptoms should persist for at least two weeks, there should be no anamnestic manic or hypomanic symptoms, and the current episode should not be retraceable to the use of psychotropic substances or other organic psychiatric disorders. Depending on the quantity and severity of symptoms, the respective episodes can be classified as "mild", "moderate", or "severe". In addition, severe depressive episodes can be further differentiated by the presence of psychotic symptoms such as delusions or hallucinations (i.e., "severe depressive episode with psychotic symptoms"). In general, the first depressive episode can emerge between childhood and late adulthood, with an acute or gradual onset. If left untreated, depressive episodes can last from a few weeks to several months (Dilling and Freyberger, 2019). Globally, depressive disorders remain the most prevalent of all mental disorders in adults (28.9% of all mental disorders, including dysthymia), followed by anxiety disorders. As of 2019, 280 million people (3.8%) worldwide lived with depressive disorders, with women (4.5%) being more often affected than men (3.0%). The prevalence of depressive disorders has been rising since a few years, but the most profound increase was noticed during the COVID-19 pandemic (World Health Organization, 2022a).

1.1.2. Manic episodes

The diagnosis "manic episode" can only be given for single manic episodes, which are differentiated into hypomania, mania without psychotic symptoms, and mania with psychotic symptoms. Hypomania refers to a disorder, which is characterized by the main criterion of persistent, mildly elevated mood and at least three of the secondary criteria of increased activity or motoric restlessness, talkativeness, difficulties to maintain concentration, decreased need for sleep, increased libido, reckless behaviour, and/or increased sociability. In comparison, manic episodes share the same symptoms as hypomania, but are more severe. In mania, the individual's mood is predominantly and unusually elevated, expansive, or irritated. Secondary criteria encompass a severe disruption of the individual's life caused by a wide range of symptoms (e.g., elevated activity, loss of concentration and/or social inhibition, talkativeness,

racing thoughts/flight of ideas, inflated self-esteem, reckless behaviour). In mania with psychotic symptoms, additional psychotic symptoms are present. Symptoms of hypomania should persist for at least four consecutive days, while symptoms of full manic episodes should persist for at least seven days (unless hospitalization is necessary). Manic episodes can only be diagnosed if the episode does not fulfill the criteria for depressive disorders, bipolar affective disorders, cyclothymia, or anorexia nervosa, and are not retraceable to the use of psychotropic substances or other organic psychiatric disorders (Dilling and Freyberger, 2019). In general, the beginning of manic episodes is acute. If left untreated, manic episodes can last up to three months. Compared to depressive or bipolar affective disorders, single manic episodes are less prevalent (Rothenhäusler and Täschner, 2012).

1.1.3. Bipolar affective disorders

Bipolar affective disorders are characterized by at least one depressive and one manic episode ("bipolar disorder type I"), or at least one depressive and one hypomanic episode ("bipolar disorder type II"), or at least two (hypo-)manic episodes ("recurrent (hypo-)manic episodes"). Depending on the severity of the current symptomatology, episodes can be classified as "mild", "moderate", and "severe", with severe episodes additionally being differentiated by the presence of psychotic symptoms. Moreover, other subtypes of bipolar disorders encompass cyclothymia, "current mixed episodes", which signify a current combination or fast change of manic and depressive symptoms, and bipolar disorders with rapid episode changes ("rapid-cycling"; Dilling and Freyberger, 2019). The latter is defined by the presence of at least four episodes of a bipolar affective disorder within twelve months. In general, bipolar affective disorders emerge earlier than unipolar depressive episodes with an average onset age of 25-30 years. Moreover, episode frequency and suicide risk is higher in bipolar than in unipolar affective disorders (Rothenhäusler and Täschner, 2012). The recent World Mental Health Report showed that 4.1% of all mental disorders are bipolar affective disorders. In total, 40 million people were reported to have a bipolar affective disorder, with men (0.5%) and women (0.6%) being equally affected (World Health Organization, 2022a).

1.2. Health behaviours

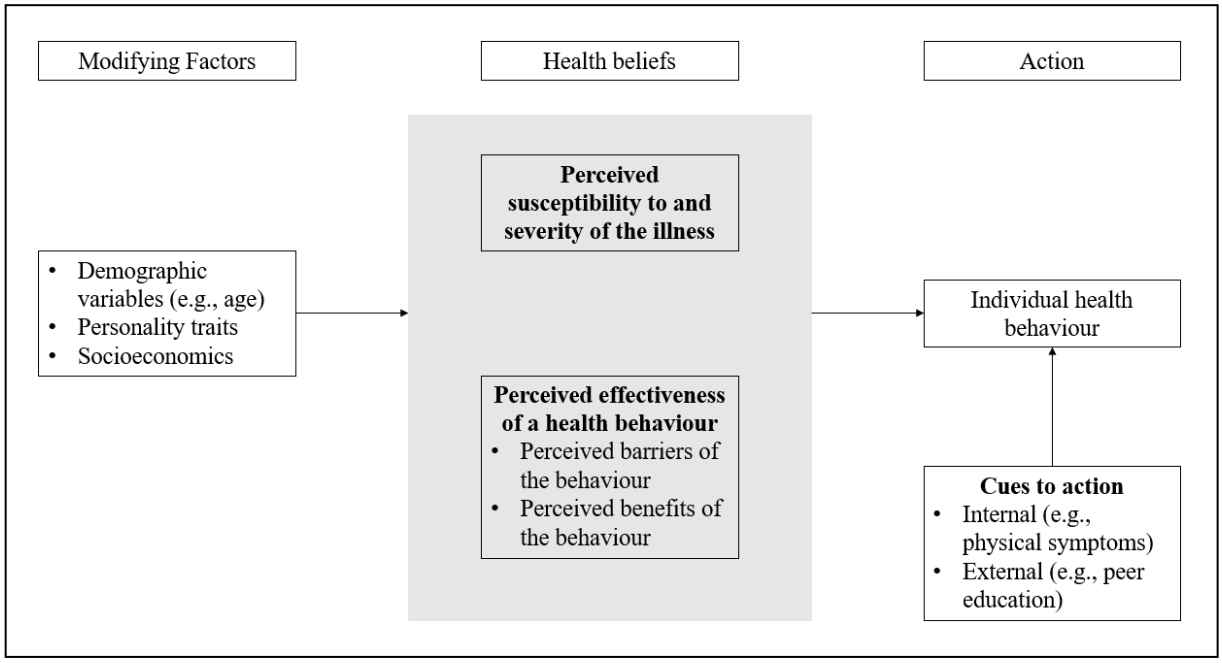
Health is broadly defined as "the capability to cope with and manage one's own malaise and well-being conditions" (Leonardi, 2018, p. 8). Thus, health behaviours are any activities undertaken for the purpose of preventing or detecting disease or for improving health and well-being (Norman and Conner, 1996). In particular, health behaviours can be subdivided into *health risk behaviours* and *health protective behaviours*. While *health risk behaviours* reflect

deteriorating activities, which elevate the probability of diseases or prevent recovery, *health protective behaviours* subsume all activities that decrease illness susceptibility or promote health recovery. Previous research suggested that the reduction of health risk behaviours could prevent 40% of oncological diseases, and 80% of cardiovascular diseases and type 2 diabetes (Spring, Moller and Coons, 2012), thus significantly counteracting various public health problems. Moreover, health behaviours affect quality of life by deferring the onset of chronic disease and enlarging the active lifespan. A large body of health psychological research has focussed on investigating the psychological determinants of health behaviours, since the modification of health behaviour directly affects health outcomes. In general, performing health behaviours is impacted by access to medical care, personality factors, and cognitive factors (e.g., perception of health risk; Conner, 2015; see the following paragraphs for a detailed explanation). Throughout the years, various models of health behaviour determinants have been developed, including the health belief model (Becker, 1974), theory of planned behaviour (Ajzen, 1991), and the self-determination theory (Ryan and Deci, 2002). The health belief model, for example, postulates that there are two kinds of health beliefs, which affect the behaviour in response to illness: *perceptions of the illness threat* and *perceived effectiveness of the behaviours* to counteract this threat. *Perceptions of the illness threat* depend upon the perceived vulnerability to and perceived severity of the disease. The *perceived effectiveness of the behaviours* subsume perceived barriers to and perceived benefits of the health behaviour. Thus, individuals are more likely to perform certain health behaviours, if they believe to be vulnerable to their condition and believe that the benefits of their health behaviour outweigh the costs. Taken together, these two perceptions determine the likelihood of conducting a health-related behaviour. Demographic variables, personality traits, and social pressure may influence the effect of the perceptions. Subsequently, health behaviours are undertaken to reduce the threat. This process is usually initiated by action cues, such as internal (e.g., physical symptoms) or external factors (e.g., media campaigns, peer education; Conner, 2015; Green, Murphy and Gryboski, 2020). A visualization of the health belief model can be found in Figure 2.

In general, health behaviour models aim to examine the common determinants of health behaviours across several domains of health behaviours (Conner & Norman, 2017). Recent health behaviour research mostly focussed on the investigation of the following five key health behaviours, which may co-occur: (1) substance use, (2) adherence to a healthy and balanced diet, (3) participation in medical service and compliance with medical regimens (e.g., physician visits, health screening, vaccination), (4) sufficient physical activity, and (5) risk-avoiding sexual behaviours (Conner, 2015; Jepson *et al.*, 2010; Spring, Moller and Coons, 2012). In

addition, sleep quality was found to be an important representant of health behaviour (Hagger, 2014; Oftedal *et al.*, 2019). The current study focussed on the investigation of the health behaviours substance abuse, diet, participation in medical services, physical activity, and sleep quality. All health behaviours will be described in the following paragraphs.

Figure 2. Health belief model.



Note. Reproduced with modifications from "The health belief model" with permission of authors Skinner, Tiro and Champion, 2015; editors Glanz, Rimer, and Viswanath; and publisher Jossey-Bass.

1.2.1. Substance use

Substance use includes the excessive consumption of alcohol, tobacco, prescription and illicit drugs (Spring, Moller and Coons, 2012). For instance, tobacco smoking is one of the health behaviours most closely associated with long-term negative health outcomes, as well as increased morbidity and mortality. It is well-researched that smoking causes a variety of different cancer types and heightens the risk of chronic obstructive pulmonary disease, coronary artery disease, cerebrovascular disease, atherosclerotic peripheral vascular disease, and respiratory infections (Sherman, 1991). Additionally, there is a strong positive association between the number of cigarettes smoked per day and the incidence of the aforementioned diseases. In spite of the negative long-term health outcomes, smoking is often used as a strategy to cope with distress and thus remains a common phenomenon (Conner, 2015). As of 2020, 22.3% of the global population used tobacco on a daily basis (World Health Organization, 2022b). Similarly, excessive consumption of alcohol has been associated with a wide array of

negative health outcomes including hypertension, cardiovascular diseases, and liver cirrhosis. Apart from the long-term health outcomes, short-term consequences of excessive alcohol consumption are accidents, injuries, and high-risk behaviour (Conner, 2015). A recent survey of 2019 showed that the global lifetime prevalence of alcohol abuse disorders is 8.6% (Glantz *et al.*, 2020). Relatedly, the long-term abuse of prescription (e.g., benzodiazepines, methylphenidate) or illicit drugs (e.g., cannabis, ecstasy, cocaine) has deteriorating effects on health, with differing symptoms depending on the type of drug (Van Amsterdam *et al.*, 2013). For instance, overdoses, injuries, infections (e.g., human-immunodeficiency-virus (HIV)), mental disorders (e.g., exacerbation of psychotic disorders in vulnerable individuals, substance use disorders), neurocognitive impairments, cardiovascular diseases, respiratory complications, and other diseases are common health outcomes of chronic substance use (Airagnes *et al.*, 2016; Franchitto, 2020; Skeie et al., 2008).

1.2.2. Diet

It is well established that diet significantly affects morbidity and mortality. While lack of nutrition is an issue in some countries, overconsumption of food is a problem in other countries. Specifically, Western industrialized diets are characterized by an overconsumption of fat and insufficient intake of foods rich in fibre, fruits, and vegetables. However, this type of diet is responsible for numerous health problems and noncommunicable diseases such as cardiovascular diseases, strokes, hypertension, type 2 diabetes, obesity, cancer, osteoporosis, and dental illnesses (Conner, 2015). The World Health Organization guidelines for a healthy diet include the consumption of fruits, vegetables, legumes, nuts, and whole grains every day (at least five portions of fruit and vegetables a day). Total energy intake from free sugars (e.g., soft drinks, honey) should be limited to 50 gram, and total energy intake from fats should be less than 30% with unsaturated fats being more favourable than saturated fats. According to the recommendations, salt intake should be limited to less than five gram of iodized salt per day and red meat may be eaten twice per week (World Health Organization, 2019). The Mediterranean diet is close to these guidelines, since it includes a high intake of olive oil, vegetables, fruits, cereals, nuts, and legumes, as well as a moderate intake of fish and other meat, dairy products and red wine, and low intakes of eggs and sweets (Davis *et al.*, 2015). Indeed, the adherence to a Mediterranean diet has been shown to have beneficial effects on blood pressure, insulin sensitivity, inflammation, carotid atherosclerosis, and oxidative stress (Martínez-González *et al.*, 2015).

1.2.3. Participation in medical services

Participation in medical services is a health-protective behaviour, which subsumes physician visits, vaccinations, and health screenings. This health behaviour aims to detect or prevent diseases at an early or asymptomatic stage (Conner, 2015). For example, health screenings for breast cancer were found to decrease breast cancer mortality by up to 35% (Mittra et al., 2021; Van Schoor *et al.*, 2011). However, participation rates in breast screening programs show great variability across different countries, ranging from 50% to more than 75% (Acharya *et al.*, 2021). Regarding vaccinations, the hesitation to get vaccinated has played a significant role throughout the last years due to the COVID-19 pandemic (Troiano and Nardi, 2021), although vaccinations represent one of the most effective public health interventions against infectious diseases. For instance, routine paediatric immunizations in a North American birth cohort study were estimated to have prevented 20 million illness cases and 42.000 illness-related deaths (Siddiqui, Salmon and Omer, 2013; Zhou *et al.*, 2014). Reinforcing the participation in medical services has thus been proven to be a health-promoting activity.

1.2.4. Physical activity

Physical activity subsumes all body movements, which are generated by the contraction of skeletal muscles, thus increasing the energy expenditure above the resting metabolic rate. Moreover, physical activity can be differentiated by its modality, intensity, duration, frequency, and context of practice. Exercise is a subcategory of physical activity, subsuming planned, structured, and repetitive activities, which are in favour of maintaining physical fitness (Caspersen, Powell and Christenson, 1985). It has been frequently shown that engaging in regular physical activity and exercise is a health-promoting activity. Being physically active results in lower cardiovascular morbidity and mortality, glycaemic control, prevention of cognitive and physical decline, increased muscle and bone strength, as well as a variety of positive mental health outcomes (e.g., positive mood states, reduced stress and anxiety). Contrary, a sedentary lifestyle represents a major risk factor for cardiovascular diseases, cancer, and type 2 diabetes (Conner, 2015; Posadzki *et al.*, 2020). In general, the majority of guidelines in different countries recommend 150 minutes per week of moderate aerobic physical activity (or equivalent of 75 min of vigorous physical activity), depending on present morbidities and age (Posadzki et al., 2020; Warburton and Bredin, 2017).

1.2.5. Sleep quality

Deteriorated sleep quality and shortened or prolonged sleep duration have been frequently highlighted as risk factors in the development of cardiovascular diseases (Garfield *et al.*, 2019), metabolic syndrome (Lian et al., 2019; Zohal *et al.*, 2017), obesity, diabetes (Cappuccio and Miller, 2017), mental disorders (Cable *et al.*, 2017; João *et al.*, 2018), and premature all-cause mortality (Hublin *et al.*, 2007). Sleep quality has thus been considered as health behaviour domain (Hagger, 2014; Oftedal *et al.*, 2019), and represents an umbrella term for several sleep measures including total sleep time, sleep onset latency, sleep maintenance, sleep efficiency, total wake time, and sleep disruptive events (e.g., apnea; Krystal and Edinger, 2008). In order to elicit a good sleep quality, various recommendations for healthy sleep habits have been made. For instance, avoiding caffeine, nicotine, and alcohol (especially before bedtime), exercising regularly, and managing distress has a positive impact on sleep quality (Irish *et al.*, 2015), thus highlighting the interconnected effects of health behaviours. On average, a total sleep quantity of seven to eight hours of sleep per night has been found to have a health-promoting effect (Alvarez and Ayas, 2004; Patel *et al.*, 2006).

1.3. Current research on affective disorders and health behaviours

The bidirectional relationship between affective disorders and health behaviours is well-researched, with most of the findings pointing towards a negative interaction between these constructs (e.g., Kilian *et al.*, 2006; Verger, Lions and Ventelou, 2009). This indicates that the association between affective disorders and negative health behaviours may reflect either the cause or the consequence of the disorder, especially in depressive disorders (Kivelä and Pahkala, 1991). For instance, affective disorders have been associated with a higher prevalence of substance use (Cassidy, Ahearn and Carroll, 2001; Kelder *et al.*, 2001; Wilhelm *et al.*, 2003; Zullig and Divin, 2012), unhealthy diet habits (Dash *et al.*, 2015; Gabriel *et al.*, 2023), lower participation in medical screenings (e.g., Wang *et al.*, 2019), physical inactivity (Kivelä and Pahkala, 1991; Vancampfort *et al.*, 2017), and deteriorated sleep patterns (Gold and Sylvia, 2016; Lopresti, Hood and Drummond, 2013).

In contrast, not using substances was found to elicit superior treatment outcomes in bipolar disorder (Berk *et al.*, 2008; Van Rossum *et al.*, 2009) and substantially decrease the risk of developing a depressive disorder (Pasco *et al.*, 2008), which has previously been led back to the alterating effects of substances on neurotransmitter activity (Boden, Fergusson and Horwood, 2010; Busto *et al.*, 2009). Relatedly, adhering to a Mediterranean diet style was found to significantly reduce depressive symptoms (Psaltopoulou *et al.*, 2013; Quirk *et al.*, 2013), due

to a better functioning of the microbiome–gut–brain axis (Dash *et al.*, 2015), lower inflammation parameters and oxidative stress, and ameliorated neurotransmission, since diet quality is important in the production of monoamines (e.g., serotonin; Lopresti, Hood and Drummond, 2013). For the participation in medical services, research reported either increased medical care utilization due to current symptomatology (Rowan *et al.*, 2002), or a decreased participation in health care due to internal (e.g., beliefs, symptoms) or external barriers (e.g., organizational or financial problems, mental health stigmata; Björk Brämberg *et al.*, 2018; Corrigan, Druss and Perlick, 2014; Wang *et al.*, 2019). Although depression was associated with a greater use of acute medical services (e.g., hospitalization), this does not seem to apply for routine medical services such as preventive screenings or immunizations (Peytremann-Bridevaux, Voellinger and Santos-Eggimann, 2008; Shin *et al.*, 2012). Further, physical activity has been frequently shown to have beneficial effect in affective disorders, which has been lead back to somatic alterations such as ameliorated neurotransmission, lower inflammation, and positive alterations of the hypothalamic-pituitary-adrenal axis (Lopresti, Hood and Drummond, 2013), as well as psychological variables such as distraction from negative stimuli, elevation of self-efficacy, enhanced executive cognitive functions, and social interaction (Ng, Dodd and Berk, 2007). Regarding sleep as a health behaviour, it was found that affecting sleep rhythms has a beneficial effect on the trajectory of affective disorders, which is reflected by sleep deprivation and light therapy treatments, as well as sleep hygiene (Dallaspezia and Benedetti, 2014; Rahimi *et al.*, 2016; Walsh *et al.*, 2014). Additionally, sleep disturbances in affective disorders are connected to poor diets, reduced energy levels, as well as suicidal ideation (Gold and Sylvia, 2016). Further, sleep disturbances serve as a marker for phase relapses and symptom severity (Franzen and Buysse, 2008; Gruber *et al.*, 2011; Ritter *et al.*, 2011).

Overall, several studies recommended the promotion of health behaviours as a feasible way to prevent and ameliorate affective disorders, especially since it was found that affective disorders are associated with a greater desire to make health behaviour changes, but also with greater barriers to perform these changes (Clayborne and Colman, 2019). Thus, it is necessary to determine factors, which drive the relationship between affective disorders and health behaviours. According to the Health Belief Model (Becker, 1974), personality traits impact health behaviours, which could also apply for the specific population of affective disorders. Indeed, it was reported that depressive disorders and substance use are related to the Big Five personality traits (openness, conscientiousness, extraversion, agreeableness, neuroticism; Goldberg, 1993; John and Srivastava, 1999; McCrae and Costa, 1987), specifically with high neuroticism and low conscientiousness (Kotov *et al.*, 2010). Similarly, there was a significant

positive relationship between substance use and the personality trait "novelty seeking" (i.e., the tendency to participate in exploratory activities) of Cloninger's Biosocial Theory of Personality in bipolar disorder (Cloninger, 1986; Haro *et al.*, 2007). For diet, it was suggested that the relationship between depression and diet is, among others, dependent upon personality traits, since they impact food choices and eating habits (Bear *et al.*, 2020) as well as the gut microbiome composition (Johnson, 2020). Moreover, the personality trait conscientiousness was found to have a significant impact on physical health through unhealthy eating habits and physical inactivity in a sample of individuals with depressive symptoms (Kummer *et al.*, 2021). In bipolar disorder, it was found that specific lipid profiles, which are controlled by an interaction between diet and genetics, are positively associated with the Big Five personality traits extraversion and agreeableness, and negatively associated with openness (Evans *et al.*, 2012). Regarding the participation in medical services, it was found that higher conscientiousness is associated with more frequent medical help-seeking in depression (Schomerus *et al.*, 2013). Moreover, the interaction between higher neuroticism and more depressive symptoms significantly increased health care use in individuals with medically unexplained physical symptoms (Den Boeft *et al.*, 2016). For physical activity, it was observed that individuals who were more physically active had fewer depressive symptoms and were more extroverted and less neurotic, which highlights the role of personality traits in the relationship between depression and physical activity (Brunes, Augestad and Gudmundsdottir, 2013). Regarding sleep, it was found that the personality traits agreeableness and emotional stability significantly interact with sleep quality and biological rhythm in bipolar disorder (Keleş Altun *et al.*, 2023). Moreover, sleep quality was found to mediate the relationship between the personality traits neuroticism and conscientiousness, and depressive symptoms (Huang *et al.*, 2016). Summarizing, various research findings point towards specific interactions between affective disorders, health behaviours, and personality traits. The vast majority of these findings investigated the Big Five personality traits, however, there is little research on personality traits, which are known to have deteriorating effects on both affective disorders and health behaviours, such as the Dark Triad personality traits.

1.4. Dark Triad personality traits

The Dark Triad subsumes three overlapping but unique personality traits: Machiavellianism, narcissism, and psychopathy. The common core of the Dark Triad traits consists of a socially malicious character with behavioural tendencies towards self-promotion, aggression towards others, emotional coldness, and duplicity (Paulhus and Williams, 2002).

Moreover, these traits share the central features of callousness and manipulative behaviour (Jones and Figueredo, 2013).

Specifically, Machiavellianism is characterized by cold and manipulative behaviour, a tendency to strategically pursue self-beneficial and agentic goals, as well as cynical, misanthropic, and immoral beliefs (Christie and Geis, 1970; Fehr, Samsom and Paulhus, 1992; Rauthmann, 2012). The term "Machiavellianism" was coined by the 16th century Italian chief political advisor Niccolò Machiavelli, who counselled the ruling Medici family in Florence, Italy. According to Machiavelli, rulers should use any effective strategies, including manipulative interpersonal tactics such as lying and flattery (Jones and Paulhus, 2009). Individuals, who are high in Machiavellianism, are thus oftentimes described as initially charming, but interpersonally exploitative (Wilson, Near and Miller, 1996), and are not interested in helping others in need unless it serves their personal goals (Wolfson, 1981). Narcissism, on the other hand, is characterized by feelings of subjective grandiosity, entitlement, dominance, and superiority (Paulhus and Williams, 2002). Those with higher manifestations of narcissism tend to demonstrate charming and sociable behaviour, but are also exploitative and insensitive to others' needs, and respond to criticism with cold indifference, rage, or feelings of humiliation (Morf and Rhodewalt, 2001; Raskin and Hall, 1979). Finally, psychopathy is defined by high impulsivity and thrill-seeking, as well as a lack of empathy and anxiety (Paulhus and Williams, 2002). Similar to Machiavellianism, psychopathy encompasses manipulative and callous behaviour, but of a more reckless and antisocial nature (Jones and Figueredo, 2013; Jones and Paulhus, 2009).

1.5. Current research on Dark Triad traits, and affective disorders, health behaviours

The Dark Triad traits have been associated with both affective disorders and health behaviours, with most results pointing towards a negative effect of these traits on both affective disorders (Bonfá-Araujo *et al.*, 2021; Shih *et al.*, 2019) and health behaviours (Dębska *et al.*, 2021; Malesza and Kaczmarek, 2021). However, each trait has been found to have a unique relationship to these constructs, which will be elaborated in the following paragraphs.

1.5.1. Machiavellianism, affective disorders, and health behaviours

In regard to affective disorders, Machiavellianism has been previously associated with a higher prevalence of depressive symptoms, which was explained by deficits in feeling and identifying emotions, the inability to experience pleasure, and social maladjustments, which are

present in both Machiavellianism and depressive disorders (Al Aïn *et al.*, 2013; Bianchi and Mirkovic, 2020; Jonason, Duineveld and Middleton, 2015). Contrary, other studies found a lower prevalence of depressive symptoms, especially in males (Latorre and McLeoad, 1978), who were high in Machiavellianism and exhibited higher emotional intelligence and thus more profound manipulation skills. This finding is explained by greater goal achievement in those with higher Machiavellian manipulation skills, which results in personal success and rewarding and mood-uplifting experiences (Bianchi and Mirkovic, 2020).

Regarding health behaviours, it has been suggested that the Machiavellian ability to delay impulsive behaviours might lead to positive health behaviours, however, most studies reported a negative effect of Machiavellianism on health behaviours. For instance, Machiavellianism was associated with more frequent alcohol (Gardiner and Lawson, 2023) and illicit drug use (Brajković, Jelinčić and Kopilaš, 2022), as well as following a diet rich in meat (Sariyska *et al.*, 2019), not adhering to recommended health behaviours (Grežo and Adamus, 2022), and experiencing sleep disturbances (Sabouri, Gerber, Lemola, *et al.*, 2016). Moreover, Machiavellianism represents a positive predictor for the use of tobacco, and a negative predictor for regular exercise, regular food intake, adhering to safety measures, and participating in physician visits. This finding was explained by the fact that the long-term delay of impulsive behaviours found in individuals higher in Machiavellianism may elicit stress and thus result in harmful health behaviours (Malesza and Kaczmarek, 2021).

1.5.2. Narcissism, affective disorders, and health behaviours

Research on narcissism and affective disorders, specifically depressive disorders, has shown that these constructs are inversely associated, indicating that higher narcissism is related to less depressive symptoms (Denovan *et al.*, 2021; Shih *et al.*, 2019). This finding was explained by a greater manifestation of mental toughness, resilience, and self-esteem (Denovan *et al.*, 2021; Papageorgiou *et al.*, 2019; Papageorgiou, Denovan and Dagnall, 2019a; Sedikides *et al.*, 2004; Szabó *et al.*, 2022), all of which are known to be protective factors in the development of depression (Loh, Schutte and Thorsteinsson, 2014; Poole, Dobson and Pusch, 2017). Moreover, individuals high in narcissism tend to prefer task-oriented and emotionally controlled coping styles (Birkás, Gács and Csathó, 2016; Denovan *et al.*, 2021), which were found to be associated with less negative affect (Rafnsson, Jonsson and Windle, 2006). Since individuals high in narcissism are more likely to seek validation of others, they might have more social support, which is considered a protective factor in affective disorders (Gómez-Leal *et al.*, 2019; Jonason, Duineveld and Middleton, 2015). Nevertheless, other studies indicated that

narcissism is positively related to affective disorders. For instance, in bipolar disorders, pathological narcissism was found to be more prevalent than in unipolar affective disorders (Brieger, Ehrt and Marneros, 2003), which was attributed to a considerable overlap between bipolar disorders and narcissism. Both constructs share common features in the domains associated with reward-seeking, excessively high aims, impulsivity, harm avoidance, and social functioning (Fulford, Johnson and Carver, 2008; Nagel, Marcus and Zeigler-Hill, 2023). Further, certain sub-characteristics of narcissism were linked to higher depressive symptoms (Gómez-Leal *et al.*, 2019; Shen, 2022), especially the phenotypic manifestation of vulnerable narcissism, which is characterized by fragility, introversion, and avoidance of interpersonal relationships due to fear of criticism and rejection (Erkoreka and Navarro, 2017; Marčinko *et al.*, 2014).

In light of health behaviours, narcissism has been shown to be either protective or harmful. For instance, narcissism was associated with less substance use, frequent exercising, eating regularly and healthy, adhering to safety measures, participating in medical check-ups, and less sleep disturbances (Dumitrescu *et al.*, 2013; Hill, 2016; Malesza and Kaczmarek, 2021; Sabouri, Gerber, Lemola, *et al.*, 2016). The positive impact of narcissism on various health behaviours has been explained by the narcissistic need to present a successful image and an attractive physical appearance to their surroundings (Malesza and Kaczmarek, 2021). However, the higher need for self-promotion might also convert into excessive health behaviour, which might have a deteriorating effect on health. Particularly, it was found that narcissism is associated with exercise dependency (Miller and Mesagno, 2014), orthorexia nervosa and restrained eating (Martinovic *et al.*, 2022; Mills *et al.*, 2018), risky driving behaviour (Hill, 2016), smoking (Kertzman *et al.*, 2022), and more experimenting with drugs and alcohol, as these behaviours represent strategies to achieve social inclusion and admiration from others (Stenason and Vernon, 2016; Welker, Simons and Simons, 2019).

1.5.3. Psychopathy, affective disorders, and health behaviours

Similar to the other Dark Triad traits, research on psychopathy and affective disorders has shown ambiguous results. Regarding psychopathy and depression, a large body of studies reported a positive association between these constructs (e.g., Bonfá-Araujo *et al.*, 2021; Gómez-Leal *et al.*, 2019; Love and Holder, 2014; Shih *et al.*, 2019; Stinson, Becker and Tromp, 2005). It is assumed that difficulties in emotion regulation and negative coping strategies might be an underlying factor of both depressive symptoms and psychopathy (Shen, 2022; Stinson, Becker and Tromp, 2005; Yang *et al.*, 2022). Further, it has been suggested that the

externalization of negative mood states such as depressive symptoms might result in antisocial and psychopathic behaviours (Gómez-Leal *et al.*, 2019; Stinson, Becker and Tromp, 2005). Contrary, other studies found either no association (e.g., Denovan *et al.*, 2021), or a negative association between psychopathy and depressive symptoms, indicating that higher levels of psychopathy serve as protective factors against depression (Willemsen, Vanheule and Verhaeghe, 2011). Specifically, the psychopathic personality factor "fearless dominance" was related to subjective lower stress-levels and more adaptive stress coping strategies (Dalkner *et al.*, 2018), both of which are assumed to be pivotal in depression (Billings and Moos, 1984).

Regarding psychopathy and health behaviour, the majority of recent research points towards a negative impact of this trait on several health behaviours (e.g., Hudek-Knežević, Kardum and Mehić, 2016; Malesza and Kaczmarek, 2021). For instance, it was shown that psychopathy is positively associated with substance use (tobacco, alcohol, drugs) and uncontrolled eating behaviour, as well as negatively associated with regular vigorous physical activity, adhering to safety and preventive guidelines, and participation in medical check-ups (Blanchard *et al.*, 2023; Malesza and Kaczmarek, 2021; Shi, Sun and Geng, 2022; Vaughan *et al.*, 2018). Moreover, psychopathy was associated with deteriorated sleep quality (Sabouri, Gerber, Lemola, *et al.*, 2016; Yang *et al.*, 2019), including wake-up time instability, later bedtimes, sleep disturbances (Rahafar, Kalbacher and Randler, 2022), and increased insomnia symptoms (Akram *et al.*, 2018). The negative relationship between psychopathy and health behaviours could be explained by the fact that individuals high in psychopathy tend to have a reduced perception of their health, thus possibly not noticing the consequences of health-risk behaviour (Beaver *et al.*, 2014). By nature, they are more likely to exhibit greater impulsivity, stimulation seeking, and reduced inhibitory control, which leads to poorer health choices (Dębska *et al.*, 2021; Jauk and Dieterich, 2019). This explanation is supported by the fact that psychopathy is associated with an increased number of diseases, missed number of workdays due to sickness, and a greater risk for developing chronic conditions (e.g., hypertension; Hudek-Knežević, Kardum and Mehić, 2016; Malesza and Kaczmarek, 2021).

1.6. Relevance and aims of the current study

In light of the current research on affective disorders, health behaviours, and the Dark Triad traits, the question regarding a possible interaction between these constructs remains to be answered. Although there is profound evidence on single associations between affective disorders, health behaviours, and the Dark Triad traits, the constructs have not yet been investigated altogether. Nowadays, the number of affective disorders in the population is

continuously rising. Frequently occurring somatic comorbidities among individuals with affective disorders, which are partially elicited by health behaviours, are representing an additional burden to these individuals, society, and economy. Contrary, promoting health behaviour interventions has been repeatedly shown to improve somatic and mental health in this specific population (Happell, Davies and Scott, 2012; Martins *et al.*, 2021; Siddiqui *et al.*, 2019). Targeting health behaviour interventions provides a feasible way to involve individuals with affective disorders in their own recovery process, thus strengthening their self-efficacy and treatment adherence, and ameliorating mental and somatic symptoms in a sustainable and cost-effective fashion (Park *et al.*, 2013). It is thus of great importance to investigate factors, which could possibly determine the relationship between affective disorders and health behaviours. Interindividual differences in personality might elucidate the mechanisms behind this relationship. If personality traits like the Dark Triad traits were to play a role in the relationship between affective disorders and health behaviours, actively altering these aversive traits through psychological therapies could assist individuals in adjusting their health behaviours. Moreover, the integration of personality traits into the treatment of affective disorders could help to monitor individuals with certain personality trait manifestations for somatic comorbidities.

Therefore, this study examines the influence of the Dark Triad personality traits between individuals with affective disorders (versus mentally healthy individuals) and the abovementioned health behaviours. Moreover, the influence of the Dark Triad personality traits on the relationship between individuals with affective disorders (versus mentally healthy individuals) and depression severity was explored to observe whether these traits affect symptom severity. Overall, the aim of this study was to create an integrative model of affective disorders (versus mental health), Dark Triad personality traits, and health behaviours. To investigate these matters, behavioural data were collected in an adult sample. Subjects performed self-report questionnaires measuring the previously mentioned health behaviours, Dark Triad traits, and depression severity.

1.7. Research questions and hypotheses

Derived from the literature above, the following main research questions (RQ1 and RQ2) were examined and accompanied by summative hypotheses (H1–H7).

RQ1: Is there an association between **affective disorders** (versus mentally healthy individuals) and **health behaviours** (substance abuse, diet, Mediterranean diet adherence, use of health services, physical activity, sleep quality), and is this association moderated by the individual manifestation of the **Dark Triad traits**?

H1: It is expected that individuals with **affective disorders** show less protective **health behaviours** compared to mentally healthy individuals. Further, it is expected that this relationship is negatively moderated by the individual manifestations of the **Dark Triad traits**, i.e., protective health behaviours are less prevalent in individuals with affective disorders and higher scores in the Dark Triad traits.

H2: It is expected that individuals with affective disorders show more **substance use** compared to mentally healthy individuals. Further, it is expected that this relationship is positively moderated by each of the **Dark Triad traits**, i.e., substance use is higher in individuals with affective disorders and higher scores in the Dark Triad traits.

H3: It is expected that individuals with **affective disorders** show poorer **dietary behaviour** (including **Mediterranean diet adherence**) compared to mentally healthy individuals. Further, it is expected that this relationship is negatively moderated by each of the **Dark Triad traits**, i.e., dietary behaviour is poorer in individuals with affective disorders and higher scores in the Dark Triad traits.

H4: It is expected that individuals with **affective disorders** show less **participation in medical services** (including **vaccination attitudes** and **perceived sensitivity to medicines**) compared to mentally healthy individuals. Further, it is expected that this relationship is negatively moderated by each of the **Dark Triad traits**, i.e., participation in medical services is less frequent in individuals with affective disorders and higher scores in the Dark Triad traits.

H5: It is expected that individuals with **affective disorders** show less **physical activity** compared to mentally healthy individuals. Further, it is expected that this relationship is negatively moderated by each of the **Dark Triad traits**, i.e., physical activity is lower for individuals with affective disorders and higher scores in the Dark Triad traits.

H6: It is expected that individuals with **affective disorders** show poorer **sleep quality** compared to mentally healthy individuals. Further, it is expected that this relationship is negatively moderated by each of the **Dark Triad traits**, i.e., sleep quality is worse in individuals with affective disorders and higher scores in the Dark Triad traits.

RQ2: Is there an association between **affective disorders** (versus mentally healthy individuals) and **depressive symptom severity**, and is this association moderated by the individual manifestation of the **Dark Triad traits**?

H7: It is expected that individuals with **affective disorders** show a greater **severity of depressive symptoms** compared to mentally healthy individuals. Further, it is expected that this relationship is positively moderated by each of the **Dark Triad traits**, i.e., severity of depressive symptoms is higher for individuals with affective disorders and higher scores in the Dark Triad traits.

2. Method

2.1. Sample

Participants were recruited at the Department of Psychiatry and Psychotherapeutic Medicine, or online via a participant recruiting company (probando.io), and social media platforms. They were presented with an online link, which identified every link opening as one participation. In total, 1.483 participations were registered, however, only 1.265 participations were completed and thus considered for analyses. Participants in the affective disorder group were included if they had a diagnosed affective disorder, while participants in the mentally healthy control group were included if they did not report psychiatric medication intake, a present psychiatric disorder, first-degree relatives with psychiatric disorders, or lifetime depression symptoms (see Appendix B1 and B2 for the exact questions). Moreover, participants were excluded if they were not of legal age (18 years), which applied to two individuals. In the mentally healthy control group, 18 reported an intake of psychiatric medication, further 19 a present psychiatric disorder, and further 72 at least one first-degree relative with a diagnosed psychiatric disorder. Moreover, 216 in the mentally healthy control group reported lifetime depression symptoms, which was assessed with nine dichotomous questions from the Structural Clinical Interview for DSM-IV, screening for the primary and secondary symptoms of depression (SCID-IV; Wittchen, Zaudig and Fydrich, 1997; e.g., *"Has there ever been a time, that is, at some point in your life, when you felt depressed or down for at least two weeks every day for most of the day?"*). In total, 327 participants were excluded from further analyses due to the pre-determined exclusion criteria, resulting in a total sample size of 938 adults. An a-priori power analysis (version 4.0; Soper, 2023) showed that for a small effect size (f^2 = .01), a recommended power of 80%, an α-level of .05, and the assumption of three latent variables (affective disorder, Dark Triad traits, health behaviours) and twelve manifest variables within a structural equation model, the minimum sample size is 1.258.

The sample consisted of 551 individuals with affective disorders and 387 mentally healthy individuals. In the affective disorder group, 68 reported a single-episode unipolar depression, 389 a recurrent depression, 78 were diagnosed with bipolar disorder, and 17 with dysthymia, and 16 stated to be diagnosed with other affective disorders. Overall, the sample comprised 686 women (73.13%), 238 men (25.38%), and 14 individuals, who identified themselves as diverse (1.49%), between the ages of 18 and 82 (M = 34.97, SD = 13.95). Moreover, 0.53% (n = 5) of the participants had no formal education, 6.72% (n = 63) had at least nine years of schooling, 19.51% (n = 183) had absolved an apprenticeship, 35.39% (n =

332) had a high school diploma, and 37.85% (*n* = 355) held a university degree. 24.41% (n = 229) of the participants reported a somatic disorder and 52.45% (*n* = 289) of the individuals in the affective disorder group reported a comorbid psychiatric disorder. In sum, 23.53% (*n* = 220) stated an intake of somatic medication, and 81.31% (*n* = 448) of the individuals in the affective disorder group reported an intake of psychiatric medication. In the affective disorder group, 38.11% (*n* = 210) stated to have first-degree relatives with a psychiatric disorder. Subjects provided German language skills at least at level C1. All participants gave written informed consent prior to participating in the study. This study was approved by the local ethics board of the Medical University of Graz (EC-number: 33-632 ex 20/21) and was conducted in accordance with the Declaration of Helsinki and guidelines for Good Scientific Practice. The study was pre-registered at AsPredicted.org (aspredicted.org/blind.php?x=6PD_1LZ; see Appendix C).

2.2. Measurements

2.2.1. Demographic Questionnaire

To assess socio-demographic characteristics, participants were asked to fill out a demographic questionnaire. First, they reported their gender, age, highest education qualification, relationship status, region of residence, current living situation (e.g., alone, with partner, with children), and job situation. Subsequently, anthropometric data (self-reported height and weight) and medical data (self-reported somatic diseases, hospital stay during the last 14 days, somatic medication, presence of an affective disorder, presence of other psychiatric diseases, psychopharmacological medication) were assessed. If participants stated to be diagnosed with an affective disorder, they were asked on their specific diagnosis of affective disorder (e.g., bipolar disorder), age at diagnosis, age at first symptoms, number of episodes, and whether the diagnosis was made by a healthcare professional in the psychiatric field. Finally, all participants were asked whether they have first-degree relatives with psychiatric disorders. The demographic questionnaire can be found in Appendix B1 (English version) and B2 (German version).

2.2.2. Multidimensional Health Behaviour Inventory (MHBI)

The MHBI (Kulbok *et al.*, 1999) assesses health behaviours on seven scales (diet, substance use, safety, check-up, social resources, stress, exercise). For the purpose of this study, the scales "diet" (13 items), "substance use" (ten items), "check-up" (nine items), and "exercise" (four items) were used. In total, 35 items were presented as questions (e.g., *"How often do you limit fat in diet?"*). Participants were asked to rate their individual frequency of

the presented health behaviour on an ascending five-point Likert scale, ranging from (1) = "never" to (5) = "always". Scores for each scale were computed by building the sum of the corresponding items. Higher scores indicate more frequent health-promoting behaviours. Cronbach's α indicated good internal consistency for each scale, except for "substance use" (α = .63). However, after excluding one item, which significantly deteriorated the internal consistency of this scale, all Cronbach's α values reflected a good internal consistency ("diet": α = .75; "substance use" : α = .71; "check-up" : α = .75; "exercise" : α = .78).

2.2.3. Mediterranean Diet Score (MEDAS)

The MEDAS (original English version: Trichopoulou *et al.*, 1995; German translation by Hebestreit *et al.*, 2017) measures the adherence to Mediterranean diet, which has been shown to provide multiple health benefits. In total, 14 items were presented as questions, out of which twelve questions assessed the food consumption frequency (e.g., *"How many servings of fish/seafood do you consume per week?"*) and two questions assessed the foot intake habits characteristic of the Mediterranean diet. One point was given for using olive oil as the main source of fat, one for preferring white meat over red meat or following a meat-free diet, and one for consuming each of the following:

- Four or more tablespoons of olive oil per day
- Two or more servings of vegetables per day
- Three or more pieces of fruit per day
- Fewer than one serving of red meat or sausages per day
- Fewer than one serving of animal fat per day
- Fewer than one cup (=100 ml) of sugar-sweetened beverages per day
- Seven or more servings of red wine per week
- Three or more servings of pulses per week
- Three or more servings of fish per week
- Fewer than three commercial pastries per week
- Three or more servings of nuts per week
- Two or more servings of a dish with a traditional sauce of tomatoes, garlic, onion, or leeks in olive oil per week

Fulfilled criteria were scored with the value 1. Item scores were summed up to build a total sum score, thus higher scores indicate more adherence to the Mediterranean diet. Cronbach's α was rather low for the total sum score (α = .50), but consistent with other studies using this scale (for a review see Zaragoza-Martí *et al.*, 2018).

2.2.4. Vaccination Attitude Examination Scale (VAX-Scale)

To record the attitudes towards vaccines as part of the health behaviour domain "participation in medical services", the VAX-Scale (Martin and Petrie, 2017) was administered. In total, twelve items were presented as statements (e.g., *"I worry about the unknown effects of vaccines in the future."*), with responses being given on a six-point Likert scale, ranging from (1) = "strongly agree" to (6) = "strongly disagree". The mean of the item scores was calculated to create a total score, with higher scores reflecting more negative vaccination attitudes. Cronbach's α indicated sufficient internal consistency (α = .93).

2.2.5. Perceived Sensitivity to Medicines Scale (PSM-Scale)

To assess the perceived sensitivity to medicines as part of the health behaviour domain "participation in medical services", the PSM-Scale (Horne *et al.*, 2013) was used. It comprises five items, which are presented as statements (e.g., *"My body overreacts to medicines."*). Participants were asked to rate their agreement on a five-point Likert scale, ranging from (1) = "strongly disagree" to (5) = "strongly agree". The mean of all item scores was built to create a total score, with higher scores indicating a higher sensitivity to potential adverse effects of medicines. Sufficient internal consistency for the total score was given (Cronbach's α = .89).

2.2.6. Pittsburgh Sleep Quality Index (PSQI)

To assess sleep quality, the PSQI was administered (original English version: Buysse *et al.*, 1989; German translation by Riemann and Backhaus, 1996), which assesses subjective sleep patterns throughout the previous month. It comprises 19 items, which generate seven component scores: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime sleepiness. Participants were asked to either report their answers in an open response format (e.g., *"During the past month, what time have you usually gone to bed at night?"*), or rate their agreement on the presented items, which were scored from 0 to 3 (e.g., *"During the past month, how would you rate your sleep quality overall?"*). To construct a total score, the sum of the component scores was built. Higher scores indicate worse sleep quality. Cronbach's α indicated good internal consistency (α = .80).

2.2.7. Patient Health Questionnaire (PHQ-9)

To assess the presence and severity of depressive symptoms throughout the past two weeks, the PHQ-9 (original English version: Spitzer, Kroenke and Williams, 1999; German translation by Löwe *et al.*, 2002) was administered. It consists of nine items, which are based upon the nine DSM-IV criteria for diagnosing depressive disorders (e.g. *"Little interest or pleasure in doing things"*). Participants were asked to rate the individual frequency of the

presented symptoms on a four-point Likert scale, ranging from (0) = "not at all" to (3) = "nearly every day". Scores of the items were summed up to build a total sum score. Higher scores indicated more severe depressive symptoms. Cronbach's α indicated sufficient internal consistency (α = .93).

2.2.8. Short Dark Triad (SD3)

To assess the individual DT manifestation, the SD3 (English version by Jones and Paulhus, 2014; German translation by Malesza *et al.*, 2019) was administered, which comprises 27 items. Nine items for each trait were presented as statements (e.g., Machiavellianism: *"Most people can be manipulated."*). Participants rated their agreement on a five-point Likert scale, ranging from (1)= " disagree strongly" to (5)= " agree strongly". Scale scores were constructed by calculating the mean of the corresponding items, with higher scores indicating higher individual manifestations of the trait. All scales indicated sufficient internal consistency (Cronbach's α for narcissism: α = .70, Machiavellianism: α = .80, psychopathy: α = .71).

2.2.9. Translation of questionnaires

Since the MHBI, the VAX-Scale, and the PSM-Scale were only available in English language, these questionnaires were previously translated into German according to the procedure for translating health-related questionnaires recommended by Acquadro *et al.* (2008). First, two bilingual translators (T1 and T2), whose mother tongue was the target language German, produced two independent translations of the items in the source language English. The translators were briefly informed about the concepts behind the questionnaire. Secondly, both translators discussed their translations and agreed on a common version (T1-2). Third, two additional professional translators (T3 and T4), completely blind to the original version, translated the previous common version (T1-2) back into the original language (see Appendix B3 for all translation protocols). Fourth, all translations were reviewed by an independent observer, who determined a prefinal version of the translation. Lastly, the prefinal German version and the original English version were tested on five individuals. Measures of reliability (internal consistency, intraclass correlation coefficients) and concurrent validity were assessed and showed comparable results between the prefinal German version and original English version (see Appendix B4 for all results of the translation analysis). The prefinal German version was thus determined as the final version, which was given to all participants.

2.3. Procedure

Participants were first recruited and subsequently presented with an online link to the survey tool LimeSurvey (version 3.28.39), which was completed in one session. Data collection took place between October 2021 and June 2023. To create a standardized setting, participants were asked to fill out the questionnaires in a quiet environment on a laptop, computer, or tablet. After reading the standardized general instructions, informed consent was obtained (see Appendix B5-B8 for detailed information on informed consent and standardized instructions). First, they were presented with the socio-demographic questionnaire. Subsequently, the MHBI, MEDAS, PSQI, VAX-Scale, PSM-Scale, PHQ-9, and SD3 were presented in a counterbalanced order across all participants. Finally, participants were given thanks and asked to leave the survey programme by closing the web page. The entire session took approximately 20-30 minutes.

2.4. Statistical analyses

All analyses were conducted in R (version 4.1.2., https://www.r-project.org). For descriptive purposes, group differences in demographic and psychometric variables were calculated using χ^2-tests, Mann-Whitney-*U*-tests, and *t*-tests. Moreover, to further describe the associations between demographic and psychometric variables, bivariate Pearson- and Spearman correlation analyses were conducted. To prevent type 1-error inflation due to multiple testing, the Benjamini-Yekutieli false discovery rate was applied (Benjamini and Yekutieli, 2001).

Secondly, to test the hypothesis of whether individuals with affective disorders show less protective health behaviours compared to mentally healthy individuals and whether this relationship is moderated by the Dark Triad traits, a structural equation model was established to analyse the latent relationships between affective disorders, the Dark Triad traits (Machiavellianism, narcissism, psychopathy), and health behaviours (substance use, diet, adherence to Mediterranean diet, participation in medical check-ups, perceived sensitivity to medicines, vaccination attitudes, physical activity, sleep quality). The model estimation was performed with R's *lavaan*-package (Rosseel, 2012) and *MIIVsem*-package (Gates, Fisher and Bollen, 2020), using the maximum likelihood procedure with robust standard errors (MLR) and the Yuan–Bentler correction for the χ^2-test and standard errors to account for deviations from multivariate normality. All regression coefficients were standardized. The calculations followed a two-step modelling approach (Anderson and Gerbing, 1988), in which the single parts of the measurement model (e.g., whether Machiavellianism, narcissism and psychopathy load onto a

common latent Dark Triad variable) were evaluated separately prior to testing the structural relationships among the latent constructs. This stepwise procedure ensures that the latent variables are adequately measured before continuing with the examination of their structural relationships. To assess the global model fit, the χ^2-test was used. Since the sensitivity of the χ^2-test usually increases with sample size, the calculations followed the common practice of assessing the model fit by the criterion of χ^2/df. The resulting value should be below the commonly employed criterion of 2 for a good model fit (Byrne, 1989). Further employed indices for the global model fit assessment were the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR; Beauducel and Wittmann, 2009; Hu and Bentler, 1998, 1999). Since the overall χ^2-test does not indicate the source of misfit, the so called "model-implied instrumental variables" (MIIVs), which are able to demonstrate the specification of factor-to-indicator effects, were used to identify misspecified indicators by means of an equation-specific test of endogeneity (i.e., the Sargan test). Finally, standardized residuals were examined to observe potential local misfit.

To test the hypotheses of whether the relationship between group (individuals with affective disorders versus mentally healthy individuals), and health behaviours (substance use, diet, adherence to Mediterranean diet, participation in medical check-ups, vaccination attitudes, perceived sensitivity to medicines, physical activity, sleep quality), as well as the severity of depressive symptoms is moderated by Machiavellianism, narcissism, and psychopathy, moderation analyses were conducted. Previous studies on the Dark Triad traits and health behaviours frequently included sex, age, and education as covariates in their analyses (e.g., Yang *et al.*, 2019), thus it was aimed to control for these variables. The PROCESS Macro v4.1 was used to estimate the moderation models and means for continuous variables were centered prior to analyses (Hayes, 2022b). Significant interaction effects were probed with simple slope analyses. To determine low, average, and high levels of the moderator variables, the 16^{th}, 50^{th}, and 84^{th} variable percentiles were examined. Common assumptions for conducting moderation analyses were fulfilled or corrected accordingly (i.e., linearity, absence of multicollinearity and influential outliers, independence of residuals, normality of residuals, homoscedasticity; Hayes, 2022a). For violations of normality of residuals and influential outliers, 95% BCa bootstrapping confidence intervals based on 2000 samples were applied. Regarding violations of homoscedasticity, heteroscedasticity-consistent covariance estimators (HC3) were used, as recommended by Long and Ervin (2000). Hypotheses were tested two-tailed at an α- level of .05. Data and analysis scripts can be accessed via https://doi.org/10.17605/OSF.IO/T3AS2

3. Results

3.1. Descriptive analyses

Descriptive statistics of all questionnaires can be found in Appendix A (Table A1). The χ^2-tests, Mann-Whitney-*U*-tests, and *t*-tests applied to examine group differences in demographic and psychometric variables showed significant differences between individuals with affective disorders and mentally healthy individuals regarding several demographic characteristics, personality traits, and health behaviours. Specifically, the results indicate that individuals with affective disorders were of significantly higher age, more often female, and reported more intake of somatic medication as well as more somatic and/or psychiatric comorbidities. Moreover, they reported a significantly higher manifestation of Machiavellianism and psychopathy, but a lower manifestation of narcissism. Further, individuals with affective disorders showed significantly less substance use and Mediterranean diet adherence, more negative vaccination attitudes and medication sensibility, less physical activity, worse sleep quality, and greater depressive symptom severity (for detailed values of the analyses see Table 1).

Table 1. Group differences in demographic and psychometric variables between individuals with affective disorders (AD) and healthy controls (HC).

Variable	Group			Statistics	
	HC (n = 387)	AD (n = 551)	Total (n = 938)	χ^2(df)	t/Z
Age	M = 30.75 SD = 11.01	M = 37.94 SD = 15.01	M = 34.97 SD = 13.95		**-8.46*****
Gender				**11.60(2)****	
Female	279 (40.67%)	407 (59.33%)	686 (73.14%)		
Male	108 (45.38%)	130 (54.62%)	238 (25.37%)		
Diverse	0 (0%)	14 (100%)	14 (1.49%)		
Education					-0.36
No formal education	0 (0%)	5 (100%)	5 (0.53%)		
Compulsory schooling	2 (3.17%)	61 (96.83%)	63 (6.72%)		
Apprenticeship	28 (15.30%)	155 (84.70%)	183 (19.51%)		
High school diploma	127 (38.25%)	205 (61.75%)	332 (35.39%)		
Bachelor degree	128 (70.72%)	53 (29.28%)	181 (19.30%)		
Master degree	86	63	149		

	(57.72%)	(42.28%)	(15.88%)		
PhD	16 (64%)	9 (39%)	25 (2.67%)		
Somatic comorbidities [yes]	30 (13.10%)	199 (86.90%)	229 (24.41%)	**97.58(1)*** **	
Somatic medication [yes]	26 (11.82%)	194 (88.19%)	220 (23.45%)	**101.2(1)*** **	
Psychiatric comorbidities [yes]	0 (0%)	289 (100%)	289 (30.81%)	**290.01(1)*** **	
Psychiatric medication [yes]	0 (0%)	448 (100%)	448 (47.76%)		
Professionally diagnosed [yes]	0 (0%)	544 (100%)	544 (58.00%)		
FDR [yes]	0 (0%)	210 (100%)	210 (22.39%)		
Age of first symptoms		*M* = 23.06 *SD* = 13.53			
Age of diagnosis		*M* = 29.47 *SD* = 14.23			
Number of affective episodes		*M* = 22.27 *SD* = 32.29			
Machiavellianism	*M* = 2.41 *SD* = 0.70	*M* = 2.55 *SD* = 0.80			**-2.77****
Narcissism	*M* = 2.39 *SD* = 0.59	*M* = 2.14 *SD* = 0.68			**6.14*****
Psychopathy	*M* = 1.77 *SD* = 0.56	*M* = 1.91 *SD* = 0.66			**-3.45*****
Substance use	*M* = 38.28 *SD* = 5.05	*M* = 35.91 *SD* = 6.43			**6.29*****
Diet	*M* = 40.25 *SD* = 7.37	*M* = 39.37 *SD* = 7.68			1.76
MEDAS score	*M* = 7.00 *SD* = 1.95	*M* = 6.33 *SD* = 2.11			**4.99*****
Use of medical service	*M* = 24.78 *SD* = 6.20	*M* = 25.50 *SD* = 6.13			-1.79
VAX score	*M* = 4.59 *SD* = 1.06	*M* = 4.28 *SD* = 1.22			**4.12*****
PSM score	*M* = 7.89 *SD* = 3.97	*M* = 10.66 *SD* = 5.47			**-9.12*****
Physical activity	*M* = 12.73 *SD* = 3.36	*M* = 9.95 *SD* = 3.65			**12.00*****
PSQI score	*M* = 4.47 *SD* = 2.51	*M* = 10.04 *SD* = 4.27			**-25.10*****
PHQ score	*M* = 4.42 *SD* = 3.53	*M* = 15.02 *SD* = 6.47			**-32.21*****

Note. *M* = Mean. *SD* = Standard deviation. PhD = Doctoral studies. FDR = First-degree relative with psychiatric disorder. Diet, Substance Use, Use of Medical Service, and

Physical Activity = Scale scores of the Multidimensional Health Behaviour Inventory. MEDAS score = Mediterranean Diet score. VAX score = Vaccination Attitude Examination Scale score. PSM score = Perceived Sensitivity to Medicines score. PSQI score = Pittsburgh Sleep Quality Index score (higher values indicate better sleep quality). PHQ score = Patient Health Questionnaire score. ** $p < .01$, *** $p < .001$. Significant results are printed in bold.

3.2. Preliminary analyses

3.2.1. Distribution analyses

Normal distribution for the subsequent correlation analyses was determined with skew and kurtosis values for all study variables (see Appendix A, Table A1). Significance tests of skew and kurtosis were not examined, since they are more likely to become significant in larger samples due to smaller standard errors (Field, 2018). The distribution analyses indicated that all variables were within the acceptable range of skew and kurtosis (-1.5/+1.5; Tabachnik and Fidell, 2013) and thus normally distributed.

3.2.2. Preliminary correlation analyses

To further explore the relationships between demographic and psychometric variables, preliminary Spearman- and Pearson correlations were conducted, considering the Benjamini-Yekutieli false discovery rate to prevent type I-error inflation (Benjamini and Yekutieli, 2001). To conduct point-biserial correlations for the gender variable, individuals who identified themselves as diverse gendered were excluded (n = 14). The analyses showed that, amongst others, group affiliation was associated with all Dark Triad traits and almost all health behaviours. This indicates that individuals with affective disorders tended to have higher manifestations of Machiavellianism and psychopathy, as well as lower manifestations of narcissism. Moreover, individuals with affective disorders tended to report deteriorated health behaviours. In general, higher Machiavellianism was associated with less physical activity and adherence to Mediterranean diet, worse sleep quality and depressive symptom severity, as well as a more negative attitude towards vaccines. Contrary, higher narcissism was associated with more physical activity, better sleep quality, and lower depressive symptom severity. Higher psychopathy was associated with less substance use and use of medical service, worse sleep quality and depressive symptom severity, a higher subjective medicine sensitivity, and a more negative attitude towards vaccines. All results can be found in Table 2. Moreover, correlation analyses examining the same variables separated by group (individuals with affective disorders vs. mentally healthy individuals) can be found in Appendix A (Table A2 and Table A3).

Table 2. Spearman- and Pearson correlation analyses between demographic and psychometric variables.

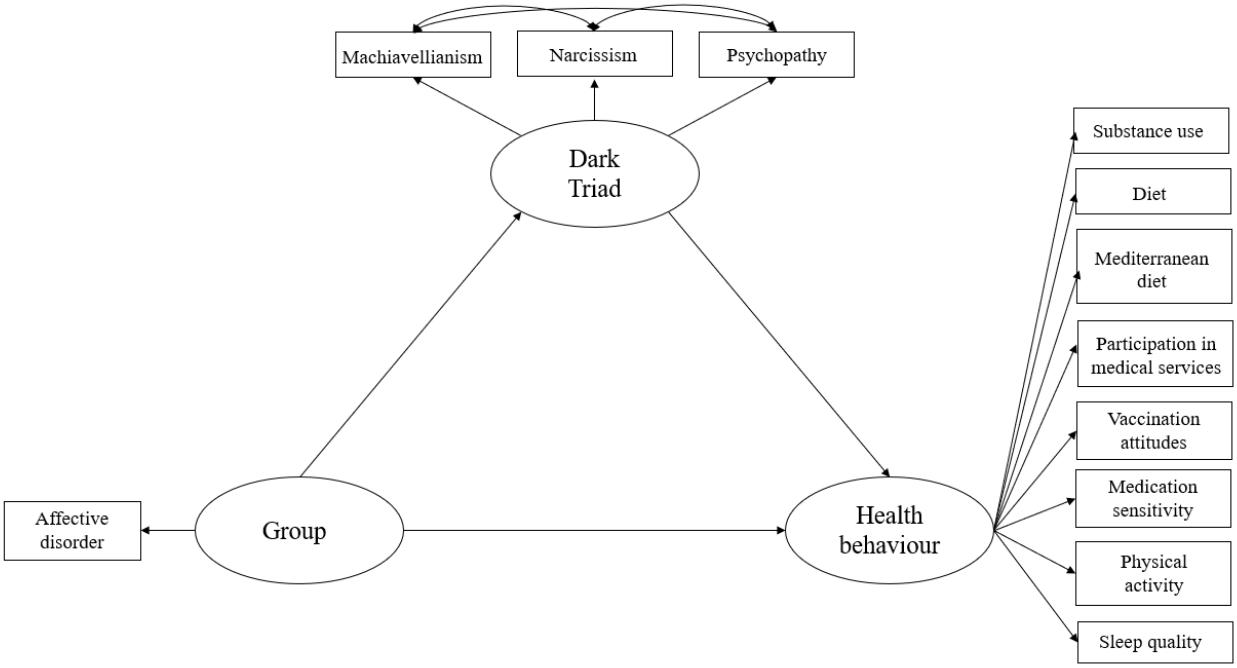
Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Group	1	-.04	**.26*** **	**-.38*** **	**.08***	**-.20*** **	**.10****	-.05	**-.19*** **	.05	**-.36*** **	**-.16*** **	**.60*** **	**.27*** **	**-.14*** **	**.69*** **
2 Gender		1	**.11****	.03	**.13*** **	**.19*** **	**.18*** **	**-.20*** **	**-.14*** **	**-.13*** **	.07	**-.13*** **	-.03	**-.11****	.03	-.08
3 Age			1	-.05	-.03	-.03	**-.10****	.02	.04	**.19*** **	**-.14*** **	**-.11***	**.22***	**.10***	**-.10***	**.11****
4 Education				1	-.05	**.15*** **	-.06	.05	**.13*** **	.04	**.27*** **	**.19*** **	**-.33*** **	**-.09***	**.22*** **	**-.35*** **
5 Machiavellianism					1	**.30*** **	**.49*** **	-.06	-.05	-.07	**-.13*** **	**-.14*** **	**.10***	.07	**-.14*** **	**.15*** **
6 Narcissism						1	**.44*** **	.00	-.08	.07	**.15*** **	.06	**-.11****	.05	-.01	**-.18*** **
7 Psychopathy							1	-.06	**-.27*** **	**-.09***	-.06	-.07	**.13*** **	**.07***	**-.09***	**.13*** **
8 Diet								1	**.25*** **	**.31*** **	**.36*** **	**.45*** **	-.01	.09	.08	-.09
9 Substance use									1	**.22*** **	**.19*** **	**.16*** **	**-.19*** **	.01	**.13*** **	**-.21*** **
10 Use of medical service										1	**.21*** **	**.23*** **	.02	**.22*** **	**.12****	-.04
11 Physical activity											1	**.35*** **	**-.35*** **	-.08	**.16*** **	**-.41*** **
12 MEDAS score												1	**-.18*** **	.03	**.14*** **	**-.19*** **
13 PSQI score													1	**.25*** **	**-.19*** **	**.71*** **
14 PSM score														1	**-.16*** **	**.30*** **
15 VAX score															1	**-.18*** **
16 PHQ score																1

Note. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Gender = Female (=1) vs. male (=2). Diet, Substance Use, Use of Medical Service, and Physical Activity = Scale scores of the Multidimensional Health Behaviour Inventory. MEDAS score = Mediterranean Diet score. PSQI score = Pittsburgh Sleep Quality Index score (higher values indicate better sleep quality). PSM score = Perceived Sensitivity to Medicines Score. VAX score = Vaccination Attitude Examination Scale score. PHQ score = Patient Health Questionnaire score. * $p < .05$, ** $p < .01$, *** $p < .001$. Benjamini-Yekutieli adjustments for all α-levels. Significant results are printed in bold.

3.3. Structural equation model

Assumptions for setting up the structural equation model were examined prior to the analysis. The results indicated no impossible values in the data, however, multivariate normality was not given as estimated by Mardia's test (skew = 18916.91, kurtosis = 56.43). Although the skew and kurtosis values were indicative of univariate normality, maximum likelihood robust standard errors (MLR) and Yuan–Bentler corrections for χ^2-tests and standard errors were used to account for deviations from multivariate normality. The structural equation model estimation converged to an admissible solution (see Figure 3 for a schematic visualization of the model).

Figure 3. Schematic visualization of a structural equation model.



Note. This structural equation model predicts health behaviour from the presence of an affective disorder (versus mentally healthy individuals), with the moderating effect of the Dark Triad traits. The model indicated an insufficient fit and is thus presented without standardized regression coefficients.

Following the two-step approach to fit the model (Anderson and Gerbing, 1988), the first step confirmatory factor analysis model demonstrated a model misfit, since the overall χ^2-square test was significant ($\chi^2(52) = 847.18$, $p < .05$). Moreover, the χ^2-value exceeded the more liberal criterion of $\chi^2/df < 2$ (i.e., 847.18/52 = 16.29), and the fit indices indicated an inadequate fit (CFI = .61; RMSEA = .13, 90% CI [0.12, 0.14], $p_{RMSEA<0.05} < .001$; SRMR = .11). Next to the inadequate global model fit, the single equation Sargan tests testing the source of the misfit revealed all indicators as problematic ($p < .001$ for all latent variable indicators). In

line with these results, an examination of the standardized residuals for further exploration of the local model fit showed pronounced residual deviations. This indicates that the relationships between the items cannot be captured by the three postulated factors. Table 3 shows the loadings of this model and the associated Sargan tests. Since the first step of the two-step approach indicated an insufficient model fit, further calculations on the model were not administered.

Table 3. Factor loadings of the confirmatory factor analysis and equation-based specification tests.

Factors and indicators	Initial model (Confirmatory Factor Analysis)	
	Standardized loading	Sargan test for indicator missspecification
Affective disorders		
Group	1.00	NA
Dark Triad traits		
Machiavellianism	.67	NA
Narcissism	.50	**123.65*** **
Psychopathy	.87	**60.79*** **
Health behaviour		
Substance use	.32	NA
Diet	.20	**167.01*** **
Mediterranean diet adherence	.32	**98.54*** **
Participation in medical services	.07	**114.70*** **
Vaccination attitudes	.27	**56.29*** **
Perceived medication sensitivity	-.29	**140.01*** **
Physical activity	.53	**109.10*** **
Sleep quality	-.74	**240.97*** **

Note. Group = Healthy controls (=1) vs. affective disorders (=2). NA = not available.
*** $p < .001$. Significant results are printed in bold.

3.4. Moderation analyses

To investigate whether the relationships between group affiliation (affective disorders vs. mentally healthy individuals) and the single health behaviours are moderated by each of the Dark Triad traits, 27 moderation analyses were conducted. These analyses included the respective health behaviour and depressive symptom severity as outcome variable, group affiliation (affective disorders vs. mentally healthy individuals) as predictor variable, Machiavellianism, narcissism, and psychopathy as moderator variables, and age, gender, and education as covariates. Assumptions to conduct moderation analyses were examined prior to the analyses (e.g., linearity, homoscedasticity, independency and normality of residuals, no influential outliers or multicollinearity; Hayes, 2022a). All assumptions were fulfilled except

for homoscedasticity in some of the moderation analyses (as indicated by residual scatterplots and Breusch-Pagan-tests). Thus, heteroscedasticity-consistent covariance estimators (HC3) and 95%-BCa bootstrapping confidence intervals based on 2000 samples were applied in all models.

3.4.1. Substance use, affective disorders and the Dark Triad traits

The analyses of substance use, affective disorders, and the Dark Triad traits, independently of age, gender, and education, indicated a significant negative main effect for group regarding substance use. This indicates that substance use tended to be less common among individuals with affective disorders. Machiavellianism and psychopathy explained significant unique negative variance, thus revealing that higher manifestations of these traits were associated with less substance use. Further, there was a significant moderating effect of Machiavellianism in the relationship between group affiliation and substance use. However, regarding narcissism and psychopathy, no significant interaction effect in the relationship between group and substance use was found. Moderation statistics are depicted in Table 4.

Table 4. Linear model of the predictors of substance use.

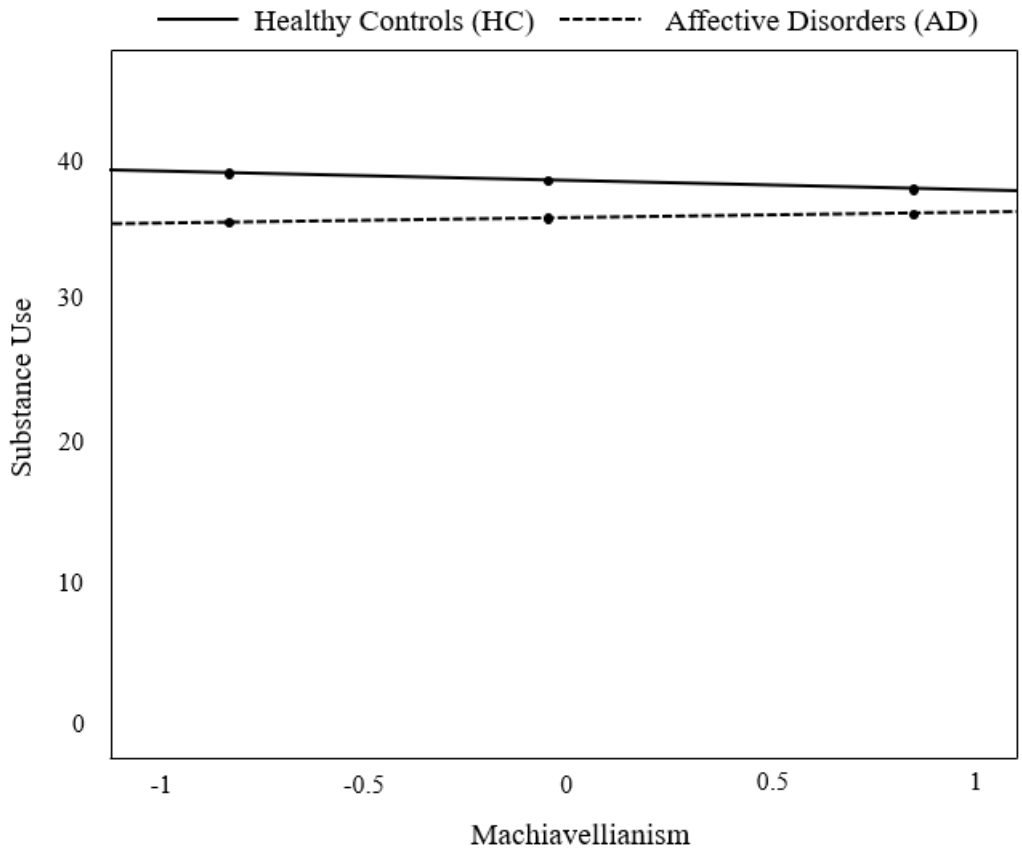
Effect	*B*	SE_B(HC3)	*t*	*p*
Constant	**40.61**	1.38	29.38	.000
	[38.04; 43.32]			
Group	**-2.51**	0.44	-5.66	.000
	[-3.38; -1.64]			
Machiavellianism[a]	**-1.75**	0.85	-2.06	.040
	[-3.38; -0.15]			
Group x Machiavellianism	**1.05**	0.51	2.03	.042
	[0.04; 2.02]			
Constant	**40.58**	1.36	29.86	.000
	[37.99; 42.20]			
Group	**-2.73**	0.43	-6.32	.000
	[-3.59; -1.88]			
Narcissism[a]	-1.14	0.97	-1.18	.239
	[-3.12; 0.64]			
Group x Narcissism	0.10	0.59	0.17	.863
	[-1.02; 1.32]			
Constant	39.92	1.36	29.35	.000
	[-2.34; 0.04]			
Group	**-2.14**	0.43	-4.93	.000
	[4.49; 5.58]			
Psychopathy[a]	**-2.60**	1.12	-2.32	.020
	[1.01; 3.74]			
Group x Psychopathy	-1.67	0.67	0.46	.646
	[-2.01; -0.26]			

Note. N = 924. HC3 = Heteroscedasticity-consistent covariance estimators. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Linear Model controlling for age, gender, and education. Total R^2: Machiavellianism = .08, narcissism = .09, and psychopathy = .12. 95% BCa bootstrapping confidence intervals based on 2000 samples in square brackets. Significant results are printed in bold.
[a] Mean centered variables.

To examine the significant interaction effect of *group affiliation x Machiavellianism* on substance use, a simple slope analysis was conducted. This analysis indicated a significant positive association between group affiliation and substance use at low ($\theta_{Group \rightarrow Substance}$|(Machiavellianism = -0.82) = -3.38, CI [-4.57; -2.19], t = -5.60, p < .001), average ($\theta_{Group \rightarrow Substance}$|(Machiavellianism = -0.05) = -2.56, CI [-3.44; -1.69], t = -5.78, p < .001), and high manifestations of Machiavellianism ($\theta_{Group \rightarrow Substance}$|(Machiavellianism = 0.84) = -1.63, CI [-2.87; -0.38], t = -2.56, p < .05). At each examined level of Machiavellianism, substance use was higher in mentally healthy individuals than in individuals with affective

disorders. Figure 4 reveals that higher Machiavellianism has a more negative impact on substance use in individuals with affective disorders.

Figure 4. Visual representation of the moderation effect of group (individuals with affective disorders (AD) vs. healthy controls (HC)) on substance use by Machiavellianism.



Note. The moderator variable Machiavellianism was centered prior to moderation analysis. Results from probing the moderator at the 16th, 50th, and 84th percentile (black dots) revealed a significant positive association between group affiliation (HC vs. AD) and substance use at low ($\theta_{Group \rightarrow Substance}$|(Machiavellianism = -0.82) = -3.38, CI [-4.57; -2.19], t = -5.60, p < .001), average ($\theta_{Group \rightarrow Substance}$|(Machiavellianism = -0.05) = -2.56, CI [-3.44; -1.69], t = -5.78, p < .001), and high manifestations of Machiavellianism ($\theta_{Group \rightarrow Substance}$|(Machiavellianism) = 0.84 = -1.63, CI [-2.87; -0.38], t = -2.56, p < .05).

3.4.2. Diet, affective disorders and the Dark Triad traits

For the relationship between group and diet, no significant main effects or moderation effects of the Dark Triad traits were found, independently of age, gender, and education. This indicates that group affiliation was not associated with dietary behaviour and that none of the Dark Triad traits had a moderating influence in the relationship between group affiliation and diet. Moderation statistics are depicted in Table 5.

Table 5. Linear model of the predictors of dietary behaviour.

Effect	*B*	SE_B(HC3)	*t*	*p*
Constant	**43.55**	1.65	26.43	.000
	[40.36; 46.85]			
Group	-0.92	0.55	-1.68	.093
	[-1.93; 0.13]			
Machiavellianism[a]	-1.73	1.06	-1.63	.103
	[-3.81; 0.24]			
Group x Machiavellianism	0.91	0.65	1.42	.157
	[-0.32; 2.20]			
Constant	**43.74**	1.66	26.42	.000
	[40.55; 47.00]			
Group	-0.87	0.56	-1.56	.119
	[-1.91; 0.19]			
Narcissism[a]	0.80	1.54	0.52	.604
	[-1.98; 3.91]			
Group x Narcissism	-0.27	0.88	-0.31	.756
	[-2.10; 1.41]			
Constant	**43.71**	1.66	26.41	.000
	[40.50; 46.96]			
Group	-0.95	0.55	-1.71	.088
	[-1.98; 0.14]			
Psychopathy[a]	-0.08	1.49	-0.05	.957
	[-3.04; 2.84]			
Group x Psychopathy	0.01	0.86	0.01	.992
	[-1.68; 1.69]			

Note. $N = 924$. HC3 = Heteroscedasticity-consistent covariance estimators. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Linear Model controlling for age, gender, and education. Total R^2 for Machiavellianism, narcissism, and psychopathy = .05. 95% BCa bootstrapping confidence intervals based on 2000 samples in square brackets. Significant results are printed in bold. [a] Mean centered variables.

3.4.3. Mediterranean diet adherence, affective disorders and the Dark Triad traits

Regarding the relationship between group affiliation and Mediterranean diet adherence, independently of age, gender, and education, significant negative main effects of group and Machiavellianism on Mediterranean diet adherence were found. This indicates that individuals with affective disorders and more Machiavellian individuals were less likely to adhere to the Mediterranean diet. Further, there was a significant positive moderating effect of Machiavellianism, as opposed to narcissism or psychopathy (see Table 6).

Table 6. Linear model of the predictors of Mediterranean diet adherence.

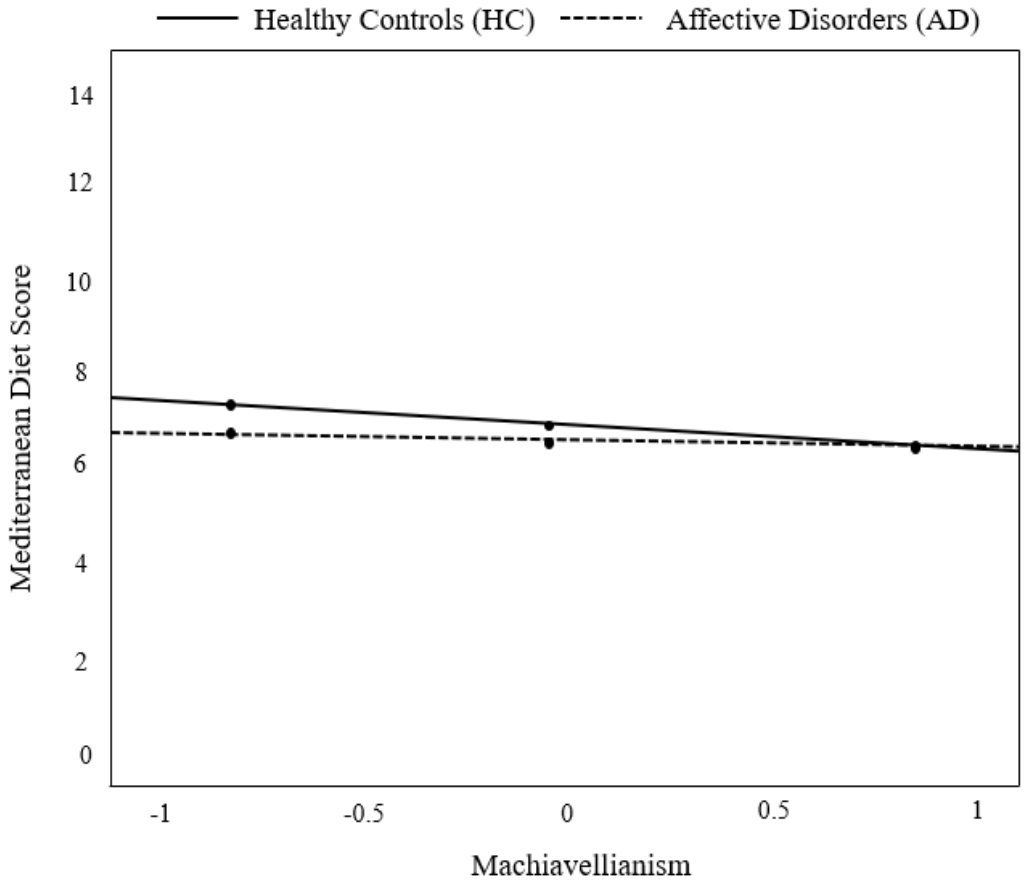
Effect	*B*	SE_B(HC3)	*t*	*p*
Constant	**7.03**	0.48	14.64	.000
	[6.10; 7.99]			
Group	**-0.31**	0.15	-2.08	.037
	[-0.59; -0.02]			
Machiavellianism[a]	**-0.91**	0.30	-3.01	.003
	[-1.52; -0.35]			
Group x Machiavellianism	**0.37**	0.18	2.04	.042
	[0.03; 0.75]			
Constant	**7.27**	0.48	15.00	.000
	[6.31; 8.21]			
Group	**-0.35**	0.16	-2.27	.023
	[-0.65; -0.06]			
Narcissism[a]	-0.20	0.37	-0.55	.585
	[-0.90; 0.58]			
Group x Narcissism	0.20	0.22	0.92	.360
	[-0.26; 0.62]			
Constant	**7.12**	0.48	14.78	.000
	[6.21; 8.06]			
Group	**-0.34**	0.15	-2.23	.026
	[-0.62; -0.04]			
Psychopathy[a]	-0.45	0.41	-1.09	.275
	[-1.27; 0.36]			
Group x Psychopathy	0.20	0.24	0.83	.408
	[-0.28; 0.68]			

Note. $N = 924$. HC3 = Heteroscedasticity-consistent covariance estimators. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Linear Model controlling for age, gender, and education. Total R^2 for Machiavellianism, narcissism, and psychopathy = .07. 95% BCa bootstrapping confidence intervals based on 2000 samples in square brackets. Significant results are printed in bold. [a] Mean centered variables.

To further examine the significant interaction effect of *group affiliation x Machiavellianism* on Mediterranean diet adherence, a simple slope analysis was conducted, which indicated a significant negative association between group affiliation and Mediterranean diet adherence at low ($\theta_{Group \rightarrow MEDAS}$|(Machiavellianism = -0.82) = -0.62, CI [-1.02; -0.22], t = -3.06, $p < .01$), and average ($\theta_{Group \rightarrow MEDAS}$|(Machiavellianism = -0.05) = -0.33, CI [-0.63; -0.04], t = -2.21, $p < .05$), but not at high manifestations of Machiavellianism ($\theta_{Group \rightarrow MEDAS}$|(Machiavellianism = 0.84) = -0.00, CI [-0.44; 0.44], t = -0.00, p = .999; see Figure 5). At the examined lower and average levels of Machiavellianism, Mediterranean diet adherence was

lower in individuals with affective disorders than in mentally healthy individuals. Graphically, higher Machiavellianism played a more pronounced role in Mediterranean diet non-adherence in mentally healthy individuals.

Figure 5. Visual representation of the moderation effect of group (individuals with affective disorders (AD) vs. healthy controls (HC)) on Mediterranean diet adherence by Machiavellianism.



Note. The moderator variable Machiavellianism was centered prior to moderation analysis. Results from probing the moderator at the 16th, 50th, and 84th percentile (black dots) revealed a significant positive association between group affiliation (HC vs. AD) and Mediterranean diet adherence at low ($\theta_{Group \rightarrow MEDAS}$|(Machiavellianism = -0.82) = -0.62, CI [-1.02; -0.22], t = -3.06, $p < .01$), and average ($\theta_{Group \rightarrow MEDAS}$|(Machiavellianism = -0.05) = -0.33, CI [-0.63; -0.04], t = -2.21, $p < .05$), but not at high manifestations of Machiavellianism ($\theta_{Group \rightarrow MEDAS}$|(Machiavellianism = 0.84) = -0.00, CI [-0.44; 0.44], t = -0.00, p = .999).

3.4.4. Participation in medical services, affective disorders and the Dark Triad traits

For the relationship between group affiliation and participation in medical services, no significant main effects or moderation effects of the Dark Triad traits were found, independently of age, gender, and education. This indicates that group affiliation was not associated with participation in medical services and that none of the Dark Triad traits had a moderating influence in this relationship (see Table 7).

Table 7. Linear model of the predictors of participation in medical services.

Effect	*B*	SE_B(HC3)	*t*	*p*
Constant	**22.97**	1.33	17.23	.000
	[20.37; 25.58]			
Group	0.29	0.44	0.66	.510
	[-0.56; 1.19]			
Machiavellianism[a]	-1.44	0.92	-1.57	.117
	[-3.61; 0.65]			
Group x Machiavellianism	0.67	0.53	1.25	.212
	[-0.54; 1.88]			
Constant	**23.54**	1.33	17.69	.000
	[20.96; 26.12]			
Group	0.38	0.45	0.84	.400
	[-0.48; 1.28]			
Narcissism[a]	-0.35	1.09	-0.32	.749
	[-2.58; 2.01]			
Group x Narcissism	0.81	0.63	1.28	.202
	[-0.56; 2.10]			
Constant	**22.98**	1.34	17.20	.000
	[20.37; 25.62]			
Group	0.31	0.45	0.70	.485
	[-0.57; 1.19]			
Psychopathy[a]	-0.74	1.17	-0.64	.523
	[-3.48; 2.22]			
Group x Psychopathy	0.19	0.67	0.29	.774
	[-1.41; 1.70]			

Note. $N = 924$. HC3 = Heteroscedasticity-consistent covariance estimators. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Linear Model controlling for age, gender, and education. Total R^2 for Machiavellianism, narcissism, and psychopathy = .07. 95% BCa bootstrapping confidence intervals based on 2000 samples in square brackets. Significant results are printed in bold. [a] Mean centered variables.

For the relationship between group affiliation and vaccination attitudes as part of participation in medical services, no significant main effect of group or moderation effects of the Dark Triad traits were found, independently of age, gender, and education. This indicates that group affiliation was not associated with vaccination attitudes and that none of the Dark Triad traits had a moderating influence. However, Machiavellianism and psychopathy explained significant unique negative variance in vaccination attitudes, revealing that these traits are related to more negative vaccination attitudes (see Table 8).

Table 8. Linear model of the predictors of vaccination attitudes.

Effect	*B*	SE_B(HC3)	*t*	*p*
Constant	**3.78**	0.25	15.39	.000
	[3.30; 4.23]			
Group	-0.05	0.08	-0.64	.525
	[-0.21; 0.11]			
Machiavellianism[a]	**-0.38**	0.16	-2.38	.017
	[-0.69; -0.08]			
Group x Machiavellianism	0.10	0.10	1.07	.282
	[-0.08; 0.29]			
Constant	**3.84**	0.25	15.47	.000
	[3.35; 4.29]			
Group	-0.11	0.08	-1.32	.187
	[-0.27; 0.05]			
Narcissism[a]	-0.13	0.20	-0.67	.501
	[-0.51; 0.25]			
Group x Narcissism	0.01	0.12	0.10	.919
	[-0.22; 0.25]			
Constant	**3.77**	0.25	15.36	.000
	[3.31; 4.22]			
Group	-0.05	0.08	-0.62	.536
	[-0.21; 0.11]			
Psychopathy[a]	**-0.49**	0.21	-2.35	.019
	[-0.91; -0.10]			
Group x Psychopathy	0.19	0.12	1.53	.127
	[-0.04; 0.43]			

Note. $N = 924$. HC3 = Heteroscedasticity-consistent covariance estimators. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Linear Model controlling for age, gender, and education. Total R^2: Machiavellianism = .08, narcissism = .06, psychopathy = .07. 95% BCa bootstrapping confidence intervals based on 2000 samples in square brackets. Significant results are printed in bold.
[a] Mean centered variables.

Regarding perceived medication sensitivity as part of participation in medical services, there was a significant positive main effect of group affiliation on perceived medication sensitivity, independently of age, gender, and education. This indicates that individuals with affective disorders were more likely to perceive their body as sensitive towards medications. No significant main or moderation effects of the Dark Triad traits were found, indicating that none of these traits had a unique or moderating influence in this relationship (see Table 9).

Table 9. Linear model of the predictors of perceived medication sensitivity.

Effect	*B*	SE_B(HC3)	*t*	*p*
Constant	**6.16**	1.21	5.11	.000
	[3.72; 8.45]			
Group	**2.56**	0.36	7.12	.000
	[1.86; 3.28]			
Machiavellianism[a]	1.02	0.67	1.54	.126
	[-0.25; 2.34]			
Group x Machiavellianism	-0.35	0.42	-0.84	.404
	[-1.17; 0.46]			
Constant	**6.15**	1.16	5.28	.000
	[3.85; 8.37]			
Group	**2.84**	0.36	8.00	.000
	[2.14; 3.57]			
Narcissism[a]	0.97	0.86	1.13	.261
	[-0.65; 2.60]			
Group x Narcissism	0.04	0.53	0.07	.941
	[-0.98; 1.09]			
Constant	**6.21**	1.20	5.18	.000
	[3.80; 8.51]			
Group	**2.50**	0.36	7.04	.000
	[1.84; 3.24]			
Psychopathy[a]	0.97	0.89	1.10	.273
	[-0.68; 2.67]			
Group x Psychopathy	-0.20	0.57	-0.36	.723
	[-1.30; 0.87]			

Note. $N = 924$. HC3 = Heteroscedasticity-consistent covariance estimators. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Linear Model controlling for age, gender, and education. Total R^2: Machiavellianism = .09, narcissism = .10, psychopathy = .09. 95% BCa bootstrapping confidence intervals based on 2000 samples in square brackets. Significant results are printed in bold.
[a] Mean centered variables.

3.4.5. Physical activity, affective disorders and the Dark Triad traits

For the relationship between group affiliation and physical activity, independently of age, gender, and education, there was a significant main effect of group affiliation on physical activity, indicating that individuals with affective disorders were less likely to be physically active. However, no significant main or moderation effects of the Dark Triad traits were found, thus reflecting that none of the Dark Triad traits significantly contribute to or moderate the relationship between group affiliation and physical activity (see Table 10).

Table 10. Linear model of the predictors of physical activity.

Effect	*B*	SE_B(HC3)	*t*	*p*
Constant	**12.37**	0.79	16.12	.000
	[10.78; 13.91]			
Group	**-2.11**	0.27	-8.11	.000
	[-2.65; -1.65]			
Machiavellianism[a]	0.56	0.64	-0.36	.722
	[-1.57; 1.11]			
Group x Machiavellianism	0.02	0.37	0.95	.340
	[-0.44; 1.11]			
Constant	**12.71**	0.79	16.12	.000
	[11.09; 14.22]			
Group	**-2.15**	0.27	-8.11	.000
	[-2.65; -1.64]			
Narcissism[a]	-0.23	0.65	-0.36	.722
	[-1.56; 1.11]			
Group x Narcissism	0.35	0.37	0.95	.340
	[-0.44; 1.11]			
Constant	**12.48**	0.79	15.85	.000
	[10.94; 14.03]			
Group	**-2.15**	0.26	-8.16	.000
	[-2.64; -1.64]			
Psychopathy[a]	0.26	0.69	0.37	.710
	[-1.13; 1.61]			
Group x Psychopathy	-0.32	0.40	-0.82	.414
	[-1.13; 0.43]			

Note. $N = 924$. HC3 = Heteroscedasticity-consistent covariance estimators. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Linear Model controlling for age, gender, and education. Total R^2: Machiavellianism = .17, narcissism = .16, psychopathy = .16. 95% BCa bootstrapping confidence intervals based on 2000 samples in square brackets. Significant results are printed in bold. [a] Mean centered variables.

3.4.6. Sleep quality, affective disorders and the Dark Triad traits

Due to a different sleep and mental health pattern in individuals with bipolar disorders within current manic episodes, these individuals were excluded from all further analyses (n = 888). Similar to the publication by Schönthaler *et al.* (2023a), the moderation analyses revealed a significant positive main effect of group affiliation, Machiavellianism, and psychopathy on sleep quality, regardless of age, gender, and education. This indicates that individuals with affective disorders and individuals exhibiting a greater level of Machiavellianism and psychopathy were more likely to report worse sleep quality. Moreover, there was a significant

negative moderating effect of Machiavellianism on the relationship between group affiliation and sleep quality, indicating that with increasing levels of Machiavellianism, the difference in sleep quality between individuals with affective disorders and mentally healthy individuals decreases. However, regarding narcissism and psychopathy, no significant interaction effect in this relationship was found (see Table 11 for detailed moderation statistics).

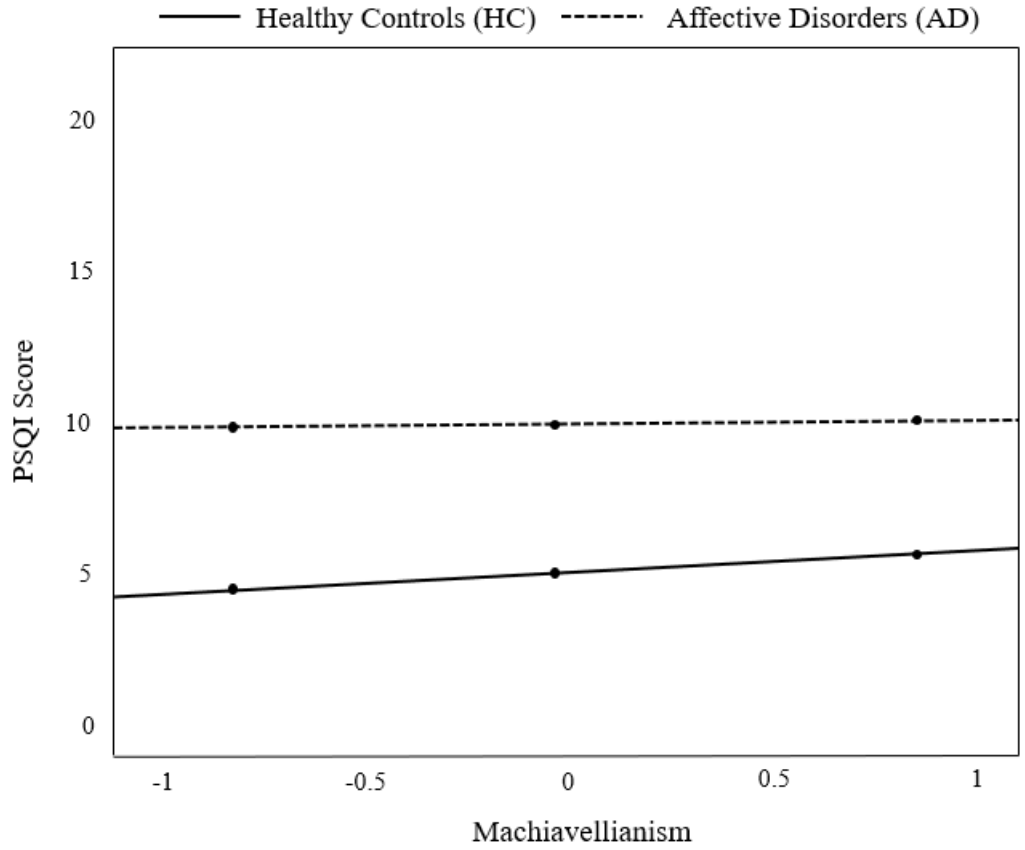
Table 11. Linear model of the predictors of sleep quality.

Effect	*B*	SE_B(HC3)	*t*	*p*
Constant	1.21	0.84	1.43	.153
	[-0.43; 2.89]			
Group	**4.92**	0.26	18.82	.000
	[4.42; 5.43]			
Machiavellianism[a]	**1.37**	0.44	3.11	.002
	[0.51; 2.27]			
Group x Machiavellianism	**-0.64**	0.30	-2.17	.030
	[-1.25; -0.05]			
Constant	1.00	0.84	1.20	.231
	[-0.66; 2.63]			
Group	**5.02**	0.26	19.05	.000
	[4.50; 5.54]			
Narcissism[a]	0.44	0.52	0.85	.397
	[-0.62; 1.46]			
Group x Narcissism	-0.17	0.36	-0.47	.641
	[-0.83; 0.57]			
Constant	1.35	0.83	1.64	.102
	[-0.39; 2.98]			
Group	**4.84**	0.26	18.60	.000
	[4.33; 5.35]			
Psychopathy[a]	**1.92**	0.59	3.27	.001
	[0.74; 3.06]			
Group x Psychopathy	-0.75	0.39	-1.93	.053
	[-1.51; 0.02]			

Note. $N = 888$. HC3 = Heteroscedasticity-consistent covariance estimators. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Linear Model controlling for age, gender, and education. Total R^2: Machiavellianism = 0.42, narcissism = .42, psychopathy = .43. 95% BCa bootstrapping confidence intervals based on 2000 samples in square brackets. Significant results are printed in bold. [a] Mean centered variables.

To examine the interaction effect of *group affiliation x Machiavellianism* on sleep quality, a simple slope analysis was conducted, indicating a negative association between group affiliation and PSQI score at low ($\theta_{Group \rightarrow PSQI}$|(Machiavellianism = -0.82) = 5.45, CI [4.73; 6.17], t = 14.83, p < .001), average ($\theta_{Group \rightarrow PSQI}$|(Machiavellianism = -0.04) = 4.95, CI [4.43; 5.46], t = 18.85, p < .015), and high manifestations of Machiavellianism ($\theta_{Group \rightarrow PSQI}$|(Machiavellianism = 0.85) = 4.38, CI [3.69; 5.07], t = 12.45, p < .001). Generally, sleep quality was worse in individuals with affective disorders, but Machiavellianism seemed to have a greater impact on the sleep quality of mentally healthy individuals (see Figure 6).

Figure 6. Visual representation of the moderation effect of group (individuals with affective disorders (AD) vs. healthy controls (HC)) on sleep quality by Machiavellianism.



Note. The moderator variable Machiavellianism was centered prior to moderation analysis. Results from probing the moderator at the 16th, 50th, and 84th percentile (black dots) revealed a significant negative association between group affiliation (HC vs. AD) and the Pittsburgh Sleep Quality Index (PSQI) at low ($\theta_{Group \rightarrow PSQI}$|(Machiavellianism = -0.82) = 5.45, CI [4.73; 6.17], t = 14.83, p < .001), average ($\theta_{Group \rightarrow PSQI}$|(Machiavellianism = -0.04) =4.95, CI [4.43; 5.46], t = 18.85, p < .015), and high manifestations of Machiavellianism ($\theta_{Group \rightarrow PSQI}$|(Machiavellianism = 0.85) = 4.38, CI [3.69; 5.07], t = 12.45, p < .001). Reproduced from Schönthaler *et al.* (2023a), with permission of publisher Frontiers in Psychology.

3.4.7. Depressive symptom severity, affective disorders and the Dark Triad traits

When investigating the relationship between depressive symptom severity, affective disorders and the Dark Triad traits, independently of age, gender, and education, significant positive main effects of group affiliation, Machiavellianism, and psychopathy were found. This indicates that individuals with affective disorders and individuals with higher manifestations of Machiavellianism and psychopathy reported greater depressive symptom severity. Moreover, there was a significant negative moderating effect of psychopathy on the relationship between group affiliation and depressive symptom severity. This demonstrates that with increasing levels of psychopathy, the difference in depressive symptom severity between individuals with affective disorders and mentally healthy individuals decreases. However, no significant moderation effects for Machiavellianism and narcissism were found (see Table 12 for detailed moderation statistics).

To further investigate the significant interaction effect of *group affiliation x psychopathy* on depressive symptom severity as measured by the PHQ, a simple slope analysis was conducted. This analysis indicated a significant negative association between group affiliation and the PHQ score at low ($\theta_{Group \rightarrow PHQ}$|(psychopathy = -0.62) = 10.96, CI [9.96; 11.96], $t = 21.53$, $p < .001$), average ($\theta_{Group \rightarrow PHQ}$|(psychopathy = -0.17) = 10.45, CI [9.70; 11.20], $t = 27.30$, $p < .001$), and high manifestations of psychopathy ($\theta_{Group \rightarrow PHQ}$|(psychopathy = 0.60) = 9.56, CI [8.50; 10.61], $t = 17.80$, $p < .001$).

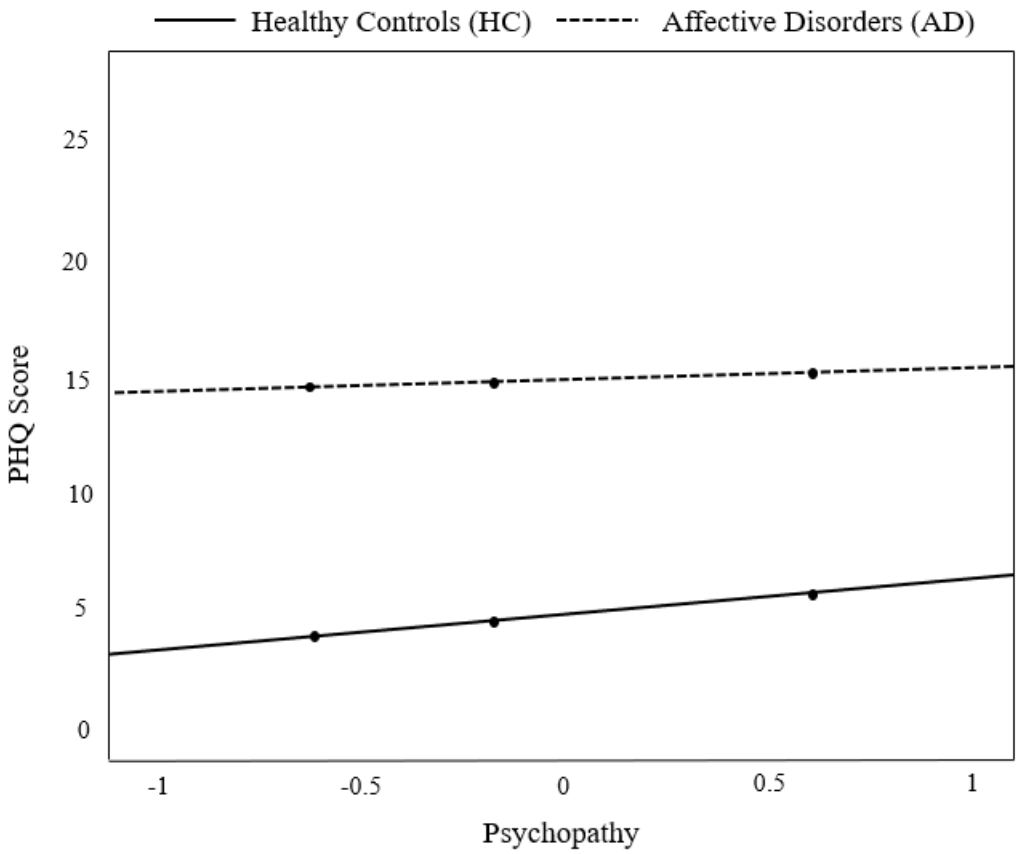
Table 12. Linear model of the predictors of depressive symptom severity.

Effect	*B*	SE_B(HC3)	*t*	*p*
Constant	-1.11	1.20	-0.93	.355
	[-3.42; 1.18]			
Group	**10.26**	0.37	27.81	.000
	[9.56; 10.96]			
Machiavellianism[a]	**1.69**	0.66	2.56	.011
	[0.40; 3.05]			
Group x Machiavellianism	-0.51	0.44	-1.15	.250
	[-1.45; 0.35]			
Constant	-1.68	1.19	-1.41	.160
	[-3.94; 0.69]			
Group	**10.37**	0.38	27.63	.000
	[9.65; 11.08]			
Narcissism[a]	0.29	0.80	0.36	.719
	[-1.27; 1.82]			
Group x Narcissism	-0.33	0.55	0.60	.549
	[-1.44; 0.76]			
Constant	-1.12	1.20	-0.93	.353
	[-3.45; 1.23]			
Group	**10.25**	0.38	27.32	.000
	[9.50; 10.96]			
Psychopathy[a]	**2.68**	0.93	2.89	.004
	[0.89; 4.51]			
Group x Psychopathy	**-1.15**	0.60	-1.93	.054
	[-2.33; -0.06]			

Note. N = 888. HC3 = Heteroscedasticity-consistent covariance estimators. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Linear Model controlling for age, gender, and education. Total R^2 for Machiavellianism, narcissism, and psychopathy = .54. 95% BCa bootstrapping confidence intervals based on 2000 samples in square brackets. Significant results are printed in bold. [a] Mean centered variables.

At the examined levels of psychopathy, depressive symptom severity was worse in individuals with affective disorders than in mentally healthy individuals. Nevertheless, psychopathy seemed to have a more negative impact on the depressive symptom severity of mentally healthy individuals (see Figure 7).

Figure 7. Visual representation of the moderation effect of group (individuals with affective disorders (AD) vs. healthy controls (HC)) on depressive symptom severity by psychopathy.



Note. The moderator variable psychopathy was centered prior to moderation analysis. Results from probing the moderator at the 16th, 50th, and 84th percentile (black dots) revealed a significant negative association between group affiliation (HC vs. AD) and the Patient Health Questionnaire (PHQ) as indicator of depressive symptom severity at low ($\theta_{Group \rightarrow PHQ}$|(psychopathy = -0.62) = 10.96, CI [9.96; 11.96], t = 21.53, p < .001), average ($\theta_{Group \rightarrow PHQ}$|(psychopathy = -0.17) = 10.45, CI [9.70; 11.20], t = 27.30, p < .001), and high manifestations of psychopathy ($\theta_{Group \rightarrow PHQ}$|(psychopathy = 0.60) = 9.56, CI [8.50; 10.61], t = 17.80, p < .001).

4. Discussion

This study sought to investigate the relationship between affective disorders (versus mentally healthy individuals) and health behaviours (substance use, diet, Mediterranean diet adherence, participation in medical services, vaccination attitudes, perceived sensitivity to medicines, physical activity, sleep quality). Specifically, it was investigated whether the relationships between affective disorders (versus mentally healthy individuals) and health behaviours, as well as depressive symptom severity, are moderated by the individual manifestation of the Dark Triad traits Machiavellianism, narcissism, and psychopathy (Paulhus and Williams, 2002).

It was found that substance use was more prevalent among mentally healthy individuals, as well as those with lower Machiavellianism and psychopathy manifestations. Machiavellianism moderated the relationship between group affiliation and substance use, with higher Machiavellianism being associated with greater substance use in individuals with affective disorders and lower substance use in mentally healthy individuals. Regarding dietary behaviour, there were neither any significant associations with group affiliation, nor any moderating effects of the Dark Triad traits. For Mediterranean diet adherence, however, it was found that individuals with affective disorders and individuals with greater Machiavellianism were less likely to adhere to Mediterranean diet recommendations. Moreover, Machiavellianism moderated this relationship, with higher Machiavellianism being associated with lower adherence to the Mediterranean diet, especially among mentally healthy individuals. Regarding participation in medical services and physical activity, there were neither any significant associations with group affiliation, nor any moderating effects of the Dark Triad traits. However, Machiavellianism and psychopathy were associated with more negative attitudes towards vaccinations, independently of group affiliation, and having an affective disorder was associated with greater subjective sensitivity towards medication. Regarding sleep quality, positive associations between sleep quality and the presence of an affective disorder, and/or higher levels of Machiavellianism and psychopathy were found. Machiavellianism moderated the relationship between group affiliation and sleep quality, with higher Machiavellianism deteriorating sleep quality in both groups, but even more so in mentally healthy individuals. Finally, depressive symptom severity was associated with affective disorders, as well as higher Machiavellianism and psychopathy scores, respectively. Psychopathy moderated the association between group affiliation and depressive symptom severity, with greater psychopathy levels having a more negative impact on depressive symptom severity in both groups, but even more so among mentally healthy individuals. These findings elucidate the complex associations between affective disorders, health behaviours, and

the Dark Triad personality traits. All hypotheses will be further discussed in the following paragraphs.

4.1. Associations between health behaviours, affective disorders, and the Dark Triad traits

The hypothesis of individuals with affective disorders showing less protective health behaviours compared to mentally healthy individuals and our hypothesis that this relationship is negatively moderated by the individual manifestations of the Dark Triad traits could not be calculated within the current analyses. Since the structural equation model required to confirm the hypothesis showed an inadequate model fit, no interpretations regarding these hypotheses can be made.

4.1.1. Substance use, affective disorders and the Dark Triad traits

Contrary to the previously established expectation that individuals with affective disorders show more substance use compared to mentally healthy individuals, the results of the current study point towards an inverse relationship. In other words, individuals with affective disorders showed less substance use than mentally healthy individuals. This is not in line with existing literature, which clearly shows a higher use of substances among individuals with affective disorders, since substances are oftentimes used as a strategy to cope with the illness symptoms or distress (Healey *et al.*, 2009; Heffner *et al.*, 2011; Moon *et al.*, 2014). However, the scale used to measure substance use in the study mostly encompassed items targeting alcohol use. Although alcohol intake is reported to be more prevalent among individuals with mental disorders in general (e.g., Jané-Llopis and Matytsina, 2006; Mangerud *et al.*, 2014), it is also oftentimes not compatible with psychiatric medication and might result in uncomfortable interaction effects (Moore, Whiteman and Ward, 2007). Possibly, the physician's recommendation not to consume alcohol during the intake of psychopharmacological medication is the reason for a lower substance use prevalence among individuals with affective disorders in the current study, who almost all were undergoing psychiatric treatment at that time. Regarding the Dark Triad traits, Machiavellianism and psychopathy were positively associated with substance use, which corroborates existing literature (Brajković, Jelinčić and Kopilaš, 2022; Gardiner and Lawson, 2023; Malesza and Kaczmarek, 2021). By nature, these traits circumcise risk-taking behaviour, impulsiveness, and disregard of long-term consequences, although individuals high in Machiavellianism tend to be more cautious and deliberate than individuals high in psychopathy. Nevertheless, these behavioural characteristics could lead to the increased substance use observed in the current study (Malesza and

Kaczmarek, 2021). Interestingly, narcissism did not show any association with substance use whatsoever. This is not in line with existing results, which points towards lower or higher substance use in individuals with higher narcissism manifestations (Hill, 2016; Malesza and Kaczmarek, 2021; Stenason and Vernon, 2016). However, it is argued that substance use is more likely associated with "vulnerable" narcissism (e.g., Priyadhersini, Kotian and Sambasivan, 2022), which is a subtype of narcissism encompassing defensive grandiosity that obscures negative affect, feelings of inadequacy, and subjective incompetence (Miller *et al.*, 2011). This might be the reason for the non-existing association between narcissism, affective disorders, and substance use, as the current study did not explicitly measure vulnerable narcissism.

Further, it was expected that the association between group affiliation and substance use is positively moderated by each of the Dark Triad traits, i.e., that this relationship is more pronounced for individuals with higher scores in the Dark Triad traits. It was found that Machiavellianism, but not the other traits moderated said relationship, with higher Machiavellianism being associated with greater substance use in individuals with affective disorders and lower substance use in mentally healthy individuals. This poses an interesting finding, since Machiavellianism seems to have a different impact on substance use, depending on the existence of an affective disorder. Hence, Machiavellianism represents a modifiable factor in the relationship between affective disorders and substance use, which implies that targeting Machiavellianism in clinical therapies could reduce substance use and thus ameliorate physical health.

4.1.2. Diet, affective disorders and the Dark Triad traits

Contrary to the expectation of individuals with affective disorders reporting worse diet habits than mentally healthy individuals, the results of the current study indicated no association between the presence of an affective disorder and dietary behaviour. This finding is not supported by the majority of recent research, which reflects deteriorated diet habits in individuals with affective disorders (Khalid, Williams and Reynolds, 2016; Lopresti, Hood and Drummond, 2013). This is partly reattracted to the symptomatology (e.g., increased or decreased appetite, emotional dysregulation; Chao, Wadden and Berkowitz, 2019; Martin *et al.*, 2016), but also to psychopharmacological medication, which may lead to food cravings (Platzer *et al.*, 2020). However, other studies found differences in diet habits and diet quality between individuals with depression and mentally healthy individuals, if subtypes of depression, but not depression as one entity was considered. Specifically, individuals with melancholic depression were found to report different diet patterns and quality than individuals with atypical depression

(Lasserre *et al.*, 2021; Rahe *et al.*, 2015; Rahe and Berger, 2016). These findings might serve as an explanation for the results of the current study, since the subtypes of affective disorders were not differentiated in the analyses. However, when considering a subtype of diet (i.e., the Mediterranean diet), an association between the presence of an affective disorder and lower adherence to a Mediterranean diet style was found. This finding is in line with current literature, which repeatedly points out the lower adherence to this diet type among individuals with affective disorders (García-Toro *et al.*, 2016; Łojko, Stelmach-Mardas and Suwalska, 2019), although it has proven to be an effective possibility in the amelioration of depressive symptoms (Psaltopoulou *et al.*, 2013; Quirk *et al.*, 2013). When considering the Dark Triad traits in relation to diet and Mediterranean diet adherence, only Machiavellianism was associated with lower Mediterranean diet adherence, which is in line with other studies investigating the effects of the Dark Triad traits on different diet styles (e.g., Mertens *et al.*, 2021).

Moreover, it was expected that the association between group affiliation and diet (including Mediterranean diet adherence) is negatively moderated by each of the Dark Triad traits, i.e., that dietary behaviour is worse in individuals with affective disorders and higher scores in the Dark Triad traits. Except for Machiavellianism, hypotheses regarding the moderating effects of the other two traits could not be supported with the study results due to non-significant moderation effects. In particular, Machiavellianism was shown to moderate the relationship between group affiliation and Mediterranean diet adherence, with higher Machiavellianism being associated with lower adherence to the Mediterranean diet in both groups, but especially among mentally healthy individuals. This finding is in line with previous studies, which reported a higher intake of red meat among individuals with higher Machiavellianism scores. Specifically, this association was explained by the Machiavellian belief of human's supremacy, negative attitudes, and cruelty towards animals, which might lead to more meat consumption (Mertens *et al.*, 2020; Palnau, Ziegler and Lämmle, 2022; Sariyska *et al.*, 2019).

4.1.3. Participation in medical services, affective disorders and the Dark Triad traits

Regarding the previously established assumption that individuals with affective disorders participate less in medical services (including vaccination behaviour and perceived sensitivity to medicines) compared to mentally healthy individuals, different associations were found in the study results. Specifically, there was neither an effect of group affiliation nor the Dark Triad traits on general participation in medical services. Previous findings show that the presence of an affective disorder is related to either a higher or lower use of medical services

(Björk Brämberg *et al.*, 2018; Corrigan, Druss and Perlick, 2014; Ludman *et al.*, 2010; Rowan *et al.*, 2002). However, it was also found that affective disorders are associated with greater use of acute medical services than routine procedures (Masters *et al.*, 2020; Peytremann-Bridevaux, Voellinger and Santos-Eggimann, 2008). Possibly, differentiating between both acute and routine settings, and analyzing additional factors (e.g., symptom severity, somatic comorbidities) could lead to different results. Concerning vaccination attitudes, no association between group affiliation and vaccination attitudes was observed. This finding is not in line with current literature, which reports that individuals with affective disorders tend to show a more negative attitude towards vaccinations (e.g., Pan *et al.*, 2022). However, other studies showed that the willingness to get vaccinated is equal in individuals with affective disorders and mentally healthy individuals, although those with an affective disorder seem to worry more about the vaccination side effects (Fellendorf *et al.*, 2022; Peritogiannis *et al.*, 2023; Ren et al., 2021). Moreover, both Machiavellianism and psychopathy were found to elicit more negative attitudes towards vaccinations, which corroborates previous study results reflecting the negative influence of these traits on vaccination attitudes in the COVID-19 pandemic. The associations between Machiavellianism, psychopathy, and negative vaccination attitudes were explained by the resistance to adhere to common health regulations, greater risk-assertive behaviour, conspiracy beliefs, and mistrust of authorities (Giancola, Palmiero and D'Amico, 2023; Konc, Petrović and Dinić, 2022; Ngo, Petrides and Vernon, 2023). Finally, it was shown that the presence of an affective disorder was associated with greater perceived medication sensitivity. This is in line with current literature and could be due to the fact that individuals with affective disorders tend to have a higher medication intake with frequent side effects than mentally healthy individuals, thus possibly perceiving themselves as more sensitive towards medication (Horne *et al.*, 2013). However, none of the Dark Triad traits was associated with perceived medication sensitivity.

Further, it was expected that the relationship between group affiliation and participation in medical service (including vaccination attitudes and perceived sensitivity to medicines) is negatively moderated by each of the Dark Triad traits, i.e., participation in medical service is lower in individuals with affective disorders and higher scores in the Dark Triad traits. However, no such associations were observed, indicating that the interaction between affective disorders and Dark Triad traits does not influence the use of medical services. Other aspects than personality traits seem to have a more profound effect on the participation in medical services among individuals with affective disorders and mentally healthy individuals (e.g., demographic variables, information seeking, symptom severity; Faasse *et al.*, 2015).

4.1.4. Physical activity, affective disorders and the Dark Triad traits

The previously established expectation that individuals with affective disorders show less physical activity compared to mentally healthy individuals could be confirmed by the study results. This is consistent with previous research, which showed an association between physical inactivity and the presence of an affective disorder (Kivelä and Pahkala, 1991; Vancampfort *et al.*, 2017). However, physical activity was found to be a good non-pharmacological option to treat depressive symptoms on multiple pathways. For instance, it increases hippocampal brain-derived neurotrophic factor (BDNF) levels and stimulates hippocampal neurogenesis, as well as synaptic plasticity, thus eliciting similar effects as anti-depressant medication (Lopresti, Hood and Drummond, 2013; Melo *et al.*, 2016). It is also associated with better cardiorespiratory and metabolic health, thus reducing the likelihood of somatic comorbidities (Kerling *et al.*, 2015; Stubbs *et al.*, 2016). Hence, it is of utmost importance to encourage physical activity interventions in the treatment of affective disorders. Regarding the Dark Triad traits, no significant effect of the traits on physical activity were found. This is not in line with previous literature, which showed a negative association between Machiavellianism, psychopathy, and physical activity (e.g., Dębska *et al.*, 2021; Malesza and Kaczmarek, 2021). Moreover, narcissism was oftentimes positively associated with exercising, due to the narcissistic need to present a successful image and an attractive physical appearance to the social context (Hill, 2016; Malesza and Kaczmarek, 2021). However, other studies found that the Dark Triad traits are associated with mental toughness (Sabouri, Gerber, Bahmani, *et al.*, 2016), which was also reported to fully mediate the relationship between the Dark Triad traits and physical activity (Vaughan *et al.*, 2018). The lacking investigation of mental toughness could be a possible reason for the null finding regarding the Dark Triad traits and physical activity in the current study.

Further, it was expected that the relationship between group affiliation and physical activity is negatively moderated by each of the Dark Triad traits, i.e., physical activity is lower in individuals with affective disorders and higher scores in the Dark Triad traits. Notably, no such moderation effects were found, indicating that other aspects than the Dark Triad traits seem to have a deteriorating impact on the association between affective disorders and physical activity.

4.1.5. Sleep quality, affective disorders and the Dark Triad traits

The previously stated hypothesis that individuals with affective disorders show poorer sleep quality compared to mentally healthy individuals was corroborated by the study results. This finding is in line with previous literature, which demonstrated that up to 90% of the individuals with affective disorders report sleep disturbances (Lopresti, Hood and Drummond, 2013). Moreover, insomnia remains one of the most common prodromal characteristics of depressive and manic episodes (Sierra *et al.*, 2007; Skjelstad, Malt and Holte, 2010), and persistent insomnia is also associated with an increased risk of a depressive episode relapse (Taylor *et al.*, 2005). This strong association has been reattracted to several biological aspects such as the increase of inflammatory molecules (such as IL-1, IL-6, and TNF-α), neurotransmitter imbalances, or oxidative distress (Lopresti, Hood and Drummond, 2013; Morris *et al.*, 2018). Independently of group affiliation, a deteriorating effect of both Machiavellianism and psychopathy on sleep quality was found. This finding is in line with previous literature, which indicates the negative effect of these so-called "Malicious Two" traits on insomnia symptoms (Akram *et al.*, 2018; Yang *et al.*, 2019), sleep disturbances (Sabouri, Gerber, Lemola, *et al.*, 2016), sleep and wake-up time instability (Rahafar, Kalbacher and Randler, 2022), and chronotypes (Costa Porfírio and Corrêa Varella, 2022; Jonason, Jones and Lyons, 2013). Deteriorated sleep amongst those high in Machiavellianism and psychopathy may be a result of insufficient emotion regulation, resulting in negatively toned cognitive activity (e.g., rumination), which, in turn, affects sleep quality (Akram *et al.*, 2018; Sabouri, Gerber, Lemola, *et al.*, 2016). Further, Machiavellianism and psychopathy were previously connected to cortisol levels (Dane, Jonason and McCaffrey, 2018), and psychopathy was associated with altered cortisol awakening responses (Atkinson, Thomas and Fernandez-Enright, 2015; Johnson *et al.*, 2014), which could also impact sleep quality and suggests an underlying biological pathway. For narcissism, however, no such association with sleep quality was found. This result is reflected by previous findings, which reported no association between narcissism and sleep-wake habits (Rahafar, Kalbacher and Randler, 2022), chronotype (Jonason, Jones and Lyons, 2013), sleep disturbances (Sabouri, Gerber, Lemola, *et al.*, 2016), and insomnia (Akram *et al.*, 2018; Yang *et al.*, 2019). A possible explanation for this inexistent association is the lesser extent of negatively affected cognitive-emotional processes due to more subjective grandiosity in individuals high in narcissism (Yang *et al.*, 2019).

Moreover, it was assumed that the relationship between group affiliation and sleep quality is negatively moderated by each of the Dark Triad traits, i.e., sleep quality is worse in individuals with affective disorders and higher scores in the Dark Triad traits. Only

Machiavellianism, but not the other two traits was found to have a moderating influence in this relationship, although strong, yet non-significant tendencies were found for psychopathy. This finding reflects the abovementioned negatively affected cognitive-emotional processes, which significantly deteriorate sleep quality, and are more present in individuals high in Machiavellianism and psychopathy (Sabouri, Gerber, Bahmani, *et al.*, 2016; Yang *et al.*, 2019), as well as individuals with affective disorders (e.g., Cooney *et al.*, 2010; Kovács et al., 2020; Silveira and Kauer-Sant'Anna, 2015). However, the study results indicated that at higher levels of sleep quality deterioration, the negative impact of Machiavellianism is more pronounced in mentally healthy individuals. Possibly, there are other variables exerting a stronger influence on the sleep quality of individuals with affective disorders than Machiavellianism, but do not affect mentally healthy individuals (e.g., illness-related variables; Becker Cretu *et al.*, 2016; Gruber *et al.*, 2011).

4.1.6. Depressive symptom severity, affective disorders and the Dark Triad traits

The expectation that individuals with affective disorders report a greater severity of depressive symptoms compared to mentally healthy individuals was supported by the study results. Moreover, Machiavellianism and psychopathy were associated with greater depressive symptom severity. This finding is in line with previous study results, which demonstrate that these traits are related to higher depression scores. For instance, Machiavellianism was found to be associated with depression due to low levels of empathy, high levels of alexithymia, anhedonia, anxiety, and social maladjustments (Al Aïn *et al.*, 2013; Bianchi and Mirkovic, 2020; Kowalski, Vernon and Schermer, 2021). Moreover, it was reported that Machiavellianism is related to depression via maladaptive coping strategies such as expressive suppression, which refers to the inhibition of emotional expression to control emotional responses (Mojsa-Kaja *et al.*, 2021; Shen, 2022). When specifying the associations with depression, Machiavellianism seems to be mostly related to the interpersonal domains of depression (e.g., limited social relationships). The Machiavellian manipulation, deception, and exploitation of others may result in losing social relationships and social reputation, thus possibly eliciting depressive symptoms (Shih *et al.*, 2019).

Relatedly, the study results corroborate previous research, which found positive associations between psychopathy and affective disorders (e.g., Bonfá-Araujo *et al.*, 2021; Gómez-Leal *et al.*, 2019). This finding was explained by difficulties in emotion regulation and negative coping strategies (Birkás, Gács and Csathó, 2016; Shen, 2022; Stinson, Becker and Tromp, 2005; Yang *et al.*, 2022). This is in line with other studies (e.g., Shih *et al.*, 2019; Walker

et al., 2022), which found that psychopathy was mostly associated with the cognitive domain of depression (i.e., cognitive performance, emotion processing, social cognition; Baune and Air, 2016). In particular, individuals high in psychopathy were reported to show less cognitive reappraisal (i.e., re-interpreting the situation and changing its emotional impact), but more expressive suppression (i.e., suppressing or hiding the expression of one's emotions), both of which are also common cognitive strategies in affective disorders (Dryman and Heimberg, 2018; Judah *et al.*, 2022; Wolkenstein et al., 2014). This finding indicates that individuals high in psychopathy do not show less emotions, because they have an emotional deficiency (e.g., Herpertz and Sass, 2000), but rather because they inhibit their intense emotions (Walker *et al.*, 2022), which might lead to depressive symptoms (Flynn, Hollenstein and Mackey, 2010). However, other studies found that certain facets of psychopathy might serve as a protective factor in the development of depressive symptoms. For instance, it was found that the sub-facets "stress immunity" (i.e., the lack of emotional reactions toward possibly fear-inducing situations) and "social potency" (i.e., superficial charm and striving for interpersonal dominance; Tonnaer *et al.*, 2013) reduce the severity of psychiatric and stress-related symptoms (Dalkner *et al.*, 2018), and that these sub-facets had a positive effect in the relationship between cognitive and emotional aspects of depression (Schönthaler *et al.*, 2023b). Thus, the psychopathic abilities to perceive less stress and be socially bold seems to have an ameliorating impact on depressive symptoms, while the lack of adaptive coping strategies and cognitive difficulties seem to be negatively associated with depressive symptoms. Hence, differing between the sub-facets of psychopathy is important within this context.

Narcissism, on the other hand, was not associated with depressive symptom severity in the current study. Previous research found either positive effects (e.g., Papageorgiou *et al.*, 2019; Papageorgiou, Denovan and Dagnall, 2019) or negative effects of narcissism on depressive symptoms (e.g., Brailovskaia *et al.*, 2021; Dawood *et al.*, 2017). It has been suggested that the relationship between narcissism and depression is multifaceted, depending on perceived social support, life satisfaction, and the predominant sub-facet of narcissism (Fang, Niu and Dong, 2021; Papageorgiou, Denovan and Dagnall, 2019). For instance, grandiose narcissism, which reflects the narcissistic sub-features subjective superiority, aggression, and dominance, was often associated with less depressive symptoms. This association was attributed to greater mental toughness and high self-esteem (Denovan *et al.*, 2021; Sedikides *et al.*, 2004), reduced stress perception (Papageorgiou *et al.*, 2019), lower affective reactivity to negative interpersonal events (Zuckerman and O'Loughlin, 2009), beneficial coping strategies (Birkás, Gács and Csathó, 2016; Ng, Cheung and Tam, 2014), and

more social support (Brailovskaia, Bierhoff and Margraf, 2019) in individuals high in this narcissistic sub-facet. However, it was also found that grandiose narcissism is connected to greater depressive symptoms due to a higher need of external validation, which can oftentimes not be fulfilled by others and results in subjective disappointment and negative affect. Vulnerable narcissism, on the other hand, was mostly associated with depressive symptoms due to higher self-criticism (Kealy, Tsai and Ogrodniczuk, 2012), co-occurring dysfunctional perfectionism (Marčinko *et al.*, 2014), negative self-regard (Pedone *et al.*, 2023), as well as more pronounced feelings of guilt and shame (Anastasopoulos, 2007; Casale, 2022). However, the current study did not differentiate between different narcissism sub-facets, thus possibly leading to no significant results.

Further, the previously stated assumption that the relationship between group affiliation and depressive symptom severity is positively moderated by each of the Dark Triad traits was only partly supported by the study results. Psychopathy, but not the other two traits, had a deteriorating moderating effect in the relationship between group affiliation and depressive symptom severity. This effect was existent in both groups, but even more pronounced among mentally healthy individuals, indicating that psychopathy might serve as a predictor of depressive symptomatology in mentally healthy individuals. In general, the result is in line with the abovementioned findings of deteriorated emotional and cognitive coping strategies, which are present in both affective disorders and psychopathy. Notably, there are common neurobiological aspects of both depressive symptoms and psychopathy, which might explain the deteriorating effect of this trait on the severity of symptoms. For instance, both affective disorders and psychopathy were associated with alterations in neurotransmitter homeostasis of dopamine and serotonin (Gulsun *et al.*, 2016; Miklowitz and Johnson, 2006; Wu and Barnes, 2013), dysbalanced endocrine responses in cortisol (Cima, Smeets and Jelicic, 2008; Glenn and Raine, 2008; Maripuu *et al.*, 2014), and altered autonomic responses (Hansen *et al.*, 2007; Lenger *et al.*, 2022; Segarra *et al.*, 2022; Thompson, Ramos and Willett, 2014). Moreover, there seem to be common structural and functional brain abnormalities in affective disorders and psychopathy, such as reduced volume and altered activity of the amygdala, and reduced grey matter volumes in the frontal and temporal areas (de Oliveira-Souza *et al.*, 2008; Dickstein *et al.*, 2005; Drevets, Price and Furey, 2008; Koenigs *et al.*, 2011; Yang *et al.*, 2005; Yang and Raine, 2009). Altered function within and between these structures may induce disturbances in emotional and cognitive aspects (Banks *et al.*, 2007; Berboth and Morawetz, 2021; Buhle *et al.*, 2014; Goldin *et al.*, 2008; Silvers *et al.*, 2017). This reinforces the hypothesis of common emotion-cognition regulation processes in affective disorders and psychopathy, which might

represent the underlying mechanisms of the negative relationship between psychopathy and depressive symptom severity. Nevertheless, psychopathy was observed to have a more negative effect on depressive symptom severity in mentally healthy individuals. Therefore, future studies should differentiate between the various facets of psychopathy to gain full understanding of which aspects of psychopathy are related to depressive symptom severity in both individuals with affective disorders and mentally healthy individuals. The individual manifestation of psychopathy could serve the early detection and prevention of depressive symptoms in mentally healthy individuals, which could otherwise possibly result in clinical disorders.

4.2. Limitations and prospects

The study findings should be interpreted with the following limitations in mind. First, the interpretation of the findings is restricted to the specific questionnaires applied. Although questionnaires like the SD3 and PHQ-9 are employed as standard measures of the examined constructs, using other measures may lead to different outcomes. Secondly, future studies should employ tests, which differ accordingly between the sub-facets of each personality trait, to gain more precise information on how the Dark Triad traits relate to affective disorders and health behaviours (e.g., the Mach IV/Mach V (Christie and Geis, 1970); the Narcissistic Personality Inventory (NPI; Raskin and Hall, 1979), and the Levenson Self-Report Psychopathy Scale (LSRP; Levenson, Kiehl and Fitzpatrick, 1995)). It would be of further interest to additionally include measures of vulnerable narcissism (e.g., the Hypersensitive Narcissism Scale; HSNS; Hendin and Cheek, 1997), since this specific trait was found to be associated with affective disorders. Third, the current study collected data in German-speaking countries. However, it was reported that self-rated health behaviours show large cross-country variations, with Germans tending to underrate their health status (Jürges, 2007). Future studies should thus conduct cross-cultural examinations of the study constructs.

Another shortcoming of the current study is the exclusive examination of personality variables, health behaviours, depressive symptom severity, and demographic variables. Including other possibly related constructs could elucidate the multifaceted relations between affective disorders, the Dark Triad traits, and health behaviours. For instance, it was previously shown that mental toughness is a mediating factor in the relationship between narcissism and physical activity (Vaughan *et al.*, 2018). Future studies should take other variables into account, to shed more light on the underlying mechanisms.

Further, a major caveat of the study is the use of self-report questionnaires to measure the constructs of interest. While this method has been proven as a valid technique, it includes

potential sources of biases (e.g., social desirability response styles; Tempelaar, Rienties and Nguyen, 2020). Future studies should thus include additional objective measurements such as fitness trackers or smartwatches (to reflect physical activity; Henriksen *et al.*, 2022). Relatedly, depression symptom severity could be additionally measured with objective psychiatric ratings (e.g., the Hamilton Depression Scale; HAM-D; Hamilton, 1960).

Finally, data were collected within an online survey. On the one hand, this setting comes with a greater risk of uncontrollable variables during data collection (e.g., different contextual aspects) and might only be accessible for a certain population group (e.g., those with internet connection). On the other hand, data are able to be collected within a larger and geographically distributed population range, thus possibly eliciting more generalizability of the results. It may hence be worthwhile to replicate the findings in offline samples.

4.3. Implications

In spite of the limitations mentioned above, the current study contributes substantially to a better understanding of the associations between affective disorders, the Dark Triad traits, and health behaviours. The results add to the biopsychosocial examination of affective disorders by investigating health-deteriorating personality traits like the Dark Triad traits. Understanding the differences between these traits in the relationship between affective disorders and health behaviours could help to identify modifiable aspects within this complex association. This, in turn, facilitates the design of interventions targeting personality traits. By designing and implementing interventions, advances in the improvement of health behaviours could be elicited, which would lead to better somatic health, higher life expectancy, and more mental stability among individuals with affective disorders and mentally healthy individuals. Moreover, integrating personality traits in the treatment of affective disorders could help to individualize treatment schedules, hence improving treatment adherence and overall outcome (Bucher, Suzuki and Samuel, 2019; Mertens *et al.*, 2022). For instance, Machiavellianism was shown to have deteriorating effects on several health behaviours in both mentally healthy individuals and individuals with affective disorders. Screening for Machiavellianism in routine procedures could help to integrate the individual manifestation of this trait in psychoeducative and psychotherapeutic interventions, in order to reduce harmful health behaviours. For instance, psychotherapeutic group therapies for individuals higher in Machiavellianism and psychopathy could be created, targeting the importance of health behaviours. Common problems in psychotherapy with individuals high in Machiavellianism encompass the employment of manipulation tactics and thus difficulties in building a stable therapeutic relationship (Mandal

and Horak, 2016). Cognitive-behavioural psychotherapy, role-taking training, emotion regulation training, and problem-solving skills may be possible interventions to ameliorate Machiavellianism and thus its influence on health behavioural characteristics (Loftus and Glenwick, 2001).

4.4. Conclusion

The current study sheds light onto the complex relationships between affective disorders, the Dark Triad traits, health behaviours, and depressive symptom severity. The findings reveal different patterns of relationships between each of the Dark Triad traits with health behaviours and mental health status. For instance, Machiavellianism was associated with less substance use, lower Mediterranean diet adherence, more negative vaccination attitudes, poorer sleep quality, and higher depressive symptom severity. Further, it moderated the relationship between group affiliation and substance use, Mediterranean diet adherence, and sleep quality. Psychopathy, on the other hand, was related to less substance use, negative vaccination attitudes, worse sleep quality, and greater depressive symptom severity. Moreover, it moderated the relationship between group affiliation and depressive symptom severity. Narcissism was not related to any health behaviours or depressive symptom severity. These results reflect that Machiavellianism and psychopathy can be reattracted to a common construct (the "dark dyad"; Egan, Chan and Shorter, 2014; Shih *et al.*, 2019), which has a negative impact on both health behaviours and mental health state. Thus, these traits could serve as a prognostic marker in the development of somatic and mental health deteriorations.

The study findings provide novel insight into the relationship between affective disorders and health behaviours, depending on personality traits. Thus, they offer important practical implications for the prevention of somatic diseases through modifiable determinants of health behaviours and strengthen existing theoretical implications (e.g., the Health Belief Model; Becker, 1974). Moreover, the study results promote the integration of personality traits into the clinical context, thus contributing to translational biopsychosocial research. In the future, findings on personality traits within the psychiatric context should be used for creating specific interventions, to enhance individual well-being in an effective and sustainable fashion.

5. References

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6. Appendix

6.1. Appendix A: Tables

Table A1. Descriptive properties and normal distribution values of the psychometric questionnaires.

Variable	*M*	*SD*	Skew	Kurtosis
Health Behaviour Inventory				
Substance use	36.89	6.09	-0.54	-0.46
Diet	39.74	7.56	-0.17	-0.06
Participation in medical services	25.20	6.09	-0.09	-0.04
Physical Activity	11.10	3.78	-0.01	-0.72
Mediterranean Diet Score	6.61	2.08	-0.09	-0.36
Pittsburgh Sleep Quality Index	7.74	4.56	0.71	-0.46
Perceived Sensitivity to Medicines Scale	9.50	5.09	1.23	0.81
Vaccination Attitude Examination Scale	4.41	1.17	-0.78	-0.18
Patient Health Questionnaire - 9	10.65	7.55	0.39	-1.01
Machiavellianism	2.49	0.77	0.43	-0.19
Narcissism	2.24	0.66	0.39	-0.11
Psychopathy	1.85	0.63	1.07	1.11

Note. *M* = Mean. *SD* = Standard deviation.

Table A2. Spearman- and Pearson correlation analyses between demographic and psychometric variables in mentally healthy individuals.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Gender	1	.02	-.01	**.21*** **	**.21*** **	**.33*** **	**-.19*** **	**-.22*** **	-.12	.06	-.09	-.03	**-.15*** *	.11	-.09
2 Age		1	**.21*** **	.03	.00	-.08	.06	.08	.09	-.03	-.07	.02	-.05	-.01	**-.17*** **
3 Education			1	-.07	-.01	-.11	-.00	.05	.04	**.12*** *	.08	-.12	-.07	.07	**-.17*** **
4 Machiavellianism				1	**.40*** **	**.52*** **	-.12	**-.14*** *	-.12	-.11	**-.23*** **	**.22*** **	.09	**-.18*** **	**.22*** **
5 Narcissism					1	**.45*** **	-.01	**-.16*** *	.01	.03	-.03	.07	.12	-.06	-.02
6 Psychopathy						1	-.09	**-.31*** **	-.12	.00	-.12	**.25*** **	.05	**-.15*** *	**.23*** **
7 Diet							1	**.30*** **	**.31*** **	**.39*** **	**.47*** **	-.04	**.18*** **	.05	-.09
8 Substance use								1	**.22*** **	**.18*** **	**.25*** **	**-.18*** **	.08	**.11*** *	**-.21*** **
9 Use of medical service									1	**.28*** **	**.23*** **	-.12	**.17*** **	**.18*** **	-.12
10 Physical activity										1	**.36*** **	**-.27*** **	.07	.12	**-.24*** **
11 MEDAS score											1	**-.20*** **	**.14*** *	.12	**-.19*** **
12 PSQI score												1	**.15*** *	**-.16*** *	**.62*** **
13 PSM score													1	-.08	.13
14 VAX score														1	**-.21*** **
15 PHQ score															1

Note. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Gender = Female (=1) vs. male (=2). Diet, Substance Use, Use of Medical Service, and Physical Activity = Scale scores of the Multidimensional Health Behaviour Inventory. MEDAS score = Mediterranean Diet Score. PSQI score = Pittsburgh Sleep Quality Index score (higher values indicate better sleep quality). PSM score = Perceived Sensitivity to Medicines score. VAX score = Vaccination Attitude Examination Scale score. PHQ score = Patient Health Questionnaire score. * $p < .05$, *** $p < .001$. Benjamini-Yekutieli adjustments for all α-levels. Significant results are printed in bold.

Table A3. Spearman- and Pearson correlation analyses between demographic and psychometric variables in individuals with affective disorders.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1 Gender	1	**.19*** **	.04	.09	**.17*** **	.10	**-.22*** **	**-.12***	**-.14***	.05	**-.17*** **	.00	-.07	-.03	-.07
2 Age		1	-.01	-.10	.03	**-.16*** **	.02	**.11***	**.23*** **	-.06	-.07	.10	.06	-.09	-.09
3 Education			1	.00	**.13*** **	.03	.06	.07	.08	**.16*** **	**.17*** **	**-.15*** **	.05	**.24*** **	-.12
4 Machiavellianism				1	**.29*** **	**.47*** **	-.01	.02	-.05	-.10	-.06	.01	.03	.10	.10
5 Narcissism					1	**.48*** **	-.01	-.11	**.12***	.12	-.06	-.01	**.11***	-.03	-.07
6 Psychopathy						1	-.03	**-.22*** **	-.08	-.05	-.01	.02	.05	-.03	.04
7 Diet							1	**.21*** **	**.32*** **	**.35*** **	**.44*** **	.05	.07	.10	-.06
8 Substance use								1	**.25*** **	.10	.08	.07	.07	.10	-.07
9 Use of medical service									1	**.22*** **	**.25*** **	.03	**.24*** **	.10	-.12
10 Physical activity										1	**.30*** **	**-.14***	-.00	**.13***	**-.25*** **
11 MEDAS score											1	-.07	.05	**.12***	-.09
12 PSQI score												1	.11	**-.14***	**-.48*** **
13 PSM score													1	**-.15*** **	**.18*** **
14 VAX score														1	-.09
15 PHQ score															1

Note. Group = Mentally healthy individuals (=1) vs. individuals with affective disorders (=2). Gender = Female (=1) vs. male (=2). Diet, Substance Use, Use of Medical Service, and Physical Activity = Scale scores of the Multidimensional Health Behaviour Inventory. MEDAS score = Mediterranean Diet Score. PSQI score = Pittsburgh Sleep Quality Index score (higher values indicate better sleep quality). PSM score = Perceived Sensitivity to Medicines score. VAX score = Vaccination Attitude Examination Scale score. PHQ score = Patient Health Questionnaire score. * $p < .05$, *** $p < .001$. Benjamini-Yekutieli adjustments for all α-levels. Significant results are printed in bold.

6.2. Appendix B: Test material

6.2.1. Appendix B1: Demographic questionnaire (English)

Which gender do you identify with?
□ female □ male □ diverse

How old are you?
Free text

How tall are you? (in cm)
Free text

How much do you weigh? (in kg)
Free text

What is your highest education?
□ no formal education □ formal education □ apprenticeship □ high school diploma □ bachelor's degree □ master's degree □ Doctoral studies/PhD

What is your current relationship status?
□ single □ in a relationship □ married □ divorced □ widowed

In which region and state is your primary residency? (format: region, state; e.g., Styria, Austria)
Free text

How do you currently live?
□ alone □ with partner □ with partner and children □ with child/children □ in a shared apartment □ with parents □ in a multi-generational household

Are you currently employed?
□ yes, as employee □ yes, self-employed □ no, retirement/rehabilitation money □ no, unemployed □ I am a pupil/student □ on parental leave □ Other (free text)

Do you currently have one/multiple somatic disease/s?
□ yes □ no
If yes: Which of the following disease/s do you have? (multiple choice possible)
□ Diabetes Mellitus □ Hypertension □ Stroke/ heart attack □ Chronic obstructive lung disease □ Chronic kidney failure □ Cancer □ Rheumatoid disease □ Other (free text)

Have you been hospitalized in the last 14 days?
□ yes □ no
If yes, why?
Free text

Are you currently taking medication for somatic diseases?
□ yes □ no
If yes: Which medication do you take for somatic diseases?
Free text

Are you currently taking psychopharmaceutical medication?
□ yes □ no
If yes: Which psychopharmaceutical medication are you taking? Please also provide information about the medication dosis in milligram (mg).
Free text

Do you have the diagnosis of an affective disorder (e.g., depression, bipolar disorder)?
□ yes □ no
If yes: Please state which diagnosis applies to you.
□ Unipolar depression (one episode in the past) □ Recurrent depressive disorder (recurrent depressive episodes) □ Bipolar affective disorder □ Cyclothymia/dysthymia □ Other (free text)

If yes: Was this diagnosis specified by a psychiatrist/psychologist/psychotherapist?
□ yes □ no
If yes: How old were you when the diagnosis was given?
Free text
If yes: How old were you when you first noticed symptoms of your disease?
Free text
If yes: How many affective episodes have you had until now?
Free text

Has there ever been a time, meaning at some point in your life, when you felt depressed or down most of the day for at least two weeks every day?
□ yes □ no
Has there ever been a time when you lost interest or pleasure in activities you usually enjoy almost every day for at least two weeks?
□ yes □ no
If the last two questions were answered with "yes": Which of the following symptoms did you have during this time?
□ changes in appetite (loss of appetite or increase in appetite) □ sleep problems (trouble falling asleep or staying asleep, frequent or early awakenings, OR increased need for sleep) □ restlessness (being nervous or agitated so you couldn't sit still) or inhibited drive (slower speech or movement than usual) □ lack of energy (constant tiredness and feeling worn out) □ feeling of worthlessness, guilt □ difficulty thinking or concentrating, difficulty making decisions about everyday things □ frequent thoughts of death, suicidal ideation

Do you have any other psychiatric diagnoses than the diagnosis of an affective disorder?
□ yes □ no
If yes: Please state which diagnosis/diagnoses apply to you. (multiple choices possible)
□ anxiety disorder (panic disorder, phobia, generalized anxiety disorder, other) □ obsessive-compulsive disorder □ schizophrenia □ addictive disorder □ eating disorder (bulimia, anorexia, binge eating) □ personality disorders □ other (free text)

Do you have a first-degree relative (parent, sibling, child) with a diagnosis of a serious psychiatric illness (schizophrenia, bipolar disorder, major depression)?
□ yes □ no

6.2.2. Appendix B2: Demographic questionnaire (German)

Welchem Geschlecht ordnen Sie sich zu?
□ weiblich □ männlich □ divers

Wie alt sind Sie?
Freitext

Wie groß sind Sie? (in cm)
Freitext

Wieviel wiegen Sie? (in kg)
Freitext

Was ist Ihre höchste abgeschlossene Ausbildung?
□ keine formale Ausbildung □ Pflichtschulabschluss □ abgeschlossene Lehrausbildung □ Matura □ abgeschlossenes Bachelorstudium □ abgeschlossenes Master-/Diplomstudium □ Doktorat/PhD

Was ist Ihr derzeitiger Beziehungsstatus?
□ Single □ in Partnerschaft □ verheiratet □ geschieden □ verwitwet

In welchem Bundesland und Land befindet sich Ihr Hauptwohnsitz? (Format: Bundesland, Land; z.B. Steiermark, Österreich)
Freitext

Wie leben Sie derzeit?
□ alleine □ mit Partner*in □ mit Partner*in und Kindern □ mit Kind/Kindern □ in einer Wohngemeinschaft □ mit den Eltern □ in einem Mehrgenerationenhaushalt

Sind Sie derzeit berufstätig?
□ ja, als Angestellte*r □ ja, als Selbstständige*r □ nein, in Pension/Rehageld □ nein, arbeitslos □ ich bin Schüler*in/Student*in □ in Karenz □ Anderes (Freitext)

Haben Sie derzeit eine/mehrere somatische Erkrankung/en?
□ ja □ nein □
Wenn ja: Welche der folgenden Erkrankungen haben Sie? (Mehrfachwahl möglich)
□ Diabetes Mellitus □ Bluthochdruck □ Schlaganfall/ Herzinfarkt □ Chronisch obstruktive Lungenerkrankung □ Chronisches Nierenversagen □ Krebs □ Rheumatoide Erkrankung □ Andere (Freitext)

Waren Sie in den letzten 14 Tagen stationär im Krankenhaus?
□ ja □ nein
Wenn ja, weswegen?
Freitext

Nehmen Sie derzeit Medikamente für somatische Erkrankungen ein?
□ ja □ nein
Wenn ja: Welche Medikation für somatische Erkrankungen nehmen Sie derzeit ein? (Freitext)
Freitext

Nehmen Sie derzeit Psychopharmaka ein?
□ ja □ nein
Wenn ja: Welche Psychopharmaka nehmen Sie ein? Bitte geben Sie auch die Dosis der Medikation in Milligramm (mg) an.
Freitext

Haben Sie die Diagnose einer affektiven Erkrankung (z.B. Depression, bipolare Störung)?
□ ja □ nein
Wenn ja: Bitte geben Sie an, welche Diagnose auf Sie zutrifft.
□ Unipolare Depression (Eine Episode in der Vergangenheit) □ Rezidivierend depressive Störung (wiederkehrende depressive Episoden) □ Bipolar affektive Störung □ Zyklothymie/Dysthymie □ Andere (Freitext)

Wenn ja: Wurde diese Diagnose von einem/einer Fachärzt*in / Psycholog*in / Psychotherapeut*in gestellt?
□ ja □ nein
Wenn ja: Wie alt waren Sie, als die Diagnose gestellt wurde?
Freitext
Wenn ja: Wie alt waren Sie, als Sie zum ersten Mal Symptome Ihrer Erkrankung verspürten?
Freitext
Wenn ja: Wieviele affektive Episoden hatten Sie bisher?
Freitext

Gab es jemals, das heißt irgendwann in Ihrem Leben, eine Zeit, in der Sie sich mindestens zwei Wochen lang jeden Tag die meiste Zeit des Tages depressiv oder niedergeschlagen fühlten?
□ ja □ nein
Gab es jemals eine Zeit, in der Sie mindestens zwei Wochen lang fast jeden Tag das Interesse oder die Freude an Aktivitäten verloren haben, die Ihnen gewöhnlich Freude machen?
□ ja □ nein
Wenn die letzten beiden Fragen mit „ja“ beantwortet wurden: Welche der folgenden Symptome hatten Sie während dieser Zeit?
□ Veränderungen im Appetit (Appetitlosigkeit oder Zunahme im Appetit) □ Schlafprobleme (Ein- oder Durchschlafprobleme, häufiges oder zu frühes Erwachen, ODER gesteigertes Schlafbedürfnis) □ Unruhe (nervös oder unruhig sein, so dass Sie nicht stillsitzen konnten) oder gehemmter Antrieb (Langsamere Sprache oder Bewegung als sonst) □ Energielosigkeit (ständige Müdigkeit und Gefühl der Abgeschlagenheit) □ Gefühl der Wertlosigkeit, Schuldgefühle □ Schwierigkeiten beim Denken oder Konzentrieren, Schwierigkeiten beim Entscheiden alltäglicher Dinge □ Häufige Gedanken an den Tod, Suizidgedanken

Haben Sie andere psychiatrische Diagnosen als die Diagnose einer affektiven Erkrankung?
□ ja □ nein
Wenn ja: Bitte geben Sie an, welche Diagnose(n) auf Sie zutrifft/zutreffen. (Mehrfachauswahl möglich)
□ Angsterkrankungen (Panikstörung, Phobie, Generalisierte Angststörung, andere) □ Zwangserkrankung □ Schizophrenie □ Suchterkrankungen □ Essstörungen (Bulimie, Anorexie, Binge Eating) □ Persönlichkeitsstörungen □ andere (Freitext)

Haben Sie einen Angehörigen ersten Grades (Eltern, Geschwister, Kinder) mit der Diagnose einer schweren psychiatrischen Erkrankung (Schizophrenie, Bipolare Störung, Major Depression)?
□ ja □ nein

6.2.3. Appendix B3: Translated questionnaire protocols

Translation protocol: Source language (English) to target language (German). Translator T1: MM, translated on 16/06/2021.

Fragebogen zum multidimensionalen Gesundheitsverhalten

a) Ernährung:

1. Wie oft begrenzen die Einnahmen von Fetten in Ihrer Ernährung?
2. Wie oft begrenzen Sie die Einnahme von rotem Fleisch in Ihrer Ernährung?
3. Wie oft essen Sie wöchentlich 2-mal rotes Fleisch?
4. Wie oft essen Sie täglich rotes Fleisch?
5. Wie oft essen Sie fettfreie Milchprodukte?
6. Wie oft begrenzen Sie die Einnahme von Kalorien?
7. Wie oft begrenzen Sie die Einnahme von Zucker?
8. Wie oft essen Sie Süßigkeiten in Ihrer Ernährung?
9. Wie oft essen Sie eine Mahlzeit/Portion von Junk-Food?
10. Wie oft machen Sie Sport, um Gewicht zu verlieren?
11. Wie oft begrenzen Sie die Einnahme von Salz?
12. Wie oft essen Sie Vollkorn?
13. Wie oft lesen Sie Lebensmittelkennzeichen?

b) Substanzkonsum/Drogenkonsum

1. Wie oft trinken Sie 5 oder mehr alkoholische Getränke?
2. Wie oft begrenzen Sie den Konsum alkoholischer Getränke?
3. Wie oft konsumieren Sie Drogen, um high zu werden?
4. Wie oft trinken Sie täglich Alkohol?
5. Wie oft vermeiden Sie es, passiv zu rauchen?
6. Wie oft rauchen Sie täglich Zigaretten?
7. Wie oft trinken Sie, während Sie Medikamente zu sich nehmen?
8. Wie oft trinken Sie und fahren anschließend mit dem Auto?
9. Wie oft vermeiden Sie es zu trinken, wenn Sie mit dem Auto fahren?
10. Wie oft vermeiden Sie es, Produkte mit Tabak zu sich zu nehmen?

c) Check-Up

1. Wie oft sprechen Sie über gesundheitliche Probleme?
2. Wie oft gehen Sie zu regelmäßigen Untersuchungen?
3. Wie oft ersuchen Sie um gesundheitliche Informationen?
4. Wie oft ersuchen Sie um eine zweite Meinung?
5. Wie oft berichten Sie von anhaltenden Symptomen?
6. Wie oft ersuchen Sie um Aufklärung zu gesundheitlichen Themen?
7. Wie oft messen Sie Ihren Blutdruck?
8. Wie oft führen Sie monatliche Selbstuntersuchungen im Bereich der Brüste und Testikel durch?
9. Wie oft messen Sie Ihren Cholesterinspiegel?

d) Sport

1. Wie oft treiben Sie energisch Sport?
2. Wie oft unternehmen Sie aerobe Tätigkeiten (z.B. schnelles Gehen, Schwimmen, Laufen)?
3. Wie oft unternehmen Sie erholende Tätigkeiten (z.B. Wandern, Campen, Skifahren)?
4. Wie oft strecken Sie Ihre Muskeln?

Skala zur wahrgenommenen Empfindlichkeit gegenüber Medikamenten (PSM-Skala)

1. Mein Körper ist Medikamenten gegenüber sehr empfindlich.
2. Mein Körper überreagiert auf Medikamente.
3. Ich zeige normalerweise stärkere Reaktionen auf Medikamente auf als die meisten Menschen.
4. Ich hatte eine schlechte Reaktion gegenüber Medikamenten in der Vergangenheit.
5. Selbst eine kleine Menge an Medikamenten kann sich schlecht auf meinen Körper auswirken.

Skala zur Überprüfung der Einstellung gegenüber Impfungen (VAX-Skala)

1. Ich fühle mich sicher, nachdem ich geimpft wurde.
2. Ich kann mich darauf verlassen, dass Impfungen schwere übertragbare Krankheiten stoppen/abhalten können.
3. Ich fühle mich geschützt, nachdem ich geimpft wurde.
4. Auch wenn die meisten Impfungen sicher erscheinen, könnte es Probleme geben, von denen wir bis jetzt noch nichts wissen.
5. Impfungen können unvorhergesehene Probleme bei Kindern hervorrufen.
6. Ich sorge mich über die unbekannten Auswirkungen von Impfungen in der Zukunft.
7. Impfungen bescheren den pharmazeutischen Firmen viel Geld, bringen der Bevölkerung jedoch keinen großen Nutzen.
8. Die Behörden fördern Impfungen für einen finanziellen Gewinn, nicht jedoch für die Gesundheit der Bevölkerung.
9. Impfaktion sind ein Betrug.
10. Natürliche Immunität hält länger an als eine Impfung.
11. Eine natürliche Aussetzung gegenüber Viren und Keimen stellt den besten Schutz dar.
12. Eine natürliche Aussetzung gegenüber Krankheiten ist sicherer für das Immunsystem als eine Aussetzung durch eine Impfung.

Translation protocol: Source language (English) to target language (German). Translator T2: NM, translated on 15/06/2021.

Mehrdimensionaler Fragebogen zum Gesundheitsverhalten

a) Diet – Ernährung (MBI1-MBI12)

1. Wie oft reduzierst du Fett in deiner Ernährung
2. Wie oft reduzierst du deinen Verzehr von rotem Fleisch
3. Wie oft isst du zweimal die Woche rotes Fleisch
4. Wie oft isst du rotes Fleisch als eine Mahlzeit pro Tag (R)
5. Wie oft isst du fettfreie Milchprodukte

6. Wie oft reduzierst du deine Kalorienzufuhr
7. Wie oft reduzierst du deinen Zuckerkonsum
8. Wie oft reduzierst du den Konsum von Süßigkeiten in deiner Ernährung
9. Wie oft isst du eine Portion Fast Food (R)
10. Wie oft trainierst du, um Gewicht zu verlieren
11. Wie oft reduzierst du deinen Salzkonsum
12. Wie oft isst du Vollkornprodukte
13. Wie oft liest du Lebensmitteletiketten

b) Substance use: Konsum von Suchtmitteln: (MBI13-MBI22)

14. Wie oft trinkst du mehr als 5 alkoholische Getränke (R)
15. Wie oft reduzierst du deinen Alkoholkonsum
16. Wie oft nimmst du Drogen, um high zu werden (R)
17. Wie oft trinkst du täglich Alkohol (R)
18. Wie oft vermeidest du Passivrauchen
19. Wie oft rauchst du täglich Zigaretten (R)
20. Wie oft trinkst du Alkohol und nimmst gleichzeitig Medikamente (R)
21. Wie oft trinkst du Alkohol und fährst anschließend mit dem Auto (R)
22. Wie oft trinkst du Alkohol und fährst anschließend nicht mehr Auto
23. Wie oft vermeidest du den Konsum von Tabakprodukten

c) Checkup: Vorsorgeuntersuchung: (MBI23-MBI31)

24. Wie oft besprichst du Gesundheitsfragen
25. Wie oft gehst du zu regelmäßigen Kontrolluntersuchungen
26. Wie oft informierst du dich zu Gesundheitsthemen
27. Wie oft holst du dir eine zweite Meinung ein
28. Wie oft berichtest du über anhaltende Symptome
29. Wie oft bildest du dich zum Thema Gesundheit
30. Wie oft überprüfst du deinen Blutdruck
31. Wie oft führst du monatliche Selbstuntersuchungen der Brust oder der Hoden durch
32. Wie oft misst du deinen Cholesterinspiegel

d) Exercise: Sport: (MBI32-35)

33. Wie oft treibst du intensiv Sport
34. Wie oft machst du ausdauerfördernde Übungen / Ausdauertraining (z. B. zügiges Gehen, Schwimmen, Laufen)
35. Wie oft genießt du Freizeitaktivitäten (z. B. Wandern, Campen, Skifahren)
36. Wie oft dehnst du deine Muskeln

Perceived Sensitivity to Medicines Scale: Skala zur wahrgenommenen Empfindlichkeit gegenüber Medikamenten: (PSMG1-PSMG5)

1. Mein Körper reagiert sehr empfindlich auf Medikamente.
2. Mein Körper überreagiert auf Medikamente.
3. Meistens reagiere ich stärker auf Medikamente als die meisten Menschen.

4. Ich habe in der Vergangenheit schlecht auf Medikamente reagiert.
5. Bereits kleine Mengen von Medikamenten können meinen Körper aus dem Gleichgewicht bringen.

Vaccination Attitudes Examination Scale: Skala zu den Einstellungen gegenüber Impfungen: (VAXg1-VAXg12)

1. Ich fühle mich sicher, nachdem ich geimpft wurde. (R)
2. Ich kann mich darauf verlassen, dass durch die Impfungen ernsthafte Infektionskrankheiten gestoppt werden. (R)
3. Ich fühle mich nach einer Impfung geschützt. (R)
4. Auch wenn die meisten Impfungen sicher zu sein scheinen, gibt es möglicherweise Probleme, die wir bislang noch nicht entdeckt haben.
5. Impfungen können unvorhergesehene Probleme bei Kindern verursachen.
6. Die unbekannten Langzeitwirkungen der Impfungen verunsichern mich.
7. Impfungen bringen Pharmaunternehmen große Gewinne ein, allerdings bringen sie normalen Menschen nicht viel.
8. Behörden werben für Impfungen, um daraus einen finanziellen Profit zu schlagen, nicht für die Gesundheit der Menschen.
9. Impfprogramme sind ein großer Betrug.
10. Die natürliche Immunität hält länger an als eine Impfung.
11. Den sichersten Schutz erlangt man dadurch, dass man Viren und Keimen ausgesetzt ist.
12. Sich mit einer Krankheit anzustecken ist sicherer für das Immunsystem als einer Krankheit durch eine Impfung ausgesetzt zu werden.

Translation protocol: Target language (German) to source language (English). Translator T3: LW, translated on 19/06/2021.

Multidimensional Health Behavior Questionnaire

a) Diet

1. How often do you limit the intake of fats in your diet?
2. How often do you limit the intake of raw meat in your diet?
3. How often do you eat raw meat 2 times a week?
4. How often do you eat raw meat a day?
5. How often do you eat fat free dairy products?
6. How often do you limit the intake of calories?
7. How often do you limit the intake of sugar?
8. How often do you eat sweets in your diet?
9. How often do you eat a meal/portion of junk food?
10. How often do you exercise to lose weight?
11. How often do you limit the intake of salt?
12. How often do you eat whole grain?
13. How often do you read food labels?

b) Substance use/use of drugs

1. How often do you drink 5 or more alcoholic drinks?
2. How often do you limit the consumption of alcoholic drinks?
3. How often do you take drugs to get high?
4. How often do you drink alcohol a day?
5. How often do you avoid smoking passively?
6. How often do you smoke a cigarette a day?
7. How often do you drink while taking medicines?
8. How often do you drink and drive a car afterwards?
9. How often do you avoid drinking when you have to drive a car?
10. How often do you avoid taking products with tobacco?

c) Check-Up

1. How often do you talk about health problems?
2. How often do you go to for regular checkups?
3. How often do you request health information?
4. How often do you request a second opinion?
5. How often do you report persistent symptoms?
6. How often do you request clarification on health topics?
7. How often do you measure your blood pressure?
8. How often do you perform monthly breast and testicular self-exams?
9. How often do you measure your cholesterol level?

d) Sports

1. How often do you exercise energetically?
2. How often do you do aerobe activities (e.g., fast walking, swimming, running)?
3. How often do you do relaxing activities (e.g., hiking, camping, skiing)?
4. How often do you stretch your muscles?

Perceived sensitivity to medication scale

1. My body is very sensitive to medicines.
2. My body overreacts to medicines.
3. Usually, I show stronger reactions to medicines than most people.
4. I had a bad reaction to medicines in the past.
5. Even a small amount of medicines can have a bad effect on my body.

Vaccination Attitude Examination Scale (VAX-Scale)

1. I feel safe after being vaccinated.
2. I can rely on vaccinations to stop/prevent severe communicable diseases.
3. I feel protected after being vaccinated.
4. Even though most vaccinations seem safe, there could be problems we don't know about yet.
5. Vaccinations can evoke unpredicted problems in children.
6. I worry about the unknown impacts of vaccinations in the future.
7. Vaccinations make pharmaceutical companies a lot of money, but do not bring much benefit to the population.

8. Authorities promote vaccination for financial gain, but not for public health.
9. Vaccination campaigns are a scam.
10. Natural immunity lasts longer than a vaccination.
11. A natural exposure to viruses and germs is the best protection.
12. A natural exposure to illnesses is safer for the immune system than a vaccination.

Translation protocol: Target language (German) to source language (English). Translator T4: MO, translated on 19/06/2021.

Multidimensional Health Behavior Questionnaire

a) Diet

1. How often do you limit fat in your diet?
2. How often do you limit your intake of red meat?
3. How often do you eat red meat 2x/week?
4. How often do you eat red meat as a meal per day?
5. How often do you eat fat-reduced dairy products?
6. How often do you limit calorie intake?
7. How often do you limit sugar intake?
8. How often do you reduce sweets in your diet?
9. How often do you eat one serving of fast food?
10. How often do you work out to loose weight?
11. How often do you reduce salt intake?
12. How often do you eat whole grain products?
13. How often do you read food labels?

b) Substance use

1. How often do you drink more than 5 alcoholic beverages?
2. How often do you reduce alcohol intake?
3. How often do you take drugs to get high?
4. How often do you drink alcohol daily?
5. How often do you avoid secondary smoking?
6. How often do you smoke cigarettes daily?
7. How often do you drink alcohol and take medicine at the same time?
8. How often do you drink alcohol and drive?
9. How often do you drink alcohol and avoid driving?
10. How often do you avoid consuming tobacco products?

c) Check-Up

1. How often do you discuss health questions?
2. How often do you go for regular check-ups?
3. How often do you inform yourself about health topics?
4. How often do you get a second opinion?
5. How often do you report persisting symptoms?
6. How often do you educate yourself regarding the topic of health?
7. How often do you control your blood pressure?
8. How often do you perform monthly self-examination of breasts or testicles?
9. How often do you measure your cholesterine level?

d) Physical activity

1. How often do you exercise intensely?
2. How often do you do endurance training? (e.g., brisk walking, swimming, running)
3. How often do you enjoy leisure activities? (e.g., hiking, camping, skiing)
4. How often do you stretch your muscles?

Perceived Sensitivity to Medicines Scale (PSM-Scale)

1. My body reacts very sensitive to medicines.
2. My body overreacts to medicines.
3. Most of the time, I react more strongly to medicines than most people.
4. I have reacted badly to medicines in the past.
5. Even small amounts of medicines can bring my body out of balance.

Vaccination Attitudes Examination Scale (VAX-Scale)

1. I feel safe after being vaccinated.
2. I can rely on vaccines stopping serious infectious diseases.
3. I feel safe after being vaccinated.
4. Even if most vaccines seem to be safe, there might be problems which we have not discovered so far.
5. Vaccines can cause unforeseen problems in children.
6. Unforeseen long-term effects of vaccines make me insecure.
7. Vaccines bring a lot of profit to pharmaceutical companies, but they are not useful for normal people.
8. Authorities advertise vaccines for making financial profit, not for the health of the people.
9. Vaccination programs are a big fraud.
10. Natural immunity lasts longer than a vaccination.
11. The safest protection is reached through exposure to viruses and germs.
12. Infecting oneself with a disease is more safe for the immune system than being exposed to a disease through a vaccination.

6.2.4. Appendix B4: Pilot study results of translated questionnaires

Table A2. Psychometric properties of the translated questionnaires.

Questionnaire	Scale	Internal consistency[a]		ICC		Concurrent validity[b]
		English	German	English	German	
MHBI	Diet	.81	.79	.81	.79	.97**
	Substance Use	.86	.75	.86	.75	.99***
	Check-Up	.88	.90	.88	.90	.95*
	Exercise	.55	.58	.55	.58	1.00***
PSM-Scale		.59	.48	.59	.48	.95*
VAX-Scale		.74	.61	.74	.61	.99**

Note. [a] Internal consistency is measured by Cronbach's α. ICC = Intraclass correlation coefficient. [b] Concurrent validity is measured by correlations between scales of the English and German version. MHBI = Multidimensional Health Behaviour Inventory. PSM-Scale = Perceived Sensitivity to Medicines scale. VAX-Scale = Vaccination Attitude Examination scale.

6.2.5. Appendix B5: Standardized instructions (English)

Study of Health Behaviour and Personality

Dear participant,

We would like to invite you to participate in a study investigating health behaviours in individuals with affective disorders (especially depression and bipolar disorder). Special attention will be paid to whether certain personality traits play a significant role in this context. The survey includes different questionnaires as well as individual-related questions and will take about **20-30 minutes** of your time. Within this survey, personal information (e.g., gender, age) will be assessed first, followed by seven brief questionnaires about your health behaviours, including substance use (e.g., alcohol, tobacco use), dietary behaviours, physical activity, sleep, use of medical services, and mental health. Subsequently, a questionnaire assessing personality traits will be administered. The answers to these questions are relevant clues for prevention, therapy and causal research of affective disorders in the context of health behaviours. The aim of this study is to learn more about the influence of health behaviours and personality traits on affective disorders in order to incorporate these findings into therapies for affective disorders in the future.

All your statements are anonymous. It is not possible to draw conclusions about your person. Your participation in this study is voluntary. You can withdraw from the study at any time without giving any reason and without any disadvantages. If you decide to participate in the study, your data will of course be treated confidentially and in accordance with the data protection law.

6.2.6. Appendix B6: Standardized instructions (German)

Studie zu Gesundheitsverhalten und Persönlichkeit

Sehr geehrte Teilnehmerin,

sehr geehrter Teilnehmer,

Wir möchten Sie einladen, an einer Studie teilzunehmen, die das Gesundheitsverhalten bei Personen mit affektiven Erkrankungen (insbesondere Depression und bipolare Erkrankungen) untersucht. Hierbei wird besonders darauf geachtet, ob bestimmte Persönlichkeitsmerkmale eine bedeutsame Rolle in diesem Zusammenhang spielen. Die Untersuchung umfasst verschiedene Fragebögen so wie personenbezogene Fragen und wird in etwa **20-30 Minuten** Ihrer Zeit in Anspruch nehmen. Im Rahmen dieser Umfrage werden zunächst personenbezogene Daten erhoben (z.B. Geschlecht, Alter), gefolgt von sieben Kurzfragebögen zu Ihrem Gesundheitsverhalten, wobei hier Substanzgebrauch (z.B. Alkohol-, Tabakgenuss), Ernährungsverhalten, körperliche Aktivität, Schlaf, Inanspruchnahme von medizinischen Diensten und psychische Gesundheit erhoben werden. Daraufhin wird ein Fragebogen zur Erhebung von Persönlichkeitseigenschaften vorgegeben. Die Beantwortung dieser Fragestellungen sind relevante Anhaltspunkte für Vorbeugung, Therapie und Ursachenforschung von affektiven Erkrankungen im Rahmen des Gesundheitsverhaltens. Ziel dieser Studie ist es, mehr über den Einfluss von Gesundheitsverhalten und Persönlichkeitseigenschaften auf affektive Erkrankungen zu erfahren, um diese Erkenntnisse auch zukünftig in Therapien von affektiven Erkrankungen einzubauen.

All Ihre Angaben sind anonym. Ein Rückschluss auf Ihre Person ist nicht möglich. Ihre Teilnahme an dieser Studie erfolgt freiwillig. Sie können jederzeit ohne Angaben von Gründen aus der Studie ausscheiden, ohne dass Ihnen dadurch irgendwelche Nachteile entstehen. Falls Sie sich dazu entscheiden an der Studie teilzunehmen, werden Ihre Daten selbstverständlich vertraulich und gemäß dem Datenschutzgesetz behandelt.

6.2.7. Appendix B7: Data privacy statement and informed consent (English)

Data protection

With regard to the data collected and processed about you in the course of this study, a differentiation must be made between

1. those personal data by which you are directly identifiable (e.g., name, date of birth)

2. pseudonymized (encrypted) personal data, in which all information that allows direct conclusions to be drawn about your identity is replaced by a code (e.g., a number). This leads to the result that the data can no longer be assigned to your person without consulting additional information and without disproportionate effort, and

3. anonymized data that can no longer be traced back to your person.

Access to your anonymized data will be granted to the investigator(s) and other employees of this study, who are involved in the study. The data are protected against unauthorized access. In addition, authorized representatives of the Medical University of Graz, who are bound to secrecy, as well as representatives of domestic and/or foreign health authorities and the respective ethics committees may inspect the data, as far as this is necessary or prescribed for the verification of the proper conduct of the study.

The data will only be passed on in anonymized form. Further, only the anonymized data will be used for any publications. All individuals, who receive access to your anonymized data are subject to the

Data Protection Regulation (DSGVO) and the Austrian adaptation regulations in the currently valid version when handling the data. In the context of this study, a transfer of data to countries outside the European Union is foreseen. Appropriate measures will be taken by the main center (Medical University of Graz) in accordance with the DSGVO. You cannot revoke your consent to the collection and processing of your data due to anonymization. Furthermore, due to the lack of possibility to assign your person to the data, you have no possibility to inspect the data concerning your person and no possibility to delete the data or to correct it if you find errors. However, you have the right to lodge a complaint with the Austrian data protection authority about the handling of your data (www.dsb.gv.at). The expected duration of the study is two years. The duration of the storage of your anonymized data beyond the end of the study is regulated by legal provisions.

If you have any questions regarding the handling of your data in this study, please first contact your investigator (Assoz. Prof. Priv.-Doz. Mag. Dr. Andreas Baranyi). He can, if necessary, forward your request to the persons responsible for data protection at the study center (data protection officer of the Medical University of Graz: datenschutz@medunigraz.at; data protection officer of the KAGes: datenschutz@kages.at).

The data collected and processed about you in the context of this study are anonymized data, where a traceability to your person is no longer possible. Please read the following paragraph carefully.

I agree to participate in the study "Health behaviours and personality traits in affective disorders". I have been informed in detail and comprehensibly by the study directors about the study, possible burdens and risks, as well as about the nature, significance and scope of the study and the requirements resulting from it for me. I have also read the text of this patient information and informed consent form, which comprises a total of one web page. If I had any questions, I contacted the study director, who answered them in a comprehensible and sufficient manner. I have had sufficient time to decide upon my study participation. I have no further questions at this time. I reserve the right to terminate my voluntary participation at any time without any disadvantages for my further medical care. I explicitly consent to the use of my data collected as part of this study as described in the "data protection" section of this document. In the event that I withdraw from the study, I agree that my data will continue to be retained and analysed as described in this information.

Opportunity to discuss further questions

If you have any further questions related to this study, please do not hesitate to contact your study director. Any questions regarding your rights as a participant in this study, will be gladly answered.

Contact person: Elena Schönthaler, MSc BSc

Reachable at: 0316 385 30079 / elena.schoenthaler@medunigraz.at

Thank you very much for your participation in the study.

The study team of the Department of Psychiatry and Psychotherapeutic Medicine of the Medical University of Graz

□ I have carefully read and understood all information regarding data protection, I feel sufficiently informed and consent to participate in this study.

6.2.8. Appendix B8: Data privacy statement and informed consent (German)

Datenschutz

Bei den Daten, die über Sie im Rahmen dieser Studie erhoben und verarbeitet werden, ist grundsätzlich zu unterscheiden zwischen

1. jenen personenbezogenen Daten, anhand derer Sie direkt identifizierbar sind (z.B. Name, Geburtsdatum)

2. pseudonymisierten (verschlüsselten) personenbezogenen Daten, bei denen alle Informationen, die direkte Rückschlüsse auf Ihre Identität zulassen, durch einen Code (z. B. eine Zahl) ersetzt werden. Dies bewirkt, dass die Daten ohne Hinzuziehung zusätzlicher Informationen und ohne unverhältnismäßig großen Aufwand nicht mehr Ihrer Person zugeordnet werden können und

3. anonymisierten Daten, bei denen eine Rückführung auf Ihre Person nicht mehr möglich ist.

Zugang zu Ihren anonymisierten Daten haben der Prüfarzt bzw. die Prüfärztinnen und andere Mitarbeiter*innen dieser Studie, die an der Studie mitwirken. Die Daten sind gegen unbefugten Zugriff geschützt. Zusätzlich können autorisierte und zur Verschwiegenheit verpflichtete Beauftragte der Medizinischen Universität Graz sowie Beauftragte von in und/oder ausländischen Gesundheitsbehörden und jeweils zuständige Ethikkommissionen in die Daten Einsicht nehmen, soweit dies für die Überprüfung der ordnungsgemäßen Durchführung der Studie notwendig bzw. vorgeschrieben ist.

Eine Weitergabe der Daten erfolgt nur in anonymisierter Form. Auch für etwaige Publikationen werden nur die anonymisierten Daten verwendet. Sämtliche Personen, die Zugang zu Ihren anonymisierten Daten erhalten, unterliegen im Umgang mit den Daten der Datenschutz-Grundverordnung (DSGVO) sowie den österreichischen Anpassungsvorschriften in der jeweils gültigen Fassung. Im Rahmen dieser Studie ist eine Weitergabe von Daten in Länder außerhalb der EU vorgesehen. Vom Hauptzentrum (Medizinische Universität Graz) werden die entsprechenden Maßnahmen ergriffen, die gemäß der DSGVO vorgesehen sind. Sie können Ihre Einwilligung zur Erhebung und Verarbeitung Ihrer Daten aufgrund der Anonymisierung nicht widerrufen. Aufgrund der fehlenden Möglichkeit der Zuordnung Ihrer Person zu den Daten haben Sie außerdem keine Möglichkeit der Einsicht in die Ihre Person betreffenden Daten und keine Möglichkeit der Löschung der Daten oder Berichtigung, falls Sie Fehler feststellen. Sie haben jedoch das Recht, bei der österreichischen Datenschutzbehörde eine Beschwerde über den Umgang mit Ihren Daten einzubringen (www.dsb.gv.at). Die voraussichtliche Dauer der Studie ist zwei Jahre. Die Dauer der Speicherung Ihrer anonymisierten Daten über das Ende der Studie hinaus ist durch Rechtsvorschriften geregelt.

Falls Sie Fragen zum Umgang mit Ihren Daten in dieser Studie haben, wenden Sie sich zunächst an Ihren Prüfarzt (Assoz. Prof. Priv.-Doz. Mag. Dr. Andreas Baranyi). Dieser kann Ihr Anliegen ggf. an die Personen, die am Studienzentrum für den Datenschutz verantwortlich sind, weiterleiten (Datenschutzbeauftragte/r der Medizinischen Universität Graz: datenschutz@medunigraz.at; Datenschutzbeauftragte/r der KAGes: datenschutz@kages.at).

Die Daten, die über Sie im Rahmen dieser Studie erhoben und verarbeitet werden, sind anonymisierte Daten, bei denen eine Rückführung auf Ihre Person nicht mehr möglich ist. Bitte lesen Sie sich den folgenden Absatz genau durch.

Ich erkläre mich bereit, an der Studie „Gesundheitsverhalten und Persönlichkeitseigenschaften bei affektiven Erkrankungen“ teilzunehmen. Ich bin von den Studienleiter*innen ausführlich und verständlich über die Studie, mögliche Belastungen und Risiken, sowie über Wesen, Bedeutung und Tragweite der Studie, sich für mich daraus ergebenden Anforderungen aufgeklärt worden. Ich habe darüber hinaus den Text dieser Patient*innenaufklärung und Einwilligungserklärung, die insgesamt

eine Webseite umfasst gelesen. Bei aufgetretenen Fragen habe ich mich an den/die Studienleiter*in gewandt, wobei diese mir verständlich und genügend beantwortet wurden. Ich hatte ausreichend Zeit, mich zu entscheiden. Ich habe zurzeit keine weiteren Fragen mehr. Ich behalte mir das Recht vor, meine freiwillige Mitwirkung jederzeit zu beenden, ohne dass mir daraus Nachteile für meine weitere medizinische Betreuung entstehen. Ich stimme ausdrücklich zu, dass meine im Rahmen dieser Studie erhobenen Daten wie im Abschnitt „Datenschutz“ dieses Dokuments beschrieben verwendet werden. Für den Fall, dass ich aus der Studie ausscheide, bin ich einverstanden, dass meine Daten weiterhin aufbewahrt und analysiert werden, wie in dieser Information beschrieben.

Möglichkeit zur Diskussion weiterer Fragen

Für weitere Fragen im Zusammenhang mit dieser Studie steht Ihnen Ihre Studienleiterin gern zur Verfügung. Auch Fragen, die Ihre Rechte als Teilnehmer*in an dieser Studie betreffen, werden Ihnen gerne beantwortet.

Kontaktperson: Elena Schönthaler, MSc BSc

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Wir danken Ihnen herzlich für Ihre Teilnahme an der Studie.

Das Studienteam der Universitätsklinik für Psychiatrie und Psychotherapeutische Medizin der Medizinischen Universität Graz

☐ Ich habe alle Informationen bezüglich des Datenschutzes aufmerksam gelesen und verstanden, ich fühle mich ausreichend informiert und willige in die Teilnahme an dieser Studie ein

6.3. Appendix C: Pre-registration

‘Influence of Dark Triad Traits on Health Behaviour in Affective Disorders'
(AsPredicted #77913)

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1) Have any data been collected for this study already?

No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?

The main question of this study is:

Is there an association between affective disorders (versus mentally healthy individuals) and health behaviours (substance abuse, diet, physical activity, use of health services, sleep, mental health), and is this association moderated by the individual manifestation of the Dark Triad traits (psychopathy, Machiavellianism, narcissism)?

The following hypotheses (H) will be investigated:

H1: We expect individuals with affective disorders to show less protective health behaviours compared to mentally healthy individuals. Further, we expect this relationship to be significant positively moderated by the characteristics of the Dark Triad, i.e. it is stronger for individuals with high scores in the Dark Triad compared to individuals with low scores in the Dark Triad.

H2: Individuals with affective disorders show more substance use compared to mentally healthy individuals. This relationship is positively moderated by the Dark Triad traits.

H3: Individuals with affective disorders show less physical activity compared to mentally healthy individuals. This relationship is positively moderated by the Dark Triad traits.

H4: Individuals with affective disorders show poorer dietary behaviour compared to mentally healthy individuals. This relationship is positively moderated by the Dark Triad traits.

H5: Individuals with affective disorders show poorer sleep quality compared to mentally healthy individuals. This relationship is positively moderated by the Dark Triad traits.

H6: Individuals with affective disorders show less use of health services compared to mentally healthy individuals. This relationship is positively moderated by the Dark Triad traits.

H7: Individuals with affective disorders show poorer mental health compared to mentally healthy individuals. This relationship is positively moderated by the Dark Triad traits.

3) Describe the key dependent variable(s) specifying how they will be measured.

This study is essentially correlative. All key variables are listed below.

Substance use, physical activity, diet and use of health services. These health behaviours will be measured with the German version of Multidimensional Health Behaviour Inventory (MHBI; Kulbok et al., 1999), consisting of 36 items. Subjects answer on a five-point Likert scale, ranging from (1) = "never" to (5) = "always".

Diet. Dietary behaviour will be measured with the German version of the Mediterranean Diet Score (MEDAS; Hebestreit et al., 2017), which consists of 14 items. Items are either presented dichotomously or in frequencies of the eating habit asked (e.g., 3-4x per week).

Sleep. Sleeping behaviour will be measured with the German version of Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989), which consists of 19 items. Subjects answer on a four-point Likert scale, ranging from (1) „not during the past month" to (4) „three or more times a week".

Perceived Sensitivity to Medicines. Perceived sensitivity to medicines as a part of use of health services will be measured with the German version of the Perceived Sensitivity to Medicines Scale (PSM-Scale; Horne et al., 2013), which consists of 5 items. Subjects answer on a five-point Likert scale, ranging from (1) = "strongly disagree" to (5) = "strongly agree".

Vaccination attitude. Vaccination attitudes as a part of use of health services will be measured with the German version of Vaccination Attitudes Examination Scale (VAX-Scale; Martin & Petrie, 2017), which consists of 12 items. Subjects answer on a six-point Likert scale, ranging from (1) = "strongly disagree" to (6) = "strongly agree".

Mental health. Mental health status will be measured with the German version of the Patient Health Questionnaire (PHQ-9; Löwe et al., 2004), which consists of 9 items. Subjects answer on a four-point Likert scale, ranging from (0) = "not at all" to (3) = "almost everyday".

Dark Triad. The Dark Triad will be measured with the German version of the Short Dark Triad questionnaire (SD3; Jones & Paulhus, 2014), which consists of 27 items. Subjects answer on a five-point Likert scale, ranging from (1) = "strongly disagree" to (5) = "strongly agree".

For the questionnaires, responses will be averaged over items to build (sub-) scale scores. Specifically, a composite score will be calculated for the Dark Triad traits.

4) How many and which conditions will participants be assigned to?

Participants will be assigned to two conditions (affective disorders vs. mentally healthy controls).

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.

Before we examine the hypotheses, we will compute bivariate correlations between all items

in this study. All correlation analyses will be calculated with Bonferroni adjustments for the family of predictors (α = .05 divided by 3 (Dark Triad traits) and 10 (health behaviours)). To examine the causal relationship between the Dark Triad traits, health behaviours and affective disorders (H1), a structural equation model will be calculated. Further, single moderation analyses will be administered to determine the effects of affective disorders and the single traits of the Dark Triad on each health behaviour domain (H2-H8). The range in which moderators show significant interactions is determined using Johnson-Neyman intervals. All analyses will also differentiate by type of affective disorder (bipolar disorder vs. depression). We will use 95% BCa bootstrapping confidence intervals based on 2000 samples for the interpretation of affected analyses if assumptions regarding normality, homoscedasticity, or (plausible) outliers are violated. All hypotheses will be tested two-tailed.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

Only people within the age of 18-90 will be tested. Outliers will be considered in further analyses. Data will only be excluded if they are not plausible or realistic (e.g. participants skipped parts of the questionnaires). Plausible data (e.g. high narcissism scores) will not be excluded.

7) How many observations will be collected or what will determine sample size?
No need to justify decision but be precise about <u>exactly</u> how the number will be determined.

Due to a lack of related research, we assume a small effect size (path coefficient = 0.1). With an α-level of 5%, a power of 80%, 10 manifest variables, and one latent construct (health behaviour), a power analysis for structural equation models yields a sample size of 1100. We expect 15% of the participants to drop out of the study, thus the planned number of study participants will be 1265 (1100 + 15% drop-outs). However, if more data are available, they will also be included in all analyses.

8) Anything else you would like to pre-register?
(e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)

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6.4. Appendix D: Publication

The article can be found online using the following reference:

Schönthaler, E. M. D., Dalkner, N., von Lewinski, D., Reininghaus, E.Z., & Baranyi, A. (2023) 'Machiavellianism and Psychopathy worsen Sleep Quality in Individuals with Affective Disorders and Mentally Healthy Individuals', *Frontiers in Psychology*, 14, p. 1248931, doi: 10.3389/fpsyg.2023.1248931