The Association of Trait Mindfulness with Psychosocial and Bio-behavioral Variables among Adolescents with Type 1 Diabetes

by

Hiba Abujaradeh

Bachelor of Science in Nursing, The University of Jordan, 2008

Master of Science in Nursing, University of Pittsburgh, 2011

Submitted to the Graduate Faculty of the

School of Nursing in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

University of Pittsburgh

2021

UNIVERSITY OF PITTSBURGH

SCHOOL OF NURSING

This dissertation was presented

by

Hiba Abujaradeh

It was defended on

July 9, 2021

and approved by

Susan M. Sereika, PhD, Professor, School of Nursing

Christine A Feeley, PhD, MSN, RN, Assistant Professor, School of Nursing

Monica DiNardo, PhD, ANP-BC, CDE, Adjunct Professor, School of Nursing

Pushpa Viswanathan, MD, Associate Professor, School of Medicine

Dissertation Advisor: Denise Charron-Prochownik, PhD, RN, CPNP, Professor, School of Nursing

The Association of Trait Mindfulness with Psychosocial and Bio-behavioral Variables among Adolescents with Type 1 Diabetes

Hiba Abujaradeh, PhD, MSN, RN, CPNP

University of Pittsburgh, 2021

Background: Type 1 diabetes (T1D) is one of the most common chronic diseases in childhood. Adolescents with T1D are especially vulnerable to stress, diabetes distress, depression and anxiety, which can lead to deteriorated diabetes self-management (DSM) and glycemic regulation. Protective factors have been identified to improve the well-being of adolescents with T1D by decreasing the risk of stress, depression, and anxiety which could improve DSM and glycemic regulation (A1c). Mindfulness, either as an individual trait or as a result of training, has been identified as a protective factor against stress and is associated with positive well-being in adults with diabetes. However, there has been limited investigation of mindfulness among adolescents with chronic disorders in general and among adolescents with T1D in particular.

Objectives: 1) Describe trait mindfulness and mindfulness practices among adolescents with T1D; 2) Compare levels of trait mindfulness and mindfulness practices on adolescents' demographics, clinical, and bio-behavioral variables; 3) Examine the association of trait mindfulness with psychosocial and bio-behavioral variables; 4) Examine which mindfulness facets (Observe, Describe, Act with Awareness, Nonjudgement; and Nonreactivity) are associated with psychosocial and bio-behavioral variables; 5) Explore the association between trait mindfulness and stigma toward chronic disorder; and 6) Explore the potential moderating and/or mediating role of shared responsibility on the relationship between trait mindfulness and bio-behavioral variables.

Methods: This cross-sectional study recruited adolescents (age=12-18 years) with T1D at UPMC Children's Hospital of Pittsburgh. Participants completed questions on a tablet computer including demographic data, measures on mindfulness, and psychosocial variables (stress, diabetes-specific stress, diabetes distress, depression, anxiety). For bio-behavioral variables (diabetes self-management and glycemic regulation) participants completed diabetes self-management measures on the tablet and A1c was obtained from medical records.

Summary: Adolescents with higher levels of trait mindfulness and with more types of mindfulness practices had lower diabetes-specific stress, higher DSM, and lower A1c. Higher mindfulness as a unidimensional concept was significantly associated with better psychosocial variables and DSM. Mindfulness facets Act with Awareness, Nonjudgment, and Nonreactivity were associated with most psychosocial variables. Nonjudgement was associated with DSM and Nonreactivity was associated with A1c. It appears that mindfulness-based interventions could be tailored to target different mindfulness facets which may improve varied aspects of mental and physical health in adolescents with T1D. These findings provided better understanding of trait mindfulness among adolescents with T1D, which could be applied to establish a theory-based and developmentally-appropriate mindfulness-based intervention to improve psychological health, adherence to diabetes self-management, and glycemic regulation.

Table of Contents

List of Tables

List of Figures

Preface

To begin with, I want to thank Allah for giving me the strength, determination, and endurance to complete my PhD degree. Thank you Allah for all the blessings you have given to me. I want to sincerely thank my dissertation chair and advisor Dr. Denise Charron-Prochownik for the constant guidance, support, and patience across the years. Dr. Charron-Prochownik, there are no words to express my gratitude for having you. Thank you for having your door always open to me. Your encouragement, understanding, and support helped me to grow up in my professional career and personal life. You were not only a mentor to me, but a true leader and role model.

I also want to thank my dissertation committee Dr. Susan Sereika, Dr. Christine A Feeley, Dr. Monica DiNardo, and Dr. Pushpa Viswanathan for their continuous guidance, support, and mentoring throughout this journey. Dr. Sereika, thank you for the endless hours you spent with me on statistics and methodology. Dr. Feeley, thank you for sharing your expertise in pediatrics and diabetes. Dr. DiNardo, thank you for your guidance on mindfulness and diabetes and for having your door always open to me. Dr. Viswanathan thank you for your deep insight on mindfulness and your continuous help in recruitment and making this study possible. I want to also to thank Dr. Vicki Helgeson, Dr. Korey Hood, and Dr. Brian Galla for their guidance and support, giving me access to valuable datasets, mentoring me over different research projects, and helping to grow as a researcher. In addition, I want to recognize Dr. Reema Safadi, Dr. Cathy Bender, Dr. Lora Burke, Dr. Cynthia Danford, Dr. Andrea Fischl for their guidance, support, and having their doors open to me.

I would also like to thank the University of Pittsburgh School of Nursing and R01 STOPPING GDM for providing me the opportunity to work as teaching fellow and graduate

student researchers which improved my teaching and research skills and provided me with the financial support toward the completion of my doctoral studies. I would also like to acknowledge the grants that I received toward this dissertation including funds from the University of Pittsburgh School of Nursing :Swigart/Gold Doctoral Award in Nursing Ethics, Jayne F Wiggins Memorial Award, and Jennifer Thurheimer-Cacciotti Award, Sigma Theta Tau (Eta Chapter), and the National Association of Pediatric Nurse Practitioners. I am grateful that you chose to invest in my research. I also want to thank the participants of this study and their families, I thank you for all you have given, and I hope to someday pay you back by improving mental and physical health for adolescents with type 1 diabetes.

Finally, I dedicate this work to my parents who believed in me and encouraged me all the way to pursue my goals. My parents say that they are proud of me, but I also want them to know how proud I am of them. Also, I dedicate this work to my former mentor, the late Dr. Susan M. Cohen. She was not only my mentor, but she had also been a role model to me that I will always continue to look up to hoping to be as inspiring, loving, advocating, and supporting mentor to my students as she was to me. I want to thank my wonderful husband Mohammad for all his support through the years. I am forever grateful for having you and for sharing our love for learning, research, and being better versions of ourselves to us and to the humanity. Thank you my kids Zaina and Rayyan for bringing joy and happiness into my life. Because of you, I always stayed motivated to pursue my dreams. My brothers, sisters, and dear friends, thank you for all your support and being there for me when I needed you.

1.0 Dissertation Proposal

1.1 Specific Aims

Type 1 diabetes (T1D) is one of the most common chronic diseases in childhood. The American Diabetes Association (ADA) estimated that 210,000 Americans under the age of 20 years have a diagnosis of diabetes with more than 80% of them (~167,000) having T1D (Centers for Disease Control and Prevention, 2014; Dabelea et al., 2014). Data from the SEARCH for Diabetes in Youth Study indicate that the estimated annual incidence of T1D in the United States included 17,900 youth younger than 20 years during 2011-2012 (CDC, 2017; E. J. Mayer-Davis et al., 2017). T1D is a long-term disease that requires both children and family to adapt their lives and to be involved in a complex treatment regimen to prevent short- and long-term major complications (American Diabetes Association, 2021).

Adolescents are at risk for stress as they go through rapid and dynamic physiological, psychological, and social changes where new developmental tasks need to be achieved (Holmbeck, Friedman, Abad, Jandasek, & Wolfe, 2006). In addition to stressors related to growth and development, adolescents with T1D need to follow a complex and time-consuming regimen to manage their diabetes (American Diabetes Association, 2021; Silverstein et al., 2005). Evidence shows that adolescents with T1D perceive stress related to their growth and development (e.g., school and social life) as well as stress specific to their diabetes (i.e., adolescents perceive situations related to having and managing diabetes to be a hassle or uncontrollable) (Chao et al., 2016). Stress plays a critical role in adolescents with T1D. Stress has a direct effect on glycemic regulation through its impact on cortisol and increasing hepatic glycogen production and insulin

resistance (McEwen, 1998) and indirect effect where it interferes with adolescents' behaviors, including diabetes self-management (DSM) behaviors (Helgeson, Escobar, Siminerio, & Becker, 2010). Further, stress can increase the risk of developing psychological problems (American Psychological Association, 2014; McMahon, Grant, Compas, Thurm, & Ey, 2003; Moksnes, Espnes, & Haugan, 2013). Adolescents with T1D are at increased risk for anxiety (Buchberger et al., 2016; K. Rechenberg, Whittemore, & Grey, 2017), depression (Buchberger et al., 2016; Reynolds & Helgeson, 2011), and diabetes distress (i.e., which is different than diabetes-specific stress, and it represents the negative emotions that arise from living with and managing diabetes such as feeling frustrated, hopeless, angry, sad, and fearful) (Hagger, Hendrieckx, Sturt, Skinner, & Speight, 2016; Reynolds & Helgeson, 2011). High levels of anxiety, depression, and diabetes distress are associated with impaired DSM and poor glycemic regulation (Buchberger et al., 2016; Hagger et al., 2016; K. Rechenberg et al., 2017). To improve the psychological and physical health of adolescents with T1D, it is important to study factors that could have a protective effect against stress and diabetes-specific stress and other psychosocial variables (i.e., anxiety, depression, and diabetes distress), and facilitate adherence to diabetes management), and glycemic regulation.

Mindfulness has been known as a protective factor against stress. Mindfulness is defined as an enhanced awareness to the present moment while adopting an attitude of non-judgmental acceptance to the experience (Bishop et al., 2004). Other researchers have identified five factors or facets of mindfulness including Observing, Describing, Acting with Awareness, Nonjudgment of experience, and Nonreactivity to the current experience (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). Evidence has shown that mindfulness, as an individual difference variable (trait) or when cultivated by training, has been identified as a protective factor against stress and is associated with positive well-being (Marks, Sobanski, & Hine, 2010; Weinstein, Brown, & Ryan,

2009). Both psychological and neurobiological theories have been examined to explain the underlying mechanisms of mindfulness capacity to reduce stress (Creswell, 2017). Being mindful can decrease perceived stress level which can decrease an adolescent's psychological distress and improve health outcomes. Thus, according to this theory, the reduction of perceived stress in adolescents with T1D could improve diabetes outcomes including DSM and glycemic regulation.

The application of mindfulness-based interventions has increasingly become popular among adolescents in both clinical and non-clinical settings, and the evidence supporting their effectiveness and efficacy is growing (Burke, 2009; Creswell, 2017; Zenner, Herrnleben-Kurz, & Walach, 2014; Zoogman, Goldberg, Hoyt, & Miller, 2015). The improvement in psychological and physiological outcomes in clinical trials with adults with T1D and T2D (Hartmann et al., 2012; Schroevers et al., 2015; Tovote et al., 2014; van Son et al., 2013); adolescents with depression (Ames, Richardson, Payne, Smith, & Leigh, 2014; Shirk, DePrince, Crisostomo, & Labus, 2014), anxiety (Cotton et al., 2016), cancer (Malboeuf-Hurtubise et al., 2016), cardiac problems (Freedenberg, Thomas, & Friedmann, 2015), and pain (Chadi et al., 2016; Jastrowski Mano et al., 2013; Ruskin, Kohut, & Stinson, 2014); and healthy adolescents (Sibinga et al., 2013; Sibinga, Webb, Ghazarian, & Ellen, 2016; Zenner et al., 2014) provide supportive evidence that mindfulness-based interventions could benefit adolescents with T1D. Evidence from empirical studies among adults with T1D and T2D have shown that mindfulness-based interventions are effective in improving glycemic regulation (Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007; Rosenzweig et al., 2007), DSM (Gregg et al., 2007), depressive symptoms (Hartmann et al., 2012; Rosenzweig et al., 2007; Tovote et al., 2014; van Son et al., 2013), anxiety (Tovote et al., 2014; van Son et al., 2013), general psychological (Rosenzweig et al., 2007) and diabetes distress (Tovote et al., 2014), mental health (Hartmann et al., 2012), stress, and quality of life (van Son et

al., 2013). Furthermore, empirical research among adults with diabetes (T1D and T2D) has shown that trait mindfulness is associated with lower depression and anxiety symptoms and can be a potentially protective characteristic against the influence of stressful events on emotional well-being (Jenny van Son et al., 2015) and a significant predictor of DSM (J. Brown, 2014). Yet, the association between trait mindfulness and psychosocial variables, DSM, and glycemic regulation among adolescents with T1D has not been examined. Therefore, the purpose of the proposed study is to describe trait mindfulness and its practices and to examine the association of trait mindfulness with psychosocial and bio-behavioral variables among adolescents with T1D. The specific aims are as follows:

Aim 1: Describe trait mindfulness (overall distribution) and mindfulness practices (presence, types, duration, and use of apps);

Aim 2: Compare levels of trait mindfulness (high vs. low) and mindfulness practices (Yes vs. No) with adolescents' demographic (age, gender, and socioeconomic status, race) and clinical (duration of diabetes and use of insulin pump) characteristics among adolescents with T1D;

Aim 3: Examine the association between trait mindfulness and psychosocial variables of stress, diabetes distress, anxiety, and depressive symptoms and bio-behavioral variables of diabetes self-management and glycemic regulation (A1c) in adolescents with T1D, adjusting for age, gender, duration of disease, and socioeconomic status, and additionally adjusting for DSM for glycemic regulation;

H3a: High trait mindfulness is associated with low levels of stress, diabetes distress, depressive symptoms, and anxiety.

H3b: High levels of trait mindfulness is associated with better DSM and glycemic regulation.

Aim 4: Examine which mindfulness facets (Observe, Describe, Act with Awareness, Nonjudgement, and Nonreactivity) are associated with psychosocial and bio-behavioral variables in adolescents with T1D;

Exploratory Aim 5: Explore the association between trait mindfulness and implicit bias; and

Exploratory Aim 6: Explore the potential moderating and/or mediating role of shared responsibility on the relationship between trait mindfulness and bio-behavioral variables of DSM and glycemic regulation.

1.2 Definition of Terms

Mindfulness. As defined by John Kabat Zinn, mindfulness is "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (Jon Kabat-Zinn, 2009). Mindfulness is defined as an enhanced awareness to the present moment while adopting an attitude of non-judgmental acceptance to the experience (Bishop et al., 2004). In applied psychology, mindfulness is defined by a unidimensional concept that includes two components of mindfulness across different definitions of attention and awareness of one's present moment experience as well as adopting an attitude of acceptance toward one's experience whether the experience is negative, positive, or neutral (Creswell, 2017). In academic psychology, mindfulness has five attributes/facets of (1) Observing of the present-moment experience, (2) Describing the experiences into word, (3) Acting with Awareness, rather than responding automatically or absent-mindedly, (4) Nonjudgment of experience (i.e., taking nonjudging stance toward the experience),

and (5) Nonreactivity to inner experience (i.e., nonreactive response toward internal experience such as cognitions, emotions, and bodily sensations) (Baer et al., 2006). In our study we are interested in examining the comprehensive definition of mindfulness as well as the multiple facets nature of mindfulness as the evidence has shown that using the multi-faceted definition of trait mindfulness provides better understanding of the relationships between trait mindfulness and other variables of interest (Baer et al., 2006).

Trait Mindfulness. Trait mindfulness is an dispositional, inherent state of consciousness that varies naturally across individuals from high states of mindfulness to low levels of automatic and mindless thoughts or actions (K. W. Brown & R. M. Ryan, 2003; Shelov, Suchday, & Friedberg, 2009) and can be enhanced by training (S. L. Shapiro, Carlson, Astin, & Freedman, 2006). There is a difference in mindfulness between and within persons attributed to differences in inherent capability, discipline, or inclination (K. W. Brown & R. M. Ryan, 2003).

Mindfulness Practices: Mindfulness-based interventions are programs that aims to reduce stress and improve coping skills through a core curriculum of formal and informal mindfulness practices, group discussion, and theoretical presentations on topics such as stress theory, mindful communications, and awareness training. **Formal mindfulness practices** include body scan, mindfulness meditation, mindful breathing, and mindful yoga; and **informal mindfulness practices** means being mindful during daily activities such as mindful walking, mindful eating, and mindful showering.

Stress. Stress is the psychological and biological response when being exposed to environmental demands that exceed the individual's adaptive abilities or skills which increases

one's risk for disease (Cohen, Kessler, & Gordon, 1997). Stress is defined as a relationship between the individual and the environment that is appraised by the individual as taxing or exceeding his/her coping resources and threatening his/her wellbeing (Lazarus & Folkman, 1986).

Diabetes-specific Stress. The perceived stress specific to diabetes such as having diabetes, dealing with emotions concerning various aspects of diabetes, and managing diabetes and dysglycemia, in which adolescent with T1D perceives these situations to be stressful or hassles (Chao et al., 2016; A. M. Delamater, Patino-Fernandez, Smith, & Bubb, 2013).

Anxiety is a state, a trait, a stimulus, a response, a future-oriented emotion, and an emotional state (Endler & Kocovski, 2001). Spielberger has distinguished between two types of anxiety symptoms: state and trait anxiety (1966); state anxiety is the transient experience of the physiological arousal associated with feelings of apprehension and tension, and trait anxiety is the individual's relatively stable tendency of responding anxiously to a stimulus (Spielberger, 1966).

Depressive symptoms including feeling sad, depressed mood, loss of interest, and decreased energy, and difficulty concentrating, that are elevated but do not meet severity criteria for major depressive disorder (Gonzalez, Fisher, & Polonsky, 2011).

Diabetes Distress is the negative emotional reaction that arise from living with and managing diabetes such as feeling frustrated, hopeless, angry, sad, and fearful (Esbitt, Tanenbaum, & Gonzalez, 2013). Diabetes distress is a common psychological symptom of diabetes, and it is predictable in a variety of medical, contextual, and individual factors. Patients with diabetes

experience unique, usually hidden, emotional burdens and worries when managing the disease (Fisher, Hessler, Polonsky, & Mullan, 2012; Gonzalez et al., 2011).

Diabetes Self-Management (DSM). Diabetes is a chronic disease that is mainly self-managed by adolescents, their parents, and health care providers. Nevertheless, in the literature, there is neither uniform terminology nor uniform definition for the concept DSM (L. S. Schilling, M. Grey, & K. A. Knafl, 2002). Various concepts have been used in the literature to describe DSM such as self-care, compliance with self-care, diabetes self-care responsibility, self-care management, self-diabetes management, diabetes management, disease management, illness management, self-care autonomy, and self-care independence (L. S. Schilling et al., 2002). Compliance and adherence were seldom used interchangeably with self-care and self-management (L. S. Schilling et al., 2002). For this project, the term diabetes self-management will be used based on Schilling and colleagues' concept analysis paper where they grounded their definition on 99 articles from nursing, medicine, and psychology disciplines on the self-management of diabetes in children and adolescents. Diabetes self-management is "an active, daily, and flexible process in which youth and their parents share responsibility and decision-making for achieving disease control, health, and well-being through a wide range of illness-related activities" (L. S. Schilling et al., 2002).

Shared responsibility. Parental involvement is a vital component of optimal diabetes management during childhood and adolescence (American Diabetes Association, 2021). Parental responsibility refers to the extent to which parents assist adolescents with diabetes management behaviors and it transfers gradually from parents to adolescents (B. Anderson, Ho, Brackett, Finkelstein, & Laffel, 1997). Shared responsibility where both parents and adolescents are involved in diabetes management is optimal for reducing psychological distress and improving adherence and glycemic regulation (Helgeson, Reynolds, Siminerio, Escobar, & Becker, 2008).

Glycemic Control/Regulation. A long-term measure of metabolic control (DCCT, 1994) assessed by glycosylated hemoglobin (A1c) level (DCCT, 1994). According to the Diabetes Control and Complications Trial (DCCT), optimal glycemic regulation, achieved by adherence to diabetes management behavior, is associated with less micro- and macrovascular complications (DCCT, 1994). Nonetheless, adolescents experience greater difficulty with adherence to treatment, higher levels of perceived stress, and poorer A1c values than other age groups (DCCT, 1994).

Implicit Bias. Attitudes or stereotypes that are rooted in individuals' mind unconsciously and they can influence individuals' perceptions, actions, and decisions (Cheryl Staats, Capatosto, Wright, & Contractor, 2015).

1.3 Background, Significance, and Innovation

1.3.1 Background

1.3.1.1 Mindfulness

Mindfulness is defined as an enhanced awareness to the present moment while adopting an attitude of non-judgmental acceptance to the experience (Bishop et al., 2004). Different research teams have assigned different cores/facets to identify mindfulness. In applied psychology, two main core concepts have been identified across different definitions which are attention and awareness of one's present moment experience and adopting an attitude of acceptance toward one's experience whether the experience is negative, positive, or neutral (Creswell, 2017). In academic psychology, five facets have been used to provide a comprehensive definition of the

multi-faceted nature of mindfulness and to provide better understanding of the relationships between trait mindfulness and other variables (Baer et al., 2006). Baer and colleagues have defined five facets of mindfulness, according to an exploratory factor analysis of 4 combined scales assessing mindfulness, these include: Observing, Describing, Acting with Awareness, Nonjudgment of experience, and Nonreactivity to inner experience. The proposed study will look into trait mindfulness as a comprehensive definition with two main core concepts of enhanced attention to and nonjudgmental acceptance of life experience and to the five facets of mindfulness.

1.3.1.2 **Mindfulness and Adolescents**

Research has shown that individual differences in trait mindfulness is a moderating factor of the relationship between life hassles and psychosocial variables. A study among 317 Australian healthy adolescents (14-18 years old) showed significant correlations of trait mindfulness (measured by Mindful Attention Awareness Scale [MAAS]) with stress, anxiety, and depression (ps <.05) (Marks et al., 2010). In addition, this study found that life hassles significantly predicted stress, anxiety and depression; and that trait mindfulness weakened the relation of life hassles with stress (R^2=56%), anxiety (R^2=38%) , and depression (R^2=49%), after adjusting for sex and age as they correlate significantly with trait mindfulness (Marks et al., 2010). Moreover, a study among small sample of 78 adolescents (aged 14-18 years) showed that adolescents with lower levels of mindfulness (measured by Five Facet Mindfulness Questionnaire; FFMQ) were particularly vulnerable to the negative effects of stress (Ciesla, Reilly, Dickson, Emanuel, & Updegraff, 2012). Furthermore, another study that used a longitudinal design with two assessments showed that mindfulness buffers the predictive relationship between life hassles and some psychological symptoms among 1257 adolescents (aged 14-18 years) and that a higher level of mindfulness is associated with lower depressive symptoms at baseline (Calvete, Orue, & Sampedro, 2017).

Although the evidence shows that mindfulness buffers the relationship between stress and psychological symptoms among healthy adolescents (Calvete et al., 2017; Ciesla et al., 2012; Marks et al., 2010), trait mindfulness has not been examined among adolescents with chronic disorders in general and adolescents with T1D in particular.

1.3.1.3 Mindfulness and Psychosocial Variables (i.e., stress, diabetes-specific stress, diabetes distress, anxiety, and depression)

While there are no studies examining trait mindfulness among adolescents with diabetes, the role of trait mindfulness has been examined among adolescents with other chronic disorders. Trait mindfulness has been identified as protective factor against stress among adolescents with cancer, asthma, and pain (Cillessen, van de Ven, & Karremans, 2017; Patterson & McDonald, 2015; Petter, Chambers, McGrath, & Dick, 2013). A cross-sectional correlational study among 76 adolescents and young adults (M=18.5, SD=3.4 years) who have completed cancer therapy has shown that participants with higher level of trait mindfulness had significantly lower levels of psychological distress (p <.001, Cohen's d=1.58) and less uncertainty (p=.018, Cohen's d=0.55) in comparison with those with lower levels of mindfulness (Patterson & McDonald, 2015). Another recent cross-sectional study among 94 adolescents with asthma has shown that there is a direct relation between trait mindfulness and asthma-related quality of life (R^2=.194, p<.001), but not to asthma control (R^2=.035, p=.114) (Cillessen et al., 2017). In addition, while the use of cross-sectional design prevents causality, this study found that there is a relationship between trait mindfulness and asthma-related quality of life mediated by asthma-specific stress (p=.05), but not by general stress (p=.96). Furthermore, asthma-specific stress mediates the relation between mindfulness and asthma control (p=.047) (Cillessen et al., 2017). Moreover, among 198 adolescents with pain, mindfulness was a significant and unique predictor of day-to-day pain

interference (ΔR^2= .053, p<.001); it explained 5% of the unique variance for day-to-day pain interference. In addition, this relationship was partially mediated by pain catastrophizing in both real-world and induced pain (Petter et al., 2013). Furthermore, baseline data of 132 healthy, but stressed adolescents (M=16.76 years, SD=1.48) who participated in a five-day, intensive meditation retreats showed significant correlations between mindfulness and perceived stress (r=-0.465,-0.438; p<.001; CAMM, MAAS, respectively) and depressive symptoms (r=-0.374, -0.388; p<.001, CAMM, MAAS, respectively) (B. M. Galla, 2016).

Moreover, mindfulness has been associated with positive psychosocial variables among adults with diabetes. Results from the Diabetes MILES study in the Netherlands have shown that mindfulness is associated with positive outcomes among 666 adults with T1D and T2D (J. van Son et al., 2015). This This cross-sectional study has shown mindfulness facets (i.e., observe, describe, acting with awareness, nonjudgment, and nonreactivity), explained 26% of the unique variance for depression and anxiety (all p<.001); after adjusting for demographic, clinical, and adversity variables. In particular, acting with awareness, nonjudgment, and nonreactivity, were significant predictors of depressive symptoms and anxiety (Standardized regression coefficients; β=-0.20 to -0.33, all p<.001). In addition, mindfulness had a moderating effect on the relations between stressful life events and depression and anxiety (for the same three facets, p<.001). Mindfulness is associated with lower levels of depression and anxiety and can be a potentially protective characteristic against the influence of stressful events on depression and anxiety (J. van Son et al., 2015). Furthermore, findings from baseline data of 28 veteran adults with T2D who participated in a brief mindfulness training intervention that was provided as part of a half-day diabetes education class and was enforced with home practice, showed significant positive correlations between facets of mindfulness and psychosocial variables. In particular, there was a

positive correlation between Acting with Awareness and diabetes support needs ($r < .59$; $p < .01$) (DiNardo et al., 2017). Furthermore, mindfulness cultivated during mindfulness-based intervention mediated the improvement in stress, depression, and anxiety among adults who received mindfulness-based intervention (Haenen, Nyklíček, van Son, Pop, & Pouwer, 2016). While mindfulness-based interventions have been studied broadly in the literature and the findings are suggestive of their benefits among adults with diabetes (Medina et al., 2016; Noordali, Cumming, & Thompson, 2017), trait mindfulness has been rarely examined among younger patients with diabetes (J. Brown, 2014; Loucks et al., 2016), and never been examined among adolescents with T1D. Thus, understanding whether mindfulness is a protective factor against stress and diabetes-specific stress and adverse psychosocial variables could improve bio-behavioral variables among adolescents with T1D, paving the way to establish mindfulness-based interventions to help adolescents with T1D.

1.3.1.4 **Mindfulness and Bio-behavioral Variables (i.e., DSM and Glycemic Regulation)**

Empirical research on a trait mindfulness has shown positive associations with bio-behavioral variables among adults with T1D and T2D. A cross-sectional study examined the relations between trait mindfulness (measured by the FFMQ and Philadelphia Mindfulness Scale [PHLMS]), diabetes distress, social support, and DSM among 130 adults with T2D found trait mindfulness to be a significant predictor of DSM (Standardized regression coefficients; $\beta=0.213$, $p=.024$; $\beta=0.200$; $p=.033$, respectively for the FFMQ and PHLMS) (J. Brown, 2014). In the same study, awareness and acceptance (Subscales of PHLMS) were not significant predictors of DSM. In addition, the relationship between mindfulness and DSM was not mediated by the changes in diabetes distress (J. Brown, 2014). The New England Family Study (NEFS), which comprises a

series of adult follow-up studies of pregnant women enrolled in New England (Providence and Boston), examined both direct and mediated relations between mindfulness and glucose regulation and T2D among 399 participants (Loucks et al., 2016). This study showed that mindfulness was associated significantly with glucose regulation but not with the likelihood of having T2D. The authors found that participants with high versus low MAAS level were more likely to have normal plasma glucose levels (prevalence ratio= 1.42; 95% CI: 1.08, 1.87), after adjusting for potential confounders (age, sex, race, and family history of diabetes). For the mediated relationship, obesity and sense of control (i.e., a person's sense of efficacy in carrying out goals related to decreasing the risk of diabetes such as diet and physical exercise) explained part of the association between mindfulness and likelihood of having a normal fasting glucose (Loucks et al., 2016). In addition, mindfulness cultivated through mindfulness-based interventions has been examined as a mediator of improvement in diabetes outcomes among adults with T2D (Gregg et al., 2007). A randomized controlled trial (RCT) among 81 adults with T2D had shown significant improvement in glycemic regulation in individuals received mindfulness-based intervention in addition to diabetes education compared with those who received diabetes education only (Gregg et al., 2007). This RCT showed that the improvement in glycemic regulation was mediated by significant improvement in acceptance (measured by the FFMQ), coping, and DSM (Gregg et al., 2007). To date, no one has examined the role of trait mindfulness in diabetes management and glycemic regulation among adolescents with T1D, signifying an important gap in the existing mindfulness literature. This study will focus on trait mindfulness among adolescents with T1D and examine its relationship with DSM and glycemic regulation. We hypothesize that adolescents with higher levels of trait mindfulness would be positively related to DSM behavior and glycemic regulation.

1.3.1.5 **Mindfulness and Parental Involvement (Shared Responsibility)**

Parental involvement where both adolescent and parents are involved in the responsibility of diabetes management behaviors (i.e., shared responsibility of diabetes management) has been found to be optimal to reduce psychological distress and improve DSM and glycemic regulation in adolescents with T1D (Helgeson et al., 2008). Moreover, our team has found that shared responsibility moderates some of the relations between psychological distress proxies (i.e., anxiety, depression, and anger) and DSM among adolescents with T1D (H. Abujaradeh, Helgeson, Cohen, & Sereika, 2018a). However, no one has examined whether shared responsibility moderates or mediates any of the relationship between mindfulness and bio-behavioral variables. Thus, this study aims to explore the moderating and mediating role of shared responsibility on the relationship between mindfulness and bio-behavioral variables.

1.3.1.6 **Mindfulness and Implicit Bias**

Considering that mindfulness has positive association with many health-related outcomes, we will examine the association between trait mindfulness and a psychosocial aspect--implicit bias among adolescents with chronic disorders. Implicit biases are attitudes or stereotypes that are rooted in individuals' mind unconsciously and can influence individuals' perceptions, actions, and decisions (Cheryl Staats et al., 2015). Evidence showed that human brains are wired from birth to have preference toward people of same group and to exhibit hostility toward those who are different (Hamlin, Mahajan, Liberman, & Wynn, 2013). A study showed that infants prefer things/members who share similarities and prefer those who harm dissimilar others. Furthermore, evidence showed that most people in the U.S., regardless of race, showed a pro-white/anti-black bias on the Implicit Bias Association Test (Nosek et al., 2007; C Staats, 2014). Adolescents' with chronic disorders are same in that they can have implicit biases toward minorities and different

gender. Evidence suggests that mindfulness meditation, through its capacity to change automated prejudice, is a promising approach to reduce implicit bias against minorities (i.e., black people and elderly) (Lueke & Gibson, 2015) across different populations (Burgess, Beach, & Saha, 2017). According to Wright, individuals have subtle tribalism and emotionally-based cognitive biases that warp individuals' perception of the world and make them react upon their thoughts and feelings unconsciously (Wright, 2018). Mindfulness, by focusing on the present moment such as being aware of one's feeling and not following the default mode of automaticity, can help individuals to change their consciousnesses and reflect on their emotions before acting. To date, no one has explored implicit biases held by adolescents with chronic disorders and no one has explored whether mindfulness is associated with implicit bias among this chronic disorder population. Understanding whether mindfulness is associated with implicit bias could have the potential to influence planning for the care of adolescents with T1D; for example, if adolescents with T1D with high levels of mindfulness have less implicit bias, they may be more accepting of HCPs of different gender or race. Furthermore, understanding this relationship will add to theoretical foundation regarding trait mindfulness and implicit bias.

1.3.1.7 **Psychosocial Variables and Bio-behavioral Variables in Adolescents with T1D.**

Evidence indicates that adolescents with T1D often experience perceived stress related to life, growth, and development (i.e., school and social life) as well as to having diabetes, dealing with emotions concerning various aspects of diabetes, and managing diabetes (Chao et al., 2016). Stress can have negative effects on adolescents' psychological health, behaviors including DSM behaviors (Helgeson et al., 2010), and glycemic regulation (McEwen, 1998; Seiffge-Krenke & Stemmler, 2003). The SEARCH for Diabetes in Youth study showed that 14 % of adolescents with

T1D have mild depression and 8.6 % have moderate to severe depression (Lawrence et al., 2006). In addition, adolescents with T1D have high rates of anxiety, with 13% to 21.3% having screened positive for anxiety (Bernstein, Stockwell, Gallagher, Rosenthal, & Soren, 2013). Furthermore, adolescents with T1D are at high risk for diabetes distress which is the negative emotion that arises from living with and managing diabetes such as feeling frustrated, hopeless, angry, sad, and fearful (Hagger et al., 2016; Reynolds & Helgeson, 2011). To improve the psychological and physical health of adolescents with T1D, it is important to study the factors that could have a protective effect against stress and negative psychosocial variables and improve DSM behaviors and glycemic regulation. Compelling evidence has recently shown that mindfulness, either as a trait characteristic or cultivated through training, is a protective factor against stress and is associated with positive well-being (B. M. Galla, 2016; Marks et al., 2010). Trait mindfulness is associated with lower depression and anxiety symptoms and can be a potentially protective characteristic against the influence of stressful events on emotional well-being (J. van Son et al., 2015) and a significant predictor of DSM (J. Brown, 2014) among adults with diabetes (T1D and T2D). Trait mindfulness is associated with better well-being among adolescents with chronic disorders (Cillessen et al., 2017; Patterson & McDonald, 2015; Petter et al., 2013). However, no research has been examined the relationships of trait mindfulness with psychosocial and bio-behavioral variables among adolescents with T1D. The purpose of this study is to address this gap.

1.3.1.8 **The Relation between DSM and Glycemic Regulation**

Schilling and colleagues have assigned three essential attributes to diabetes self-management: (1) process that is lifelong, daily, active and proactive, flexible involving planning, decision making, and activities to prevent short- and long-term complications and it is collaborative between adolescents, their

parents, and health care members; (2) activities such as multiple daily insulin injection or treatment with insulin pump, blood glucose monitoring, regulating diet, exercise, documentation, responding to hypo- and hyperglycemia, and adjusting insulin dose considering physical activity, infection, and stress; and (3) goals such as maintaining blood glucose levels close to normal, being adhered to the prescribed and mutually agreed regime, and maintaining life, health, and well-being. Diabetes self-management is complex requiring on daily basis: 1) administration of multiple insulin doses by injection or pump, 2) frequent or continuous blood glucose (BG) monitoring (≥ 4), 3) attention to nutritional requirements (i.e., carbohydrate counting and meal planning), 4) making clinical decision regarding the balancing of insulin, food intake, and exercise, 5) documentation, 6) developing strategies to prevent and treat hyperglycemia or hypoglycemia, and 7) regular medical appointments (Silverstein et al., 2005). Maintaining optimal glycemic regulation by adherence to DSM behaviors (i.e., glucose monitoring, calories counting, and insulin administration) is the key to reducing micro- and macrovascular complications among individuals with T1D (DCCT, 1994). However, glycemic regulation is most difficult to manage during adolescent years with only 17-23% of adolescents with T1D achieving the American Diabetes Association target (Miller et al., 2015; Wood et al., 2013). Adolescents are at risk for poor glycemic regulation due to their developmental stage where they go through rapid biological and hormonal changes, experience life stress related to their growth and development as well as stress related to their diabetes and diabetes management, and at the same time they need develop independence from their parents (Jaser, 2010). In addition, adolescents with T1D are at risk for unfavorable psychosocial outcomes including stress, depression, anxiety, and diabetes distress which increase their risk for poor DSM and glycemic regulation (Helgeson et al., 2010; Helgeson, Siminerio, Escobar, & Becker, 2009).

1.3.1.9 **The Potential of Mindfulness to Improve Psychosocial and Bio-behavioral Variables.**

The application of mindfulness has grown rapidly among adolescents in clinical and not-clinical settings (H. Abujaradeh, Safadi, Sereika, Kahle, & Cohen, 2018; Zoogman, Goldberg, Hoyt, & Miller, 2014). Mindfulness-based interventions aim to cultivate mindfulness to improve psychological health and physical well-being (Creswell, 2017). Recently, trait mindfulness has been associated with positive psychosocial variables among adolescents with chronic disorders (Cillessen et al., 2017; Patterson & McDonald, 2015; Petter et al., 2013). Moreover, and of great significance to the proposed study, among adult patients with diabetes (T1D and T2D), trait mindfulness has been associated with positive psychological and physiological outcomes (J. Brown, 2014; Loucks et al., 2016; Medina et al., 2016; J. van Son et al., 2015). However, examination of these relationships have received less attention in adolescents with T1D. Although the mechanisms underlying the benefits of mindfulness vary across literature (Creswell, 2017), mindfulness has been found as a buffering factor against stress (Creswell & Lindsay, 2014; Marks et al., 2010; J. van Son et al., 2015). It is precisely the stress-reducing capacities of mindfulness that can be particularly relevant for adolescents with T1D.

1.3.1.10 **Conceptual Framework**

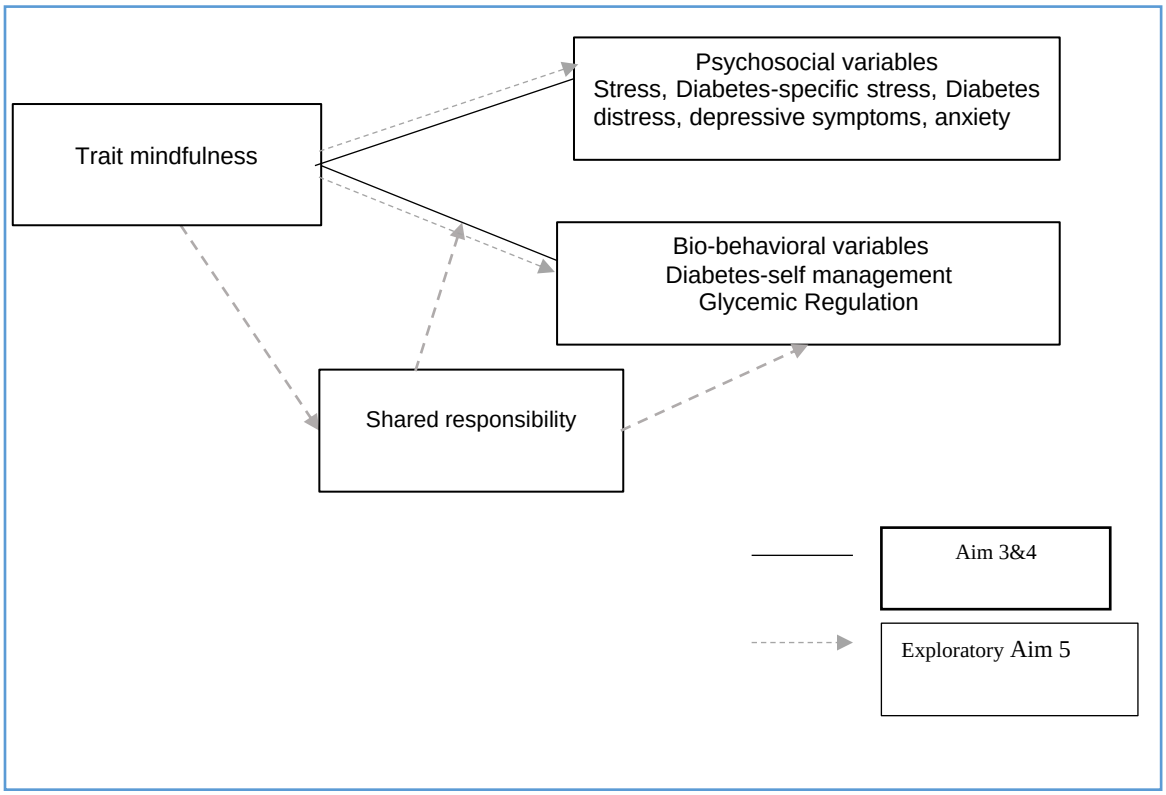

Figure 1 Conceptual model depicting the association of trait mindfulness with psychosocial and bio-behavioral variables and the moderating/mediating effect of shared responsibility in adolescents with T1D

This work has been guided by the bio-psychosocial stress theory (Lazarus & Folkman, 1987). Perceived stress occurs when individual is exposed to environmental demands exceeding his/her adaptive abilities or skills which can lead to psychological, behavioral, and biological cascades that increases one's risk for negative health outcomes (Cohen et al., 1997; Lazarus & Folkman, 1986). The bio-psychosocial stress theory posits that a protective factor such as trait mindfulness is associated with positive biological variables (i.e.,A1c) through psychological (i.e., reducing stress, diabetes-specific stress, diabetes distress, depressive symptoms, and anxiety) and behavioral (i.e., DSM) pathways. In addition, the application of bio-psychosocial stress theory in our study can be explained by mindfulness-stress-buffering theory that was proposed by Creswell and Lindsay (2014) (Creswell & Lindsay, 2014) and has been supported by evidence from many

studies addressing mindfulness and stress (K. W. Brown, Weinstein, & Creswell, 2012). This theory was originally described in the social support literature to explain how social support improve health outcomes. According to this theory, mindfulness as a protective factor mitigates stress appraisals and reduces stress-reactivity responses. The stress reduction effects explain how mindfulness may improve health outcomes. The neurobiological explanation suggests that mindfulness increases the recruitment of prefrontal regulatory regions that may inhibit activity in stress processing regions (a "top-down" regulatory pathway). Mindfulness may have direct effects on modulating the reactivity of stress processing regions (a "bottom-up" reduced stress reactivity pathway). Mindfulness can alter stress processing dynamic in brain which can reduce both Sympathetic Adrenal Medulla Axis (SAM) and Hypothalamus-Pituitary-Axis (HPA) activation. Thus, mindfulness can be beneficial to individual with stress-related diseases (i.e., adolescents with T1D). Mindfulness effects are best observed among high-stress populations such as those psychological distress and among patients with diseases that can be triggered or exacerbate by stress (i.e., diabetes) or stress can alter health behaviors (i.e., diabetes self-management behaviors). Among adolescents with T1D who are at high risk for stress, stress can lead to psychological distress, impaired DSM behaviors, and poor glycemic regulation. Mindfulness could be protective against stress in adolescents with T1D.

1.3.2 Significance

The number of adolescents diagnosed with T1D has increased in recent years. Specifically, the incidence of T1D increased by 1.4% every year between 2002 and 2012 (Elizabeth J Mayer-Davis et al., 2017) and the prevalence of T1D increased by an astounding 21% among youth under

20 years between 2001 and 2009 (Dabelea et al., 2014). Furthermore, a recent national study showed that T1D in adolescents is often poorly managed with only 17% of adolescents with T1D meet the guidelines of the American Diabetes Association for A1c (Miller et al., 2015). The rates of unfavorable psychosocial outcomes among adolescents with T1D are two to three times higher than rates for peers without T1D (Hood et al., 2006; Northam, Matthews, Anderson, Cameron, & Werther, 2005; Silverstein et al., 2005) with 11.3% to 27.5% have depression (Silverstein et al., 2005) and 13% to 21.3% have screened positive for anxiety (Bernstein et al., 2013). This vulnerable population's high risk for unfavorable psychosocial outcomes can lead to poor bio-behavioral variables including poor DSM and glycemic regulation (Helgeson et al., 2010; Helgeson et al., 2009). The proposed study will provide scientific exploration of trait mindfulness as a protective factor that can reduce stress and improve adolescents' psychological well-being and bio-behavioral variables among adolescents with T1D. This study is significant as it serves to increase the body of knowledge in the area of alternative therapies. It is the first to characterize mindfulness in this population. It could potentially provide preliminary data for the development of a mindfulness-based intervention as adjuvant therapy for adolescents with T1D and other chronic disorders. The long-term goal of the proposed study is to pave the way for improving efforts among healthcare professionals to adapt mindfulness-based interventions in their practice when caring for adolescents with T1D or by increasing their awareness to refer adolescents with T1D to appropriate mindfulness-based interventions courses to lower their stress and ultimately improve their DSM and glycemic regulation.

1.3.3 Innovation

Despite that mindfulness is broadly applied to adolescents in school and clinical setting (H. Abujaradeh, Safadi, et al., 2018; Zenner et al., 2014; Zoogman et al., 2014). To date, little work has examined mindfulness among adolescents with T1D. The proposed study is innovative as it will address a gap in adolescent health and provide evidence base for the relationship between mindfulness and positive health outcomes in this population.

(1) The T1D research community has little data related to the role of trait mindfulness in adolescents with T1D, although there is great potential for these data to inform future therapeutic interventions to improve outcomes in this population. In addition, this study may provide evidence surrounding the mindfulness-stress-buffering theory among adolescents with chronic diseases who have higher levels of stress (Creswell & Lindsay, 2014). In particular, this study will provide evidence whether trait mindfulness is associated with positive health outcomes among highly stressed population (adolescents with T1D with high levels of stress and psychological distress).

(2) This study examines a comprehensive variety of health-related outcomes including psychosocial and bio-behavioral variables using both subjective (e.g., perceived stress scale) and objective biological (e.g. A1c) measures. Adding a biological measure will significantly enrich the body of knowledge, which currently includes primarily self-reported variables among adolescents in general and those with chronic disorders in particular.

(3) This study explores the mediating/moderating role of shared responsibility of DSM in context of mindfulness, which can inform mindfulness research and the need to target parents.

(4) This study is the first to explore trait mindfulness in adolescents with chronic disorders implicit bias. Studies have extensively examined HCPs implicit bias against patients who are black, from low socioeconomic class, and non-adhering to disease management which can lead to health disparities. However, the implicit bias of adolescents with chronic disorders has been rarely examined. In addition, examining whether trait mindfulness is associated with less implicit bias among adolescents with T1D has the potential to provide support for using the adjunct therapy, mindfulness-based intervention.

1.4 Preliminary Studies

1.4.1 State of the Science

The first step in establishing the state of science for the potential benefits of mindfulness among adolescents with T1D included a systematic review to examine the benefits and effectiveness of mindfulness among adolescents with chronic disorders (H. Abujaradeh, Safadi, et al., 2018). At the time of the initial search for the systematic review, there were no studies that examined trait mindfulness among adolescents with chronic disorders, and none that were diabetes specific. Thus, the decision was made to broaden our inclusion to all mindfulness-based interventions studies delivered to adolescents with chronic disorders. Our systematic review of three data-bases (PubMed, CINAHL, and PsycINFO) revealed that there were 19 studies that examined the effectiveness of mindfulness-based interventions delivered in clinical setting to adolescents with chronic disorders. Fifteen studies included adolescents with psychiatric or pain disorders, and four included adolescents with a chronic physical disorders including cardiac

problems, cancer, and headache. Psychological outcomes and pain were examined in most studies with effect sizes for MBIs ranging from small to large. Only one study examined cortisol as a physiological measure of stress. Our review concluded that mindfulness-based intervention studies conducted in clinical settings mainly engaged adolescents with psychiatric or pain disorders. The effectiveness of mindfulness-based interventions on improving psychological outcomes were inconsistent and only four studies were conducted among adolescents with chronic physical diseases. After we conducted the systematic review, two studies examining trait mindfulness among adolescents with chronic disorders including cancer and asthma were published (Cillessen et al., 2017; Patterson & McDonald, 2015).

While this systematic review offers further key validation to the scientific premise of the proposed study, it identified a gap in the literature: 1) studies examining trait mindfulness in adolescents with chronic physical disorders, and 2) studies examining trait mindfulness and mindfulness-based interventions among adolescents with T1D. The proposed dissertation could begin to provide preliminary data for establishing theory-based and age-appropriate intervention studies to be delivered to large sample of adolescents with T1D.

1.4.2 Psychometric Properties of the FFMQ-short Format among Adolescents

A secondary data analysis was conducted to validate the psychometric properties of a short form of the Five Facets Mindfulness Questionnaire (FFMQ) among North American Adolescents (H. Abujaradeh, Colaianne, Roeser, & Galla, 2019). A total of 599 high school students (Mean age=16.27, SD=1.15; 49% female) completed a 20-item version of the FFMQ, in addition to other measures of social-emotional functioning, at three assessment waves, spaced roughly 3 months apart, over the course of one academic year. We conducted a confirmatory factor analyses (CFA)

to test the theorized factor structure and measurement invariance (across gender, grade level, and assessment wave). Convergent validity was assessed by examining bivariate correlations between the FFMQ and theoretically-related constructs, including self-compassion and perceived stress. FFMQ facets showed adequate reliability across the three waves (Cronbach's alphas =.61 to .88, .61 to .86, .67 to .88; respectively). CFA showed that a four-factor, hierarchical model (excluding the observe factor, and item 32 of the describe facet scale) (CFI=.956, TLI=.946, RMSEA=.042) fit the data better than a similar five-factor, hierarchical model (CFI=.925, TLI=.913, RMSEA=0.046). The four-factor, hierarchical FFMQ also demonstrated evidence of strong measurement invariance across gender, grade level, and assessment wave. Finally, the FFMQ total scale score (excluding the observe facet and item 32) was correlated at each assessment wave with different social-emotional outcomes including self-compassion (*r*s=.64 to .68) and perceived stress scale (*r*s=-.64 to -.54, *p*s<.001). Our results suggest that a 20-item short-form FFMQ demonstrated evidence of adequate reliability and concurrent validity with theoretically-related constructs among American adolescents. Likewise, the instrument demonstrated evidence of a hypothesized four-factor, hierarchical structure shown in adult samples and measurement invariance across gender, grade level, and time (Tran, Glück, & Nader, 2013). The current study provides initial support for the use of this short-form FFMQ instrument with high school-age adolescents. The short-version FFMQ provides a practical and developmentally-appropriate tool that will be used to measure mindfulness and its facets among adolescents with T1D. Since the short version- FFMQ has only been validated among adolescents in one study, the decision was made to use a well-established tool measuring mindfulness in addition the Short-form of FFMQ.

1.4.3 Shared Responsibility Moderates Relations between Psychological Distress and Self-Care among Adolescents with T1D

A secondary data analysis was conducted to examine whether shared responsibility (SR) moderates relations of distress on self-care (H. Abujaradeh, Helgeson, Cohen, & Sereika, 2018a). Both psychological distress and parental involvement in diabetes management are predictors of self-care behaviors among adolescents with T1D. However, little research has examined parental involvement as a moderator of the association between distress on self-care behaviors. A secondary analysis was conducted using longitudinal data from 132 adolescents with T1D (53% female; aged 10.7-14.2 years; 1-13 years duration of T1D) and their parents. Adolescents were interviewed and parents completed a questionnaire annually for 5 years. Adolescents and parents reported on the extent to which they shared diabetes care responsibilities. Adolescents reported on psychological distress (depression, anxiety, anger) and self-care. Linear mixed modeling was used to assess whether SR moderated relations of concurrent and lagged psychological distress on self-care. Results for concurrent analyses showed that parent-reported SR moderated relations between both depressive symptoms and anxiety on self-care ($p<.001$) and anger on self-care ($p=.001$). Lagged analyses showed that parent-reported SR moderated relations between depression on self-care ($p=.001$) and anxiety on self-care ($p=.003$). Moderation varied over the 5 years. During early to middle adolescence (years 1-4), SR did not moderate relations between distress and self-care; however, during middle to late adolescence (year 5), lower distress was associated with better self-care for higher SR but not associated with self-care for lower levels of SR. We conclude that as adolescents get older, lower distress was associated with better self-care for those with higher levels of SR but not for those with low SR. Continuation of SR during adolescence may mitigate the effects of distress on self-care. Healthcare providers should promote parental involvement in

diabetes management throughout adolescence for better diabetes outcomes.

1.4.4 Does Gender Moderate the relations between Shared Responsibility and Health Outcomes among Adolescents with T1D?

Shared responsibility (SR) where both parents and adolescents are involved in diabetes management is optimal for reducing psychological distress and improving diabetes outcomes. Few studies examined whether gender moderates the relations between SR and health outcomes. We conducted secondary data analysis to examine whether gender moderates the relations of SR to psychological distress and diabetes outcomes during the transition into adolescence (H. Abujaradeh, Sereika, Cohen, & Helgeson, 2018). A secondary analysis of longitudinal study of 132 adolescents with T1D and their parents was conducted. Adolescents were 10 to 14 years, 72 girls and 60 boys. All measures were taken annually for 5 years. Both reported on SR. Adolescents reported on distress (depressive symptoms, anxiety, and anger) and self-care. A1c was obtained at the clinic visit. Linear mixed models were used to assess if gender moderates the relations between SR and health outcomes. Concurrent analyses showed that gender moderated the relation between parent-reported SR and A1c ($p=.007$) and child-reported SR and anger ($p=.048$). At early adolescence, parent-reported SR was associated with lower A1c for girls but higher A1c for boys. For middle-stage adolescence, SR was associated with higher A1c for girls but lower A1c for boys. For older adolescents, SR was associated with lower A1c for boys but unrelated to A1c for girls. Among young and older adolescents, child-reported SR was associated with less anger for boys but unrelated to anger for girls. At middle-stage adolescence, SR was associated with less anger for girls but more anger for boys. We concluded that gender moderated the relations between SR and some aspects of health outcomes during transition adolescence in different patterns. SR was

associated with better glycemic regulation among young girls and older boys and was associated with less anger among boys in general. Healthcare providers need to consider adolescent's gender when recommending parental involvement in diabetes management for better health outcomes.

1.5 Research design and methods

1.5.1 Study design

The proposed study is an observational, cross-sectional study that will be conducted among adolescents with T1D to describe examine the relationships of trait mindfulness with psychosocial (stress, diabetes-specific stress, depression, anxiety, diabetes distress) and bio-behavioral variables (A1c and diabetes-self management).

1.5.2 Sample

The proposed study will take place at the Department of Pediatric Endocrinology and Diabetes at Children's Hospital of Pittsburgh of UPMC (CHP). CHP is the main center for childhood diabetes in Greater Pittsburgh Area. Currently, there are approximately 300 adolescents that would be eligible to participate in the study. Approximately 60-80 patients/week are seen in the Lawrenceville campus and 30 patients/month in Monroeville site with 25-33% of them being adolescents. A convenience sample will be recruited from both these sites over a four-month period. Inclusion criteria: adolescents with T1D between the ages of 12 to 18 years who have been

diagnosed with T1D at least 1 year prior to enrollment and are fluent in English. Exclusion criteria: comorbid conditions that can affect cognitive abilities such cognitive impairment and autism.

Sample Size Justification:

The sample size should depend on the highest sample size required for any specific aim. However, given the exploratory nature of the study, we will use sample size based on the feasibility of recruitment and not to test hypotheses. We aim to recruit 120 participants. With a sample of 120, we will have 92% power to detect a correlation as small as 0.3 using a two-sided hypothesis test with a significance level of 0.05. (G-power (Faul, Erdfelder, Buchner, & Lang, 2009). Regarding examining the associations between trait mindfulness measured by CAMM and any psychosocial or bio-behavioral variables while controlling for covariate (age, gender, duration of disease, socioeconomic status), with a sample of 120, we will have 98% power to detect medium effect size 0.15 using a two-sided hypothesis test with a significance level of 0.05. Regarding examining which facets of mindfulness (4 IVs) is associated with psychosocial or bio-behavioral variables while controlling for covariate (5), with a sample of 120, we will have 93% power to detect correlation as small as 0.15 using a two-sided hypothesis test with a significance level of 0.05.

The participation rates of adolescents with T1D who were eligible to participate in previous cross-sectional studies examining psychosocial and adherence aspects varied between (73-93%) (Ingerski, Laffel, Drotar, Repaske, & Hood, 2010; A. B. Lewin et al., 2009). Considering the lowest participation rate (73%) in previous studies (Ingerski et al., 2010), we expect to recruit (10) participants/week (15 eligible participants are seen per week at Lawrenceville site × 0.73). In addition, recruiting will take place in Monroeville site two times/month (as the Monroeville clinic runs only two days per month) with an expected 5 participants (7 eligible participants are seen per month × 0.73). Thus, it is feasible to recruit the targeted sample size (120) over four-month period.

1.5.3 Measures (Instruments APPENDIX D)

1.5.3.1 Demographic Data

A questionnaire will be used to collect demographic data such as gender (2 categories), race (5 categories), insulin pump (2 categories), number of siblings (3 categories), parents' marital status (4 categories), age (measured in years), duration of diabetes (measured in years), grade (measured in school's level), and socioeconomic status (SES). SES will be measured by the Hollingshead Four Factor Index (Hollingshead, 1975) which asks about adolescent's parents education and occupation. The adolescent's parent's education code is rated on a 7-point scale that lists highest grade completed ranging between "Graduate/professional training=7" to "Not applicable or unknown=0". The adolescent participant's parent's occupational code is rated on a 9-point scale ranging between "Higher executive, proprietor of large businesses, major professional=9" to "Not applicable or unknown=0". The total scores will be calculated with scores 8-17 indicate "Lower Class," scores 18-28 indicate "Lower-Middle Class," scores 29-47 indicate "Middle Class," scores 40-59 indicate "Upper-Middle Class," and scores 60-66 indicate "Upper Class." The total scores will be used as continuous variable in all regressions and correlations analyses, but it will used as categorical variable to describe our sample.

Measurement level of the above data: 1) Nominal variables: gender (2 categories), race (5 categories), Insulin pump (2 categories), parents' marital status (4 categories). 2) Ordinal Variables: SES (4 levels), number of siblings (number of siblings). Ratio variables: age (measured in years), duration of diabetes (measured in years), grade (measured in school's level).

1.5.3.2 **Study Variables**

Mindfulness will be measured by two instruments, **Child and Adolescent Mindfulness Measure (CAMM)** (Greco, Baer, & Smith, 2011), which describes adolescent's tendency to be mindful in daily life (i.e., being attentive and having and adopting an attitude of non-judgmental acceptance of the moment), and the **Five Facets Mindfulness Questionnaire (FFMQ)- Short Format** (Hiba Abujaradeh, Colaianne, Roeser, Tsukayama, & Galla, 2020; Baer et al., 2006; Tran et al., 2013), which reflects the multiple facets nature of mindfulness (i.e., Describing, Act with Awareness, Nonjudgement, and Nonreactivity).

Child and Adolescent Mindfulness Measure (CAMM) (Greco et al., 2011). The CAMM is a 10-item self-report measure developed to assess mindfulness among children and adolescents, and it reflects on the lack of present-moment awareness and judgmental, nonaccepting responses to thoughts and feelings (Greco et al., 2011). All items are negatively worded and reversed coded with higher scores a greater level of mindfulness. It uses a 5-point Likert scale ranging from "Always true=0". "Often true=1", "Sometimes true=2", "Rarely true=3", "Never true=4". The total scores ranges between 0 and 40. This tool has been shown to be a valid measure of trait mindfulness in children and adolescents (age= 10-17 years) and it has moderate to good correlations (0.37-0.60) with scales measuring similar constructs (Greco et al., 2011) and adequate internal consistency across studies with Cronbach's alphas of ≥ .85 among adolescents (Greco et al., 2011; Petter et al., 2013). Examples for questions asked "I get upset with myself for having feelings that don't make sense" and "''I think that some of my feelings are bad and I shouldn't have them''.

Five Facets Mindfulness Questionnaire (FFMQ)- Short Format (Hiba Abujaradeh et al., 2020; Baer et al., 2006; Tran et al., 2013). The FFMQ is a 20-item self-report measure

developed to assess individual's ability to observe, describe, act with awareness, and take a nonjudging stance and non-reactive response toward internal experience such as cognitions, emotions, and bodily sensations (Baer et al., 2006). This scale has been validated among adolescents (14-18 years) and showed adequate psychometric properties(Hiba Abujaradeh et al., 2020). It showed moderate correlations with other social-emotional constructs including self-compassion (*r*s=0.64 to 0.68) and perceived stress scale (*r*s=-0.64 to -0.54) and adequate internal consistency of the five subscales across three time points (Cronbach's alphas =0.61 to 0.88, 0.61 to 0.86, 0.67 to 0.88; respectively).

Mindfulness Practices Experience: Mindfulness experience, including mindfulness meditation, mindful yoga, body scan, and mindful breathing, will be measured by a question asking if adolescents have ever practiced mindfulness practices before (Nominal), for those answering yes, a follow-up question will ask about the type of mindfulness practices (formal, non-formal, religious), period of practice (3 categories: < 3 months, 3 months-3 years, > years), and the use of mindfulness apps.

The resulting scores of the CAMM and FFMQ represent a highly ordinal and approximate an interval scale variable. An ordinal variable provides information about the order of data points, but the interval size between the data points is not equal and there is no true zero point. Mindfulness meditation experience questions represent a nominal and categorical levels.

1.5.3.3 **Primary Psychosocial Variables**

Stress will be measured by **Perceived Stress Scale (PSS)- Short version** (Cohen, Kamarck, & Mermelstein, 1994). The PSS is a four-item self-report measure to assess the degree to which participants appraise their life demands as overwhelming, unpredictable, and uncontrollable in the last month. The scale has good psychometric properties with internal

consistency of .72 and test-retest reliability of .55. Items of the PSS are answered on a 5-point Likert scale ranging from "Never=0" to "Very often=4". The total score ranges between 0 and 16 with higher scores indicating higher general perceived stress. The PSS asks questions like "In the last month, how often have you felt that you were unable to control the important things in your life?" (Cohen et al., 1994). The scores of PSS represent a highly ordinal and approximate an interval scaled variable.

Diabetes-specific Stress will be measured by the **Diabetes Stress Questionnaire for Youths (DSQY)-Short Format**. DSQY-SF is a 10-item self-report measure to capture perceived stress related to diabetes. The DSQY-SF has an adequate internal consistency (Cronbach's α=.79), and good validity (A.M. Delamater, Pulgaron, & Niel, 2017). The DSQY is a 4-point Likert scale that asks participants to rate how stressful the situations in the current time (Not at all=1, little=2, pretty much=3, very much=4). The total score ranges between 10 and 40 with higher scores representing higher levels of perceived diabetes-specific stress. The scores of DSQY represent a highly ordinal and approximate an interval scaled variable.

Diabetes Distress will be measured by **Problem Areas in Diabetes scale (PAID)—Teen Version** (J. B. Shapiro et al., 2017). The PAID is a 14-item self-report measure developed to assess DD among adolescents. The tool consists of three subscales; emotional burden, family and friends distress, and regimen specific distress. It uses a 6-point Likert scale ranging from "Not a problem=1-2", "Moderate problem=3-4", and "Serious Problem=5-6". The sum of all items ranges between 26-84 with higher scores indicating greater diabetes distress. This tool has been shown to be a valid measure of diabetes distress in children and adolescents with a good reliability (Cronbach's alpha= 0.93) (J. B. Shapiro et al., 2017). The reliability of the subscales are >=.85 in both exploratory and confirmatory factor analyses. The scale has good validity and it is correlated

with emotional and health outcomes. The scores of PAID represent a highly ordinal and approximate an interval scaled variable.

Depression will be measured by **Children Depression Inventory(CDI)-short format** (Kovacs, 1985). The CDI is a 10-items self-report measure developed to measure depressive symptoms in children and adolescents. It uses 3-point Likert scale ranging from "Not=1", "Sort of=2", to "Very=3" with total range between 10-30 with higher scores indicating higher level of depressive symptoms. Studies have shown good reliability of this tool in psychiatric and medical-outpatients populations (Kovacs, 1985). CDI-SF has been used among adolescents with T1D and it showed sufficient internal consistency (Helgeson et al., 2008). The scores of the CDI represents a highly ordinal and approximate an interval scaled variable.

Anxiety to be measured by **Revised Children's Manifest Anxiety Scale (RCMAS)**(Stark & Laurent, 2001). The RCMAS contains the 7 items found to be unique to measure anxiety after conducting factor analysis for the RCMAS with the CDI. The scale has demonstrated good convergent and discriminate validity. The resulting scores of the RCMAS questionnaire represent a highly ordinal and approximate an interval scaled variable.

1.5.3.4 **Primary Bio-behavioral Variables**

Diabetes Self-management will be measured by the **Self-Care Inventory (SCI)** (A. La Greca, Swales, Klemp, & Madigan, 1988). The SCI is a 14-item measure assessing how well the adolescents follow their physician's recommendations for managing diabetes, such as glucose testing, insulin administration, diet, exercise, and other diabetes-related behaviors. It uses a 5-point Likert scale ranging from "1= Never do it" to "5=Always do this as recommended". The total score ranges between 14 and 70 with higher scores indicating better self-care. The scale has good psychometric properties as it reflects the main domains of self-care behaviors according to the

ADA and it has been associated with metabolic control among adolescents across studies (A. M. La Greca, Follansbee, & Skyler, 1990; Adam B Lewin et al., 2009; Lynne S Schilling, Margaret Grey, & Kathleen A Knafl, 2002). The resulting scores of the SCI questionnaire represent a highly ordinal and approximate an interval scaled variable.

***Glycemic regulation*.** A1c is a standard index of long-term glycemic regulation and it represents an objective measure of average blood glucose over the last two to three months that is not affected by short-term fluctuations in blood glucose concentrations (American Diabetes Association, 2021). A1c of the same day of the survey completion will be obtained from the medical record during the clinic visit as it is performed regularly at each visit and will be entered into the database. A1c is obtained by measuring the percentage of glucose adhered to the red blood cell, and it is tested in a blood sample where fasting is not required. Blood will be collected from a finger stick and analyzed immediately using high-performance liquid chromatography (Tosoh Medics). According to the ADA guidelines, A1c level is less than 6% of total hemoglobin in healthy people and should be maintained below 7% among children and adolescents with T1D (58mmol/mol) (American Diabetes Association, 2021). The glycemic regulation measured by recent A1c level is a continuous variable "ratio level". Ratio variable provides information about the order of the data points, in which the distance between the data points is equal, and there is a true Zero value.

1.5.3.5 **Secondary Psychosocial Variable**

Implicit Bias will be measured by **the Implicit Association Test (IAT) Questionnaire** (Greenwald, McGhee, & Schwartz, 1998) which is a timed test that assesses unconscious associations between concepts and particular attributes. The IAT has been used extensively in the field of social psychology to assess unconscious or automatic prejudicial attitudes and has good

reliability.(Li & Rukavina, 2011) Participants will have two Implicit Association Test measures to assess attributes of good versus bad and smart versus stupid of “White” and “Black” and “Male” and “Female”.

1.5.3.6 **Secondary Bio-behavioral Variable**

Shared Responsibility of Diabetes Management Tasks Between Parents and Adolescents will be measured by **The Diabetes Family Responsibility Questionnaire (DFRQ)** (B. J. Anderson, Auslander, Jung, Miller, & Santiago, 1990). The DFRQ is a 17-item self-report measure developed to assess family members sharing responsibility for diabetes management tasks, and it is completed independently by the parent and adolescent. For each statement, respondent can choose one of three response options: “parents take responsibility most of the time” =1, “adolescent takes responsibility most of the time”=2, or “responsibility is shared about equally between parents and child”=3. Percentage of shared responsibility scoring method will be used where the percentage for shared responsibility, percentage for which adolescent is solely responsible, and percentage for which the parent is solely responsibly will be calculated with total scores range between 1-100 % for each category (Helgeson et al., 2008). This study is interested in shared responsibility, “responsibility is shared about equally between parents and child” from the adolescent’s perspective. Each question will have three responses (parents only, adolescent only, both) which represent nominal variable. Nominal variable has two or more categories, but there is no intrinsic ordering to the categories. Nonetheless, the percentage of shared responsibility represent a ratio variable, and will be used in this study.

Measurement levels (Table 1 presents a summary of the variables, tools and the measurement levels of the instruments to be used)

Table 1 Summary of the variables, instruments, and measurement level

Variable	Tool	Level of Measurement
Demographic and clinical data	Gender (2 categories)	Nominal
	race (5 categories)	Nominal
	insulin pump (2 categories)	Nominal
	Siblings (2 categories)	Nominal
	Number of Siblings	Ordinal
	Parents' marital status (4 categories).	Nominal
	SES (4 levels)	Highly ordinal
	age (measured in years)	Ratio
	duration of diabetes (measured in years)	Ratio
	grade (measured in school's level)	Ratio
	Use of insulin pump (2 categories)	Nominal
	Use of continuous glaucous monitoring (CGM; 2 categories)	Nominal
Mindfulness	CAMM /FFMQ-SV	Highly ordinal*
Stress	PSS- SV	Highly ordinal
Diabetes-specific stress	DSQY-SF	Highly ordinal
Diabetes distress	PAID—Teen Version	Highly ordinal
Anxiety	RCMAS)	Highly ordinal
Depression	CDI-SF	Highly ordinal
Diabetes self-management	SCI	Highly ordinal
Glycemic regulation	A1c	Ratio
Shared responsibility	DFRQ	Ratio
Implicit Bias	IAT	Binomial

*Highly ordinal and approximate an interval scale variable

1.5.4 Survey Development in Qualtrics and Testing

- A data production specialist will develop a survey via Qualtrics® survey software (Qualtrics LCC, 2018). The survey will be accessed through a Qualtrics application that is uploaded to an iPad or through secured Qualtrics web-based webpage. The survey will be completed by the adolescents at one session and it will include the above listed self-reported questionnaires.
    - For those who wish to participate but cannot complete the survey at the clinic, they will have an option of a study survey being sent to them and they can complete it at home.
    - A hard copy of the survey will be available in case of the occurrence of any technical problem.
- The survey will be pilot tested by the primary investigator (PI), research assistants (RA), study team and nursing students to assess the time burden and the order of the questions.
- The data manager will orient the PI/ RA on how to use the Qualtrics offline application.
- The PI will orient the RA on how to approach patients and how to collect data.

1.5.5 Protocol & Procedures for Enrollment and Data Collection

Recruitment:

- Two strategies will be used to recruit participants for this study:
    - Identifying eligible patients and reaching out for them after a physician introduces the study for them.
    - Flyers

- A physician at UPMC's Pediatric Endocrinology Clinic, who is part of the PI's dissertation committee, will give an access/list to the PI and RA to identify adolescents scheduled for diabetes follow-up visits.
- The PI//RA will screen the list and identify adolescents who are potentially eligible to participate in the study based on their age and duration of diabetes. The PI/RA will inform the physician of adolescents who are potentially eligible to participate in the study.
- The physician will query the potential participants to determine interest in the study and then refer the PI/RA to interested patients for recruitment.
- For participants who reach out to the PI/RA and show interest in participating in the study, they will be screened over the phone, and they can complete the survey during routine follow-up visit.
- The PI/RA will approach the identified eligible adolescents and parents who are interested in the study and explain the study in detail.
- The PI/ RA will obtain assent and informed consent from the adolescents and parents in the clinic who are interested in the study.
- Once the adolescent is included in the study, the adolescent will be given instructions for accessing secure study application and log in information to complete the study questionnaires.
- The participant will complete the questionnaires in the waiting room or separate room assigned by the physician.
- Value of the obtained A1c level that is performed regularly at each clinic visit by the nurse will be recorded.

- A1c will be obtained from medical record if needed
- The PI/RAs will review the questionnaires to identify any missing or incomplete data and re-approach the adolescent to provide the missing information.
- A gift card of $20 will be given to each adolescent once they complete the study measures. The PI/ RA will present 3 days/ week in the main campus and two days/ month in the Lawrenceville site (the clinic runs only one day in the third and fourth week of each month) for the period of 4 months.
- All participants will have the chance to enter a raffle to win an iPad at the end of the study

1.5.6 Statistical analysis plan

1.5.6.1 Preliminary analysis procedures

Data Screening Procedures

Data accuracy will be ensured for all variables prior to the main analysis through proofreading, assessment of range, contingency tables, and graphical representations.

Outliers: For continuous type variables; univariate outliers will be screened graphically through histograms, box plots, normal probability plots, and detrended Q-Q normal probability plots as well as statistically for cases with Z scores > |3.29|. Categorical variables will be assessed for outliers through frequency distribution tables by checking that there are no categories with less than 5- 10% of cases. Multivariate outliers will be examined graphically through bivariate scatterplots as well as statistically by assessing Mahalanobis distance. Outliers will be examined to determine if they are an extreme value of the target population before taking remedial measures such as deletion, data transformation, or score alteration.

Independence: Independence will be screened graphically by assessing bivariate plots of each variable against case numbers to success for temporal trends in variable values.

Missing data: Measures to avoid missing data such as ensuring adolescents that there is no wrong answer and reviewing the questionnaires immediately after assessment will be taken. Missing data will be assessed for both amount and pattern. Percentages of cases with missing data and percentages of univariate and multivariate missing data will be examined. Cases with missing data will be compared with cases of complete data for significant differences in gender, age, duration of diabetes, and SES. Any study variable with missing data greater than 30% will be considered missing and will not be included in the analysis. Little's MCAR test will be used to examine the patterns of missing data; if the *p* value of Little's MCAR test is not significant ($p > .05$), data will be assumed to be missing completely at random. Based on the patterns of missing data (missing completely at random, missing at random, missing not at random), different imputation methods will be tried such as stochastic regression, expectation-maximization (EM), and multiple imputation. Additionally, patterns of missing data will be assumed to be missing completely at random (MCAR) given the voluntary nature of participating in the study.

Underlying assumptions: The underlying assumptions will be examined, and remedial measures will be taken to address violations in assumptions. Normality for continuous type variables will be assessed graphically by histograms, normal probability plots, and detrended normal probability plots and statistically by evaluating measures of skewness and kurtosis for values greater than |3| after being divided by their standard error to be considered for data transformation. In addition to Mahalanobis distance, multivariate outliers will be assessed by leverage, studentized residuals, and studentized deleted residuals values from fitted regression models. Influential points; observations having large |DFFITS|, Cook's D, and |DFBETAS| will

be identified from fitted regression models. Graphical plots of DFFITS and DFBETAS against case number could also be used to spot possible influential points. Linearity will be assessed by bivariate scatterplots and residual plots of residuals vs. predicted values as well as partial regression plots. If the linearity assumption is violated, data transformation will be considered. Homoscedasticity will be assessed by spread-and-level plots as well as statistically by Levene test. For continuous variables, homoscedasticity will be assessed using a scatterplot of residuals against predicted values as well as by Breusch-Pagan test. If heteroscedasticity found, variable data transformation will be considered to stabilize the variance such as a logarithmic transformation.

Multicollinearity: Multicollinearity for IVs will be assessed carefully by evaluating squared multiple correlation (SMC), tolerance, Variance Inflation Factors (VIF), and condition indices and variance decomposition proportions (BKW multicollinearity diagnostics). Independent variables with bivariate correlations greater than .7, tolerance less than .1 (value of 0 indicates singularity), VIF values exceeding 10 are suggestive of severe multicollinearity (VIF >4 needs further investigation). Variables with condition indices greater than 30 and variance decomposition proportions greater than .5 for at least two variables are suggestive of multicollinearity. Decisions will be made about variables with severe multicollinearity and singularity such as dropping a multicollinear variable from the analysis.

Data Transformations: The data transformations applied will depend on the degree and direction of the skewness and kurtosis. All assumptions will be re-evaluated after applying a data transformation. For categorial variables with sparse categories, meaningful collapsing will be applied. In addition, to fit categorical variables in regression models, categorization and meaningful collapsing will be applied.

1.5.6.2 **Data analysis procedures**

All statistical tests will be two-sided, and the P-value will be adjusted for multiple tests to achieve a family-wise error rate of 0.05. Data analyses will be carried out using IBM SPSS for Mac, Version 27 (IBM Corp., Armonk, N.Y., USA).

Descriptive Statistics

All statistical analyses will be preceded by detailed descriptive analyses of the data. For dichotomous variables (i.e., gender, presence of siblings, use of insulin pump, use of continuous glucose monitoring, mindfulness meditation experience) and for categorical variables (i.e., race and parents' marital status), frequencies, percentages, modes, graphs, such as bar and pie charts, will be used. For ordinal variables such as SES, number of siblings, frequencies, mode, median, percentiles, and graphs such as bar and pie charts will be used. For interval and ratio scaled variables, such as age, duration of diabetes, grade, HgA1c, and summary scores of CAMM, FMMQ, PSS, DSQY-SF, PAID-Teen-SF, CDI-SF, RCMAS, and SCI, standard descriptive statistics such as the mean, standard deviation will be generated. If non-normality is identified median, mode, range, minimum, maximum, and percentile will be generated. Graphics such as histogram and boxplot will be generated.

Data analysis plan for Aim 1: Describe trait mindfulness and experience of mindfulness practices (having experience vs. no experience of mindfulness meditation, mindful yoga, body scan) among adolescents with T1D;

Mean and standard deviation will be generated to describe the distribution of continuous variables including trait mindfulness depending on both CAMM and FFMQ (and its five subscales). If non-normality is identified, mode, median, range, and percentile will be used to describe trait mindfulness. For categorical variables including mindfulness practices, frequencies

and percentages will be generated. In addition, graphical techniques such as histograms, scatter plots, and boxplots will also be applied to illustrate the variable description.

Data analysis plan for Aim 2: Compare levels of trait mindfulness (high vs. low) and experience of mindfulness practices (having experience vs. no experience of mindfulness meditation, mindful yoga, body scan) on adolescents' demographic (age, gender, socioeconomic status, and race) and clinical (duration of diabetes, use of insulin pump, and use of continuous glucose monitoring) characteristics and bio-behavioral variables among adolescents with T1D;

Considering there is no validated cutoff for the CAMM scale for low and high levels of trait mindfulness in the literature, a median split will be performed based on CAMM total scores to establish low and high mindfulness groups. This method has been used to establish cutoff for low and high trait mindfulness levels in adolescents and young adults who finished cancer treatment (Patterson et al., 2015). Chi-square test of independence and two-sample t-test will be conducted to establish comparability between the two groups on levels of trait mindfulness and demographic, clinical and bio-behavioral variables. Chi-square test of independence and two-sample t-test will be conducted to investigate the comparability between the two groups (having mindfulness experiences vs. not) and demographic, clinical, psychosocial and bio-behavioral variables. If assumptions are violated, alternative approaches will be taken such as considering Fisher exact if sparse cells are encountered and Wilcoxon-rank sum test if normality is questionable. Graphs and tables to compare adolescents' based on trait mindfulness and mindfulness practices) will be generated as appropriate.

Data analysis plan for Aim 3: Examine the association between trait mindfulness and psychosocial variables of stress, diabetes-specific stress, diabetes distress, anxiety, and depressive symptoms and bio-behavioral variables of diabetes self-management and glycemic regulation (i.e.,

A1c) in adolescents with T1D, adjusting for age, gender, duration of disease, and socioeconomic status, and additionally for DSM when examining A1c;

Pearson product-moment correlation will be used to examine the correlations between mindfulness and psychosocial variables (stress, diabetes-specific stress, diabetes distress, anxiety, and depression) and bio-behavioral variables (DSM and A1c). A description of all relationships will be reported and presented in a bivariate correlation table. All statistical tests will be two-sided, and $p < 0.05$ will be set as the level of statistical significance. Scatterplots will be generated to observe for the magnitude and direction of relationships. If the assumption of linearity is violated, a Spearman's Correlation will be used. If bivariate normality assumption is violated, data transformation will be considered.

Data analysis plan for <u>Aim 4:</u> Examine which mindfulness facets (Observe, Describe, Act with Awareness, Nonjudgement, and Nonreactivity) are associated with psychosocial and bio-behavioral variables in adolescents with T1D;

Pearson product- moment correlation will be used to examine the correlations between mindfulness facets and psychosocial variables and bio-behavioral variables. Hierarchical multiple linear regression models will be conducted to examine which mindfulness facets predict the psychosocial variables (stress, diabetes-specific stress, diabetes distress, anxiety, and depression) and bio-behavioral variables (DSM and A1c). Each dependent variable will be examined in a separate model. In block 1, demographic and clinical variables to be controlled will be entered. In block 2, mindfulness (FFMQ facets: Describe, Act with Awareness, Nonjudgement, and Nonreactivity) will be entered into this model. Model diagnostics will be conducted by assessing outliers, collinearity, influential values (e.g., Leverage or Cook's D) as well as analyzing residuals.

The output will generate the unique contributions (CAMM, FFMQ) to each dependent variable including significance levels, regression coefficients, and the variance.

Data analysis plan for <u>Exploratory Aim 5:</u> Explore the association between trait mindfulness and implicit bias; Pearson product- moment correlation will be used to examine the correlations between mindfulness and implicit bias. Scatter plots will be generated to observe for the magnitude and direction of relationships. If the assumption of linearity is violated, a Spearman's Correlation will be used. If bivariate normality assumption is violated, data transformation will be considered.

Data analysis plan for <u>Exploratory Aim 6:</u> Explore the potential moderating and/or mediating role of shared responsibility on the relationship between trait mindfulness and bio-behavioral variables of DSM and glycemic regulation. The PROCESS SPSS macro by Hayes (v3.5) will be used to assess mediation. Unstandardized and standardized path coefficients (β), SE, p-value, and 10,000 bias-corrected bootstraps 95% CI reported. Three criteria for mediation to happen are:1) significant association between IV (mindfulness) and DV (separate model for DSM and A1c), 2) significant association between IV (mindfulness) and mediator (shared responsibility), 3) complete mediation occurs when mindfulness is no longer associated with DSM/A1c after shared responsibility has been controlled. Partial mediation occurs when the association between mindfulness and DV (DSM/A1c) is reduced in absolute size but is still different from zero when the mediator is introduced.

To test whether shared responsibility moderate the relationship between mindfulness and DV (DSM/ A1c,) we will create an interaction term (shared responsibility and trait mindfulness). Using the hierarchical regression model, IV (mindfulness) and moderator (Shared responsibility) will be entered in the first block, and the interaction term will be entered in the second block. The

significance of the interaction terms (shared responsibility and trait mindfulness), regression coefficients and the proportion of the variance explained by the interaction term will be reported.

1.5.6.3 **Timeframe**

TIME FRAME: A proposed 12-month schedule that specifies the timing of the main steps of the investigation.

	11/18	12/18	1/19	2/19	3/19	4/19	5/19	6/19	7/19
Hire personnel	x	x							
Developing survey and having questionnaires in Qualtrics		x							
IRB approval	x*								
Recruitment & data collection			x	x	x	x			
Data entry			x	x	x	x			
Analyses						x	x	x	
Publication							x	x	x

*IRB application in the process

1.6 Potential limitations of the proposed Procedures and alternative approaches

This study is limited by several factors. First, the use of the convenience sampling will limit the generalizability of the study. Second, the use of the cross-sectional study design provides

only a brief picture of the condition under study and does not permit causality and limits the mediation assessment. Third, the use of self-reported measures to assess most variables in the study increases the risk of bias. Fourth, variables will be measured according to the adolescents' perspectives and not their parents. However, this study is interested in understanding adolescents' perspectives. Lastly, it is possible we will have missing data as some adolescents may not be interested in answering all questions. Actions to reduce limitations will be taken such as reminding the adolescents that their truthful responses on the questionnaires are important to the study, recruiting adequate sample size that would count for at least 20% missing data. The PI/RA will go over the survey to make sure that there is no full section missing. A gift card of $20 will be given to each participant once he/she completes the survey as reimbursement for their time.

Qualtrics survey application will be used to collect data. Qualtrics survey that is uploaded to an iPad will be used to collect data from adolescents during their presence in the clinic, as it is age-appropriate, practical, and less time-consuming. For participants who wish to complete the survey but cannot stay in the clinic, they will have an option of receiving a link for the survey thru email where they can complete data at home.

1.7 Research Participant risk and protection

The proposed project will recruit adolescents with T1D from Children's Hospital of Pittsburgh of UPMC. An IRB will be obtained from the University of Pittsburgh.

Risks to human subjects. Human Subjects Involvement, Characteristics, and Design: Adolescents included in the study will provide assent and their parents will provide informed consents. Adolescents who present for a follow up clinic visit will be screened for eligibility

criteria. Inclusion criteria are: 1) adolescents (12-18 years); 2) diagnosis of T1D at least 1 year prior to enrollment; and 3) able to read/speak English. Adolescents with comorbid conditions affecting cognitive abilities will be excluded from the study. **Inclusion of special classes:** Since adolescents are considered vulnerable population, informed consent will be obtained from their parents to protect them, and an assent will be obtained from adolescents. **Sources of Materials:** The proposed study will collect data from participants using Qualtrics offline application. Qualtrics is web-based service that is approved and maintained by the University of Pittsburgh, and all data are protected. The PI will have access to the data through secure access. In addition, all data for this study will be maintained by the data manager/systems analyst. All study data are backed up on a nightly basis and the collected data will be exported, processed, and delivered to the PI. Delivery will be done via a secure, password protected web link that will allow the data manager to download the file. **Potential Risks:** Burden of the participants and breach of confidentiality is a minimum risk for this study.

Adequacy of Protection against Risks. Recruitment and Informed Consent: The informed consent and assent will include information about the purpose of the study, potential risks and benefits, confidentiality of the data, and the participant's right to withdraw at any time without any consequences. Parents and adolescents will receive an explanation of the study details including risks and benefits and will be given an opportunity to ask any questions.

Protections against Risk: There is no potential identified risk from participating in this study. To reduce the burden of collecting data from adolescents, questions will be developed using Qualtrics offline application on an iPad. The iPad will be handled to the participant during their waiting time in the clinic to answer the questions. Using an iPad to collect data is age-appropriate and will decrease the required time. To reduce the risk of breach of confidentiality, a master list

that identifies participants will be created and will be placed in a locked drawer in a locked office in a locked department in the School of Nursing at University of Pittsburgh. Identifying data will not be attached to the data available for analysis. No subject identifiers other than the subject's assigned unique identifier will be contained in any of the electronic data files. Hard copies of data with only study, subject, and site identifiers will be stored in locked cabinets. In case of technical problem in the secured access website, finalized datasets are stored on the secure centralized server housed and maintained at an offsite 24/7 network operations facility at the University of Pittsburgh. Each record is keyed by study, subject, and administration date.

Potential Benefits of the Proposed Research to Human Subjects and Others. Participants are likely to receive no direct benefit from taking part in this study. However, their participation may eventually lead to development of mindfulness-based intervention to help adolescents with T1D to have better psychological health, diabetes management, and glycemic regulation.

Importance of the knowledge to be gained. The data generated from this project will answer questions regarding the role of trait mindfulness in psychosocial variables and diabetes related outcomes. This area of investigation has only minimally been investigated among adolescents with chronic diseases particularly adolescents with diabetes. It may pave the way to establish Mindfulness Based Interventions among adolescents with T1D.

Data Safety Monitoring Plan. This is not a clinical trial; however, a data safety monitoring committee composed of student's mentors to review the collection and integrity of data.

INSTITUTIONAL REVIEW BOARD (IRB) STATUS: Ethical approval is pending.

1.8 Publications

Publications, manuscripts (submitted or accepted for publication), abstracts, or other printed materials directly relevant to the proposed research are included.

Papers

a. **Abujaradeh, H.,** Safadi, R., Kahle, C. T., Sereika, S. M., and Cohen, S. M. (2018). Mindfulness-Based Interventions among Adolescents with Chronic Diseases in Clinical Settings: A Systematic Review. Journal of pediatric health care: official publication of National Association of Pediatric Nurse Associates & Practitioners. doi:10.1016/j.pedhc.2018.04.001

Abstracts

b. **Abujaradeh, H.,** Colaianne, B., Roeser, R., and Galla, B. (2018). Measuring Adolescents' Mindfulness: Psychometric Properties of 20-item Five Facet Mindfulness Questionnaire. The 2019 Biennial Meeting of the Society for Research in Child Development 2019, April [Submitted abstract]

c. **Abujaradeh, H.,** Helgeson, V., Cohen, SM., and Sereika, SM. (2018). Shared Responsibility Moderates Relations between Psychological Distress and Self-Care among Adolescents with T1D. The 78th annual conference of the American Diabetes Association 2018, June. [Poster presentation and selected for moderated posters session]

d. **Abujaradeh, H.,** Sereika, S. M., Cohen, S. M., and Helgeson, V. (2018). Does Gender Moderate the relations between Shared Responsibility and Health Outcomes among Adolescents with T1D? The 78th annual conference of the American Diabetes Association 2018, June. [Abstract]

e. **Abujaradeh, H.,** Kahle, C. T., Klem, M. L., and Cohen, S. M. (2017). Mindfulness-Based Interventions among Adolescents with Chronic Diseases in Clinical Settings: A Systematic Review. STTI 44th Biennial Convention 2017, November. [Abstract]

2.0 Changes to the Proposed Project

2.1.1 Changes to Specific Aims

Exploratory Aim 5 was to explore the association between trait mindfulness and implicit bias toward chronic disorder. Due to unavailability of implicit bias test to measure implicit bias toward chronic disorder in the literature ("Project Implicit. Preliminary Information,") and our inability to create a tool to measure it, the review of the literature yielded stigma toward chronic disorder concept being looked at in the literature. Stigma toward chronic disorder means the prejudice, stereotyping, and discrimination individual has toward people living with chronic disorder (Earnshaw, Quinn, & Park, 2012). Thus, this aim was changed to explore the association between trait mindfulness and **stigma toward chronic disorder**.

2.1.2 Changes to the Used Instruments

2.1.2.1 Changes to Children Depression Inventory (CDI)

After consulting with a psychologist, Children Depression Inventory (CDI) was replaced with **Patient Health Questionnaire 9-Teens (PHQ-9-Teens)** as the latter is available to the public and does not need to be purchased. **PHQ-9-Teens is** a 9-item self-report measure screens for depression and severity of depressive symptoms in adolescents. The PHQ-9-Teens demonstrated adequate reliability (Cronbach's α>.80) and validity in adolescents (Ganguly et al., 2013; Iturralde et al., 2017).

2.1.2.2 **Changes to Revised Children's Manifest Anxiety Scale (RCMAS)**

After consulting with a psychologist, the **Revised Children's Manifest Anxiety Scale (RCMAS)**(Stark & Laurent, 2001) was replaced with **Generalized Anxiety Disorders 7-item Scale (GAD- 7)** (Spitzer, Kroenke, Williams, & Löwe, 2006). The GAD is available to the public and does not need to be purchased. The GAD-7 contains the 7 items measure anxiety symptoms on 4-point Likert scale from "0=not at all sure" to "4=nearly every day". The scale has demonstrated adequate reliability and validity in adolescents (Mossman et al., 2017; Spitzer et al., 2006).

2.1.2.3 **Changes to Implicit Association Test (IAT) Questionnaire**

The Implicit Association Test (IAT) Questionnaire (Greenwald et al., 1998) was not used in the study as the exploratory specific aim 5 has changed to include stigma toward chronic disorder. Thus, the Chronic Illness Anticipated Stigma Scale (CIASS) (Earnshaw et al., 2012) was used instead. The CIASS includes three subscales, measuring the extent to which participants anticipate to show stigma (i.e., prejudice, stereotyping, and discrimination) for friends and family members as well as other students with chronic disorder, and anticipated stigma healthcare workers toward people with chronic disorder. Items included 'I would blame friend/ family member who have chronic disorder for not getting better' (friends and family subscale), 'you will prefer not to work with student who have chronic disorder' (student subscale) and 'A healthcare worker will give you poor care' (healthcare subscale). Participants responded to items on a scale from 1 (*very unlikely*) to 5 (*very likely*). Average for CIASS and its subscales were calculated with higher scores indicating higher (worse) levels of anticipated stigma toward chronic disorder (subscales: friends, family, healthcare providers). The scale was modified by changing the question toward adolescents. Item 5 was developmentally inappropriate and deleted.

2.1.2.4 **Changes to Socioeconomic Status Measure**

Due to the infeasibility of applying the Hollingshead Four Factor Index (Hollingshead, 1975), maternal and paternal education were used a proxy of Socioeconomic Status.(Entwislea & Astone, 1994; Jalovaara & Andersson, 2018) The options of each education variable were collapsed into two main categories: 1) graduated from college (e.g., standard college or university graduation, graduate professional training), and 2) did not graduate from college (i.e., school, some college or at least one year of specialized training). Descriptive data was provided for all levels of education and the collapsed two categories were used in correlations and regression models analyses. Furthermore, because there were missing data on the presence of insurance and its type, it was not used as an indicator of SES.

2.1.3 Changes to the Statistical analysis plan

2.1.3.1 **Specific Aim 2**

Compare levels of trait mindfulness (high vs. low) and experience of mindfulness practices (having experience vs. no experience of mindfulness meditation, mindful yoga, body scan) on adolescents' demographic (age, gender, socioeconomic status, and race) and clinical (duration of diabetes, use of insulin pump, and use of continuous glucose monitoring) characteristics and bio-behavioral variables among adolescents with T1D;

The plan was to used median split based on CAMM total scores to establish low and high mindfulness groups. Instead, a validated clinical cutoff of 24 was used from the literature to identify adolescents with high and low mindfulness(Oppo et al., 2019)

3.0 Overview of the Study

The purpose of this study was to describe trait mindfulness and its practices (Aim 1); compare adolescents' demographics, clinical, and bio-behavioral variables based on trait mindfulness levels and experience of mindfulness (Aim 2); examine the association of trait mindfulness with psychosocial and bio-behavioral variables among adolescents with T1D (Aim 3 and 4); explore the association between stigma toward chronic disorders (Exploratory Aim 5) and explore the moderating/mediating role of share responsibility with mindfulness and bio-behavioral variables (Exploratory Aim 6). Two data-based papers directly related to the aims of this dissertation have been or will be submitted to peer-reviewed journals: *Journal of Pediatric Health Care and Pediatric Diabetes*. The first manuscript, entitled "Trait Mindfulness and Mindfulness Practices in Adolescents with Type 1 Diabetes: Descriptive and Comparative Study" was a descriptive study of trait mindfulness and mindfulness experience in adolescents with T1D and comparative study between adolescents with low/high levels of mindfulness and with and without mindfulness experience (See section 4). The second manuscript, entitled "The Association of Mindfulness with Psychosocial and Bio-behavioral Variables in Adolescents with Type 1 Diabetes (T1D)" is a correlational study exploring the association between trait mindfulness and mindfulness facets with psychosocial and bio-behavioral variables (See section 5).

Exploratory aim 5 examined the association between mindfulness and stigma toward people with chronic disorder in adolescents with T1D. The findings are presented under Results (See section 6.1).

Exploratory aim 6 examined the mediating and moderating role of share responsibility on the relationships between mindfulness and bio-behavioral variables. The findings are presented

under Results (See section 6.2). Moreover, the mediating role of shared responsibility was presented in a poster presentation at the 2021 American Diabetes Association (ADA)- Virtual meeting (APPENDIX D).

In addition to the two data-based publications/manuscripts directly related to the aims of this study, additional two articles to support the need for conducting this study were published during the course of PhD training and copies/links are provided in Appendices (C and D). The first article, published in *Journal of Pediatric Health Care*, and entitled "Mindfulness-based interventions among adolescents with chronic diseases in clinical settings: a systematic review" summarizes state of science of the effectiveness of mindfulness-based interventions delivered in clinical setting to adolescents with chronic disorders. This study provided preliminary data to support the scientific premise of the proposed study and identified a gap in studies examining mindfulness-based interventions in adolescents with chronic physical disorders in general and adolescents with T1D in particular (Appendix A).

The second article, published in the *International Journal of Behavioral Development* and entitled "Evaluating a short-form Five Facet Mindfulness Questionnaire in adolescents: Evidence for a four-factor structure and invariance by time, age, and gender" examined factor structure, invariance by time, age, and gender, psychometric properties, of a short form of the Five Facets Mindfulness Questionnaire (FFMQ) among North American Adolescents, and provided initial support to the use of the short-form FFMQ in this dissertation to examine mindfulness facets in adolescents with T1D (Appendix B).

4.0 Data Based Manuscript: Trait Mindfulness and Mindfulness Practices in Adolescents with Type 1 Diabetes: Descriptive and Comparative Study

(Under review in the Journal of Pediatric HealthCare)

4.1 Abstract

Introduction: Study describes mindfulness (trait and practices) and compares levels of trait mindfulness (low/high) and practices (yes/no) on demographic, clinical characteristics and diabetes-related outcomes among adolescents with type 1 diabetes(T1D).

Methods: Adolescents completed a survey on demographics, clinical data, trait mindfulness/practices, and diabetes self-management (DSM). Glycemic regulation(A1c) from medical record. T-tests and Chi-square tests were applied for comparative analyses.

Results: 129 adolescents (12-18yrs; 59% male; 88% white) reported moderately high levels of mindfulness (31± 8,range=10-40). One third (30%) reported having experience with mindfulness practices (formal, informal, and religious). Adolescents who reported higher levels of trait mindfulness had higher insulin pump usage ($p=0.05$), and less diabetes-specific stress ($p=0.010$), greater DSM ($p<0.01$) and less A1c ($p=0.01$). Adolescents who reported more types of mindfulness practices had greater DSM scores.

Discussion: Adolescents with higher levels of trait mindfulness and with more types of mindfulness practices had higher DSM. Introducing mindfulness training tailored to adolescents with T1D should be examined.

4.2 Introduction

Type 1 diabetes (T1D) is one of the most common chronic diseases in childhood and it is associated with physical and psychological complications (American Diabetes Association, 2021). Adherence to diabetes self-management (DSM) and achieving optimal glycemic regulation (A1c) are the keys to prevent diabetes long-term complications. Adolescents with T1D experience stress specifically related to living with diabetes as well as general stress related to their growth and development, school, family stressors, and social life, which can lead to physiological and psychological sequalae (Chao et al., 2016) (Hilliard et al., 2016). Stress has a direct effect on glycemic regulation through its impact on cortisol and increasing hepatic glycogen production and insulin resistance (McEwen, 1998), and indirect effect as it interferes with adolescents' DSM behaviors (Helgeson et al., 2010). Stress can lead to poor DSM and suboptimal glycemic regulation (Chao et al., 2016). Mindfulness has been identified as protective factor against the influence of stressful events on emotional well-being (J. van Son et al., 2015) and is associated with positive psychological and physical wellbeing (Loucks et al., 2016; J. van Son et al., 2015). Understanding the mechanisms that amplify or buffer stress is important to strengthen individual's ability to respond adaptively to stress, adhere to DSM behaviors, and promote optimal glycemic and other health outcomes.

Mindfulness is defined as the nonreactive awareness of the current experience, regardless if this experience is positive, negative, or neutral (Kirk Warren Brown & Richard M Ryan, 2003). It involves attentive awareness to the present moment while adopting a nonjudgmental and accepting manner. Trait mindfulness refers to the natural tendency to be mindful in daily life. Trait

mindfulness varies naturally across individuals, irrespective of mindfulness training (Kirk Warren Brown, Ryan, & Creswell, 2007), but can be cultivated through mindfulness training (Kirk Warren Brown et al., 2007). The application of mindfulness is growing rapidly and it is offered in different ways by different research teams in clinical and non-clinical settings including schools, work, community settings (Creswell, 2017). Mindfulness interventions programs are designed to improve broad range of psychological and physiological health-related outcomes (Creswell, 2017). Mindfulness practices reduce stress and improve coping skills by bringing in mindfulness core concepts of attention and non-judgmental attitude (Jon. Kabat-Zinn, 2003). Formal mindfulness practices include body scan, mindfulness meditation, mindful breathing, and mindful yoga; and informal mindfulness practices include mindful walking, mindful eating, and mindful showering. Mindfulness-Based Stress Reduction program is an example of curriculum that uses these different practices types (Jon. Kabat-Zinn, 2003). In addition, religious and spiritual traditions offer contemplative and meditative practices and techniques to improve mental and physical being (Plante, 2008) such as prayers, mantras, and chants (Garrison & Burklo).

Regarding individuals with T1D and T2D, mindfulness-based interventions have moderate effect size in reducing stress and slightly improving A1c (N=841 adults, age> 18 years) (Ni, Ma, & Li, 2020), and are associated with improvement in DSM in adults with T2D (N=81) (Gregg et al., 2007). In addition, preliminary findings from older adolescents and young adults with poorly controlled T1D (N=10, mean age=18.6, SD=1.2, range=16-21 years) suggested that mindfulness-based intervention reduces stress and improves blood glucose levels (Ellis, Carcone, Slatcher, & Sibinga, 2018).

Supporting evidence suggests that trait mindfulness is associated with positive health-related outcomes among adults with diabetes as well as healthy and chronically ill adolescents.

Trait mindfulness showed protective characteristic against the influence of stressful events on emotional wellbeing in adults with diabetes (N=666; T1D = 45 % and T2D = 55%; mean age=55, SD=14 years). Additionally, trait mindfulness was identified as a significant predictor of DSM (β=0.213, .2; p=.024) in a cross-sectional study in 130 adults with T2D (J. Brown, 2014). In another study among young adults with T1D (N= 423; age=19-31 years), higher mindfulness was significantly associated with lower A1c only among the oldest group (27-31 years)(Nagel et al., 2020). Furthermore, a study from the general population (n=399) found that individuals with high levels of trait mindfulness were more likely to have normal plasma glucose levels than those with lower levels of trait mindfulness (prevalence ratio= 1.42; 95% CI:1.08-1.87) (Loucks et al., 2016). Although evidence is limited in adolescents with chronic disorders, higher levels of mindfulness were associated with less asthma-specific stress and better asthma-related QoL in adolescents with Asthma (N=94, mean age=16.3, SD=1.2, range=14-18 years) (Cillessen et al., 2017) and less psychological distress in adolescents and young adults who finished cancer treatment (N = 76; mean age =18.5, SD =3.4 years) (Patterson & McDonald, 2015).

In summary, mindfulness has demonstrated positive effects on health outcomes and quality of life in different populations. However, there is a paucity of evidence about trait mindfulness and mindfulness practices (i.e., the rates and characteristics of adolescents who engaged in mindfulness practices) in younger adolescents with T1D. To improve health outcomes and well-being of adolescents with T1D, it would be beneficial to understand how this trait is naturally distributed and how it relates to their demographic and clinical characteristics and diabetes-related outcomes.

Therefore, in adolescents with T1D, this study aims to 1) describe trait mindfulness (overall distribution) and mindfulness practices (presence, duration, and use of apps); 2) compare trait mindfulness (High, Low) with demographic (age, gender, and socioeconomic status) and clinical

(duration of diabetes and use of insulin pump) characteristics, and diabetes-related outcomes (diabetes-specific stress, DSM and A1c); and 3) compare mindfulness practices (Yes, No) with demographic and clinical characteristics, and diabetes-related outcomes.

4.3 Methods

4.3.1 Design

This is a descriptive, comparative, cross-sectional study of a convenience sample of adolescents with T1D. The study was conducted at the Pediatric Endocrinology Clinic at Children's Hospital of Pittsburgh.

4.3.2 Procedures

Ethical approval was obtained from the University of Pittsburgh Institutional Review Board. Study staff (i.e., primary investigator and research assistant), with assistance from healthcare providers (i.e., physicians, physician assistants, nurse practitioners, nurses, and certified diabetes educator) at the clinic, recruited adolescents with T1D to participate in the study. Potentially eligible participants were identified and approached by study staff and healthcare providers to see if they were interested in the study. The study staff screened interested participants for eligibility, explained the study in detail, and obtained assents and informed consents from adolescents and their parents. Inclusion criteria were: 1) being an adolescent aged 12-18 years, 2) having a diagnosis of T1D at least one year prior to enrollment, and 3) being fluent in English.

Exclusion criteria were having disabilities that affecting cognitive functions such as autism. Approximately 75% of patients who were approached agreed to participate in the study.

Enrolled participants completed a survey on demographic and clinical characteristics and study variables via a secure Qualtrics App on a tablet computer during follow-up routine visits. For participants who could not complete the survey during their clinic visit, a link was sent via email/text message so they could complete the survey at their convenience.

4.3.3 Measures

Demographic and clinical characteristics. Demographic data included gender (male, female), race (White, African American, Asian, American Indian/Alaska Native, Native Hawaiian/Pacific Islander), age (years), and maternal and paternal education: 1) graduated from college (i.e., college or university graduation, graduate professional training), 2) did not graduate from college (i.e., unknown education, grade 9 or less, grade 10 or 11, high school, some college or at least one year of specialized vocational training) were used as a proxy of socioeconomic status (SES) (Entwislea & Astone, 1994; Jalovaara & Andersson, 2018). Clinical characteristics included duration of diabetes (years), use of insulin pump (yes, no), and use of continuous glucose monitoring (CGM; yes, no).

Trait Mindfulness. Participants completed the 10-item Child and Adolescent Mindfulness Measure (CAMM) (Greco et al., 2011). The CAMM assesses adolescent's trait mindfulness and describes adolescents' tendency to be attentive of the present moment while having non-judgmental attitude to the experience. Items were rated on a 5-point Likert ordinal scale from "0=*Always true"* to "4=*Never true."* Total scores range between (0-40) with higher scores indicating greater levels of trait mindfulness. A clinical cut off point of 24 has been validated in

adolescents (N = 1336; age=11-18 years), and it indicates low or poor mindfulness (Oppo et al., 2019). Items reflect attention and attitude of non-judgmental acceptance (e.g., "At school, I walk from class to class without noticing what I'm doing", "I think that some of my feelings are bad and I shouldn't have them" and "I think about things that have happened in the past instead of thinking about things that are happening right now"). The CAMM demonstrated strong reliability (Cronbach's $\alpha = 0.89$) within our sample. We used the clinical cutoff of 24 (Oppo et al., 2019) to establish low and high mindfulness groups. The low mindfulness group included 29 participants and the high mindfulness group included 100 participants. The continuous CAMM score was used to describe trait mindfulness natural distribution.

Mindfulness Practices. Participants were asked if they had mindfulness experience (yes, no). If they answered "yes," they were asked about the types of mindfulness practices:1) formal such as breathing, body scan, mindfulness meditation, and mindful yoga, 2) informal such as mindful walking and mindful showering, and 3) religious such as prayer and mantras; duration: 1) less than three months, 2) 3-12 months, and 3) more than 1 year; and the use of mindfulness apps: (yes, no). Those who checked using mindfulness app were asked for the name of the app. Participants were classified into (practicing mindfulness =1, not practicing mindfulness =0). Furthermore, participants were categorized if they have one or more than one type of mindfulness practices (if participant checked more one type).

Diabetes-Specific Stress. Adolescents completed the 10-item **Diabetes Stress Questionnaire for Youths (DSQY)-Short Format** (A.M. Delamater et al., 2017). The DSQY-SF measures adolescents' perceived stress related to diabetes and it asks participants to rate how stressful the situations in the current time on a 4-point Likert scale "0=1" to "3=very much." The total score ranges between 0 and 30 with higher scores representing higher levels of perceived diabetes-specific stress. The DSQY-SF has an adequate

internal consistency (Cronbach's α=.79), and good validity (A.M. Delamater et al., 2017). The scale demonstrated adequate reliability (Cronbach's α = 0.81) within our sample.

Diabetes Self-management (DSM). Adolescents completed the 15-item **Self-Care Inventory- Revised (SCI-R)** (Weinger, Butler, Welch, & La Greca, 2005). The SCI-R assesses how well individuals follow treatment recommendations for managing diabetes, such as glucose testing, insulin administration, diet, exercise, and other diabetes-related behaviors. Items were answered on a 5-point Likert scale from "1= *Never do it*" to "5=*Always do this as recommended*." For scoring, items were averaged and converted to a 0- to 100-point scale with higher scores indicating higher levels of DSM (Weinger et al., 2005).

Glycemic regulation. A1c is a standard index of long-term glycemic regulation and it represents an objective measure of average blood glucose over the last two to three months (American Diabetes Association, 2021). A1c at point-of-care was obtained from the medical record for the same day of the survey completion. According to the ADA guidelines, A1c level is less than 6% of total hemoglobin in healthy people and should be maintained below 7.0% among children and adolescents with T1D (53 mmol/mol) (American Diabetes Association, 2021).

4.3.4 Analytic Approach

Data analyses were carried out using IBM® SPSS®, version 27 (SPSS). Data were screened for normality and outliers by major grouping variables (trait mindfulness [high vs low] and presence of mindfulness experience [yes vs. no]). Descriptive data (mean, standard deviation, frequency, and percentages) were provided. Low and high mindfulness groups were established based on clinical cutoff of 24 of CAMM total scores. To examine the difference between adolescents with high and low levels of trait mindfulness, two-sample t-tests and Chi-square tests

of independence were conducted on continuous (age, duration of diabetes, CAMM scores, diabetes-specific stress, DSM scores, A1c) and categorical (gender, SES, use of insulin pump and CGM) variables, respectively. Mann-Whitney test was used if the data was not normally distributed. Fisher's exact test was reported if expected value (cell count) was less than 5%. To compare adolescents based on the presence of mindfulness experience (yes vs. no), two-sample t-tests and Chi-square tests of independence were conducted on continuous (age, duration of diabetes, CAMM scores, DSM scores, A1c) and categorical (gender, SES, use of insulin pump and CGM) variables, respectively. Further comparative analyses in the subset of participants who reported having mindfulness experience were conducted. To compare between participants who have one type of mindfulness practices versus more than one type, we conducted two-sample t-tests and Chi-square tests of independence on continuous and categorical variables, respectively. Finally, Chi-Square test of independence was conducted to examine the association between high and low trail mindfulness and the presence of mindfulness practices.

4.4 Results

4.4.1 Participant Characteristics

A total of 129 adolescents self-selected to participate in this study. More than half of the sample were male (59%; n=76) and the majority was White (88%; n=114), which is representative of the population seen in the clinic under age 18 years, whereby 55% are females and 88% are White. Age ranged from 12 to 18 years (Mean=14.9, SD=1.8) and duration of diabetes ranged from 1 to 17 years (Mean=7.1, SD=4.8). More than half of the sample used insulin pump (60.5%;

n=78) and around two-third of the sample used CGM (67.4%, n=87), which tends to be higher than the usage in this clinic population. Participants reported moderate level of DSM (70.3±13.7, range=33-100). Participants had an average A1c of 8.35±1.68%, with 17% (n=22) participants met ADA glycemic goal and 83% (n=107) who did not meet ADA goal. Demographic and Clinical Characteristics for participants are presented in Table 2.

Table 2 Demographic and Clinical Characteristics (N=129)

Characteristic	**N(%)**	**M (SD)**	**Range Min-Max**
Age, years		14.9±1.8	12-18
Gender			
Female	53 (58.9)		
Male	76 (41.1)		
Race/Ethnicity			
Caucasian	115 (88.5)		
Minorities			
AA	9 (6.9)		
Asian	1 (0.8)		
AI/AN	4 (3.1)		
NH/PI	1 (0.8)		
Maternal education as a proxy of SES			
Completed college	64 (49.6)		
Did not complete college	65 (50.4)		
Paternal education as a proxy of SES			
Completed college	51(39.5)		

Table 2 (continued)

Characteristic	N(%)	M (SD)	Range Min-Max
Did not complete college	78 (60.5)		
Living situation			
Both parents	81 (62.8)		
One parent	24 (18.6)		
Mother	21 (16.3)		
Father	3 (2.3)		
Parent/stepparent	20 (15.5)		
Grandparent/others	4 (3.1)		
Diabetes duration, years		7.09±3.8	1-16
A1c, %		9.0±1.9	5.4-14
Insulin pump use			
Yes	78 (60.5)		
No	51(39.5)		
CGM use			
Yes	87 (67.4)		
No	42 (32.6)		

Note. AA: African American; AI/AN: American Indian/ Alaska Native; NH/PI: Native Hawaiian/ Pacific Islander; SES: socioeconomic status; CGM: continuous glucose monitoring; DSM: Diabetes self-management SCI: Self-Care Inventory

[†]Grandparent: 15 participants lived with their grandparents in addition to their parents/stepparents. These mentioned here lived with their grandparent(s) as a primary caregiver.

Adolescents reported moderate levels of mindfulness on the CAMM with a mean score of 30.67±8.01 (range=10-40). Participant responses on the CAMM scale were negatively skewed with most participants reporting high scores of mindfulness (Skewness= -0.683±0.213; Kurtosis= -0.420±0.423) and there were no outliers.

Approximately one third of the participants (30%; n=38) reported having at least one type of mindfulness practice. Of these, 66% had formal mindfulness experience, 50% had informal experience; and 42% reported practicing mindfulness for more than 1 year. Eight participants

(21%) reported using popular mindfulness apps such as Headspace, Calm, and YouTube videos. One participant reported using Pokémon go (Kosa & Uysal, 2018; Urwin & Flick, 2019) as a mindfulness apps. See Table 3 for description of mindfulness practices.

Table 3 Description of Mindfulness Practices in Adolescents with T1D (n=38)

Mindfulness	n (%)
Mindfulness type	
Formal	25 (65.8)
Informal	19 (50.0)
Religious	4 (10.5)
Two types of mindfulness practices	10 (26.0)
Formal and informal	8 (21.0)
Formal and religious	2 (5.0)
Mindfulness duration	
< 3 months	17 (44.7)
3-12 months	5 (13.2)
> 1 year	16 (42.1)

4.4.2 Comparative analyses based on Trait Mindfulness (Low Versus High)

The low mindfulness group included adolescents who scored 24 or less on the CAMM (18.8±4.4; n=29) and higher mindfulness group included those who scored more than 24 (34.1±4.9; n=100). A comparative (trait mindfulness high vs. low) statistics for all study variables are presented in Table 4. Regarding participants' characteristics, there were no significant differences between the two mindfulness groups on age, gender, and maternal and paternal education (all ps >0.05).

Regarding clinical characteristics, there was significant difference between high and low level mindfulness groups on the use of insulin pump ($\chi^2_{1(n=129)}$=7.95, p=0.005), with the high mindfulness group reported higher use of insulin pump (67.0%) in comparison to 37.9% of the low mindfulness group who reported using insulin pump. There were no significant differences between high and low level mindfulness groups on duration of diabetes (t(127)= 1.079, p= 0.282) and use of CGM ($\chi^2_{1(n=129)=}$ 1.326, p=0.250).

Regarding diabetes-related outcomes, adolescents in the high trait mindfulness group, in comparison to adolescents in the low mindfulness group, showed less diabetes-specific stress (t(127)=5.93; 16.2±4.8 vs. 22.7±6.4; p=0.010), greater DSM scores (t(127)=2.80; 72.1±13.3 vs. 64.2±13.4; p=0.006), and lower A1c (Mann-Whitney U=1008.5; n1=29, n2=100; p=0.013) with A1c median of 8.0 for the high mindfulness group versus 8.5 for the low mindfulness group. Adolescents in the two groups did not differ in achieving ADA goal for glycemic regulation ($\chi^2_{1(n=129)}$=2.9, p=0.781).

Table 4 Comparative Analyses by Trait Mindfulness Levels (High vs Low)

Characteristic	Overall (N=129)	Low Mindfulness (n=29)	High Mindfulness (n=100)	p-value
Age, years†	14.9±1.8	14.9±1.9	15.0±1.8	0.402
Maternal education as a proxy of SES				.314
Completed college	64 (49.6)	17 (58.6)	48 (48.0)	
Did not complete college	65 (50.4)	12 (41.4)	52 (52.0)	
Paternal education as a proxy of SES				.818
Completed college	51(39.5)	17 (58.6)	61 (61.0)	
Did not complete college	78 (60.5)	12 (41.4)	39 (39.0)	
Gender				0.186
Female	53 (58.9)	15 (51.7)	38 (38.0)	
Male	76 (41.1)	14 (48.3)	62 (62.0)	
A1c, %§	9.0±1.9	8.5	8	0.013
A1c, %‡				.781
<7%	22 (17.1)	4 (13.8)	18 (18.0)	
>7%	107 (82.9)	25 (86.2)	82 (82.0)	
DSQ	17.7±5.8	22.7±6.4	16.2±4.8	<.001
Diabetes duration, years†	7.09±3.8	6.4±4.0	7.2±3.8	0.282
Insulin pump use‡				.005
Yes	78 (60.5)	11 (37.9)	67 (67.0)	
No	51(39.5)	18 (62.1)	33 (33.0)	
CGM use‡				0.250
Yes	87 (67.4)	17 (58.6)	70 (70.0)	
No	42 (32.6)	12 (41.4)	30 (30.0)	
DSM (SCI)	57.2±8.2	64.2±13.4	72.1±13.3	0.006
Mindfulness (CAMM)	30.67±8.01	18.8±4.4	34.1±4.9	<.001
Mindfulness practices‡				0.802
Yes	38 (29.5)	8 (27.6)	30 (30.0)	
No	91 (70.5)	21 (72.4)	70 (70.0)	

Note. SES: socioeconomic status; DSQ: Diabetes Distress Questionnaire; CGM: continuous glucose monitoring; DSM: Diabetes self-management SCI: Self-Care Inventory; CAMM: Child and Adolescent Mindfulness Measure
† Statistics for continuous type variables are reported as Mean±SD
‡ Statistics for categorical variables are reported as n (%)
§ Statistics for continuous type variables are reported as Median

4.4.3 Comparative Analyses Based on Mindfulness Practices

There were no significant differences between those who reported practicing mindfulness versus those who reported not practicing mindfulness on any demographic or clinical characteristics (P>0.05). Mindfulness practices were not significantly different between males and females ($\chi^2_{1(n=129)}$=1.769, p=0.148) with male participants representing half of adolescents with mindfulness experience (n=19, 50%) and two third (n=57; 62.6%) of those with no experience.

Regarding diabetes related-outcomes, there was no significant difference based on the presence of mindfulness experience in diabetes-specific stress, DSM or A1c. Further analyses among adolescents with mindfulness experience (n=38) showed that those with more mindfulness practices types reported higher DSM scores than those with one type of practices (t(36)=2.17, p=0.037; 80.0±12.3 vs. 70.7±12.8, respectively).

There was no significant difference in low and high trait mindfulness levels by having or not having mindfulness practices ($\chi^2_{1(n=129)}$ = 0.063, p=0.802). The distributions of adolescents who reported having mindfulness practices were very similar in the low and high trait mindfulness groups (27.6%, 30.0%, respectively).

4.5 Discussion

In this study, we described trait mindfulness and practices and compared demographic and clinical characteristics as well as diabetes-related outcomes based on trait mindfulness and practices in adolescents with T1D. The mean score of trait mindfulness was moderately high (30.7±8.0), which is numerically higher than mindfulness scores measured by CAMM in previous

studies of other populations including adolescents and young adults who finished cancer treatment (n=76; 27.5±8.9) (Patterson et al., 2015) and adolescents from community sample (n= 560; 28.60±6.33) (de Bruin, Zijlstra, & Bögels, 2014). The CAMM can only measure trait mindfulness in youth, which prevents comparing mindfulness scores in adolescents with adults with T1D and T2D. However, van Son et al., (2015) reported that mindfulness scores were higher in a sample of adults with T1D and T2D compared to a sample of individuals with mild to moderate symptoms of anxiety or depression (J. van Son et al., 2015). It is possible that individuals with diabetes tend to be more attentive than other populations in order to adhere to complex daily DSM behaviors.

Around one third of the participants (30%) had mindfulness practices including formal, informal and religious mindfulness practices. This rate is higher but close to the rates of self-reported meditation practice in a community sample of adolescents (24%)(Petter et al., 2013). However, it was less than self-reported meditation experience (64%) in a baseline data from healthy but stressed adolescents who were enrolled in a five-day, intensive meditation retreats (B. M. Galla, 2016). Of note, the mentioned two studies took additional efforts to recruit adolescents with mediation experience (Petter et al., 2013) or recruited adolescents who had an interest in meditation training (B. M. Galla, 2016). The nature of the included sample could explain the difference in the rates of mindfulness experience between this study and the intensive meditation retreats study. While both studies included adolescents who are at risk for stress, the adolescents in the intensive meditation retreats recruited adolescents who had interest in meditation training (B. M. Galla, 2016), in comparison to our participants who were randomly recruited in this study. Additionally, the relatively high rate of adolescents who had mindfulness experience in our sample might be indicative that mindfulness interventions are getting more popular to populations with chronic disorders who need psychological support such adolescents with T1D. Moreover, many

schools have been incorporating mindfulness in wellness initiatives (Zenner et al., 2014), thus it is possible that adolescents in our sample have been exposed to some mindfulness classes or training in schools.

Regarding demographic and clinical characteristics, adolescents with higher levels of trait mindfulness reported higher use of insulin pumps. Other than this, there were no significant differences on any demographic and clinical characteristics based on trait mindfulness or mindfulness experience. While our findings are consistent with a community sample of adolescents where there were no differences between regular meditators and nonmeditators on age (Petter et al., 2013), they do not align with their findings that more females were in the regular meditator group compared to males (females = 18, males = 3, $\chi^2_1 = 3.83$, P = .05) (Petter et al., 2013). Also, this is inconsistent with a previous study where female adults had reported having meditation experience more than male adults (Tomlinson, Yousaf, Vittersø, & Jones, 2018). Although gender difference was not statistically significant in our sample, the percentage of females who reported having mindfulness experience (36 %; 19 out 53 females) was higher than males (25%; 19 out 76 males) similar to mentioned studies. Identifying demographic and clinical characteristics of adolescents with low and high trait mindfulness, and with and without mindfulness experience could help practitioners understand the distribution of trait mindfulness and mindfulness practices, and help in targeting adolescents for mindfulness-based interventions.

Adolescents with higher levels of trait mindfulness had less diabetes-specific stress and better DSM and glycemic regulation. This is consistent with a previous study in adolescents with Asthma where higher levels of mindfulness were associated with less asthma-specific stress (Cillessen et al., 2017). Additionally, our finding that adolescents who higher mindfulness levels had better DSM is consistent with a previous cross-sectional study among 130 adults with T2D

where adults with higher levels of mindfulness had higher levels of DSM (β=.213, .2; P<.024)(J. Brown, 2014). Moreover, our finding that adolescents who higher mindfulness levels had better glycemic is consistent with Nagel et al., 2020 where they found higher mindfulness was significantly associated with lower A1c only among young adults (27 to 31 years)(Nagel et al., 2020).

On the other hand, there were no significant differences in diabetes-specific stress, DSM and HA1c among participants with or without mindful experience. However, DSM scores were significantly higher for those who reported having more than one type of mindfulness practices compared to adolescents who reported having one type of mindfulness practices. This could reflect that practicing more than one type of mindfulness practices (formal, informal, religious) could be more beneficial than practicing a single form; and therefore, would require further investigation. Furthermore, mindfulness-based interventions such as mindfulness-based stress reduction include formal and informal mindfulness practices to reinforce the core concepts of mindfulness and improves health-related outcomes (Jon. Kabat-Zinn, 2003).

There was no difference in trait mindfulness between adolescents with and without mindfulness experience. While this seems to oppose the evidence that mindfulness can be increased by mindfulness training, it is in line with other studies, for instance, findings of Petter et al. (2014) where there was no significant difference in mindfulness scores between regular meditator and nonmeditator in a community sample of adolescents (Petter et al., 2013). Possible explanation for this finding could be that adolescents who reported having mindfulness experience were not engaged enough to enhance trait mindfulness and gain benefits of mindfulness practice. For example, Creswell in a review regarding mindfulness intervention (2017), has pointed out that benefits of mindfulness training are based on the dosing of mindfulness practices and that brief

mindfulness interventions (e.g., 5–10-min guided mindfulness inductions, 3–4-session mindfulness meditation training) have small effect size, while larger doses of mindfulness interventions, such as the 8-week mindfulness-based stress reduction program produce moderate-to-large overall effects pre-post training (Creswell, 2017). In addition, it appears that individuals could learn how to apply formal mindfulness to daily life stressors to have better coping (Creswell, 2017). In our sample, 11 (29%) adolescents out of 38, reported having informal mindfulness experience without having formal or religious mindfulness practices. Furthermore, literature suggested that the term "mindfulness" might have different meaning for meditators and non-meditators as a possible explanation for the non-difference in trait mindfulness scores between meditators and non-meditators (de Bruin et al., 2014; Greco et al., 2011){de Bruin, 2014 #7}. For example, one would think of oneself as an attentive and nonjudgmental while practicing mindfulness would increase one's awareness of moments of mindlessness and inattentiveness.

This paper provides the first comprehensive description of mindfulness in adolescents with T1D. We looked to both trait mindfulness and experience of mindfulness practices with demographic and clinical characteristics, and diabetes-related outcomes. In addition, we used clinically valid cut-off point to distinguish adolescents with low and high trait mindfulness groups which is more useful to practitioners than using median split that has been used in previous studies (Cillessen et al., 2017; Nagel et al., 2020). However, this study had several limitations. First, the cross-sectional design of the study provides only a brief picture of the condition under study and does not permit statements of causality. Second, the use of convenience sampling limits the generalizability of the findings. Third, the included sample was racially homogenous, being almost White, and had limited ethnic diversity; replication of the study with more racially and ethnically diverse populations will enrich the literature and provide evidence for tailoring mindfulness-based

interventions for diverse populations. Fourth, while we described experience of mindfulness practices in adolescents with T1D, further exploration is needed of the providing resources such as being part of the regular clinic visits or referral by healthcare provider, being offered in school or community center, and the reasons motivating adolescents to practice mindfulness such as coping, peer influence, or improving health would provide information on how to introduce mindfulness to adolescents with chronic disorders. Gathering this information could identify how adolescents were engaged in informal mindfulness practices such as reading article, social media, or through school. Finally, we examined mindfulness in a general and non-disease specific context; identifying which aspect of mindfulness is particularly beneficial to adolescents with T1D could benefit tailoring mindfulness-based interventions to this population.

The findings appear to provide evidence that mindfulness could have implications for the adolescents' diabetes-specific stress, self-management of disease, and glycemic regulation. Mindfulness appeared to be helpful to adolescents with T1D in our sample by mitigating stress appraisal and thus improve adolescents' adherence DSM or by enhancing their awareness and nonjudgmental attitude to adhere to DSM behavior regardless of their feelings and thoughts. As mentioned above, trait mindfulness can be enhanced through mindfulness-based interventions (Kirk Warren Brown et al., 2007). Future studies could consider examining the inclusion of mindfulness assessment at baseline psychological screening to depict adolescents' mindfulness levels, identify those who with low levels of trait mindfulness to target patient-centered mindfulness interventions. Furthermore, future mindfulness interventions research may target adolescents with low levels of mindfulness to cultivate trait mindfulness and improve their psychological and diabetes-related outcomes. Finally, these studies could lead to providing

resources for healthcare professionals to share mindfulness training with adolescents with T1D to help with diabetes-management and improve wellbeing.

4.6 Conclusion

In our sample, adolescents with T1D had mindfulness levels higher than reported in adolescents from a community sample or with other chronic disorders. Approximately one third of our sample had been exposed to some mindfulness practices. Diabetes-specific stress, DSM, and glycemic regulation were better among adolescents who had high levels of trait mindfulness, compared to those with lower levels of trait mindfulness. Additionally, DSM scores were better among participants who reported having more than one type of practice, in comparison to those with one type of mindfulness practices. This study provides preliminary evidence for future research to examine the benefits of mindfulness-based interventions, such as mindfulness training, delivered either as a complimentary stand-alone program or integrated with diabetes education specifically for adolescents with T1D.

5.0 Data Based Manuscript: The Association of Mindfulness with Psychosocial and the Association of Mindfulness with Psychosocial and Bio-behavioral Variables in Adolescents with Type 1 Diabetes (To be submitted)

5.1 Abstract

Background: In adolescents with type 1 diabetes(T1D), we examined the association of trait mindfulness with psychosocial (stress, diabetes distress [DD], depressive symptoms, and anxiety) and bio-behavioral (diabetes self-management[DSM] and A1c) variables, and examined which mindfulness facet (Observing, Describing, Act with Awareness, Nonjudgement, and Nonreactivity) is associated with these variables.

Methods: This cross-sectional, correlational study recruited adolescents (age=12-18 years) with T1D during diabetes clinic appointments. Participants completed measures on mindfulness, stress, DD, depressive symptoms, and DSM using tablet computer. A1c was obtained from medical records. Hierarchical multiple linear regression modeling and multivariate analyses examined the associations of overall mindfulness and specific facets with psychosocial and bio-behavioral, adjusting for demographic and clinical characteristics.

Results: Adolescents (n=129) had a mean age of 14.9±1.8 years; diabetes duration of 7.1±3.9 years; were 59% male; 88% white; and had A1c of 8.3±1.6. Mindfulness as a unidimensional concept was associated with all psychosocial variables ($p<.001$) and DSM ($p= 0.016$). Mindfulness facets of Nonjudgement and Nonreactivity were significantly associated with stress, diabetes distress, depressive symptoms, and anxiety (All $Ps<0.01$). Act with Awareness was significantly associated with diabetes distress ($p=0.044$), depressive symptoms ($p<.001$), and

anxiety (p<.001). Mindfulness facet Describe was positively significantly associated with stress (p=0.026). Nonjudgment was positively significantly associated with DSM (p=0.015) and Nonreactivity was positively significantly associated with A1c (p=.001).

Conclusions: Higher mindfulness was significantly associated with better psychosocial variables and DSM. Associations between specific mindfulness facets and psychosocial and bio-behavioral variables varied. Mindfulness-based interventions should target different mindfulness facets to improve varied aspects of adolescents with T1D mental and physical health.

Keywords: Type 1 Diabetes; Mindfulness; Stress, Diabetes Distress; Depression Diabetes Self-management; Glycemic regulation; Adolescent Health

5.2 Introduction

Type 1 diabetes (T1D) is life threatening and one of the most common chronic diseases in childhood with major physical and psychological consequences (American Diabetes Association, 2021). T1D in adolescents is often poorly managed with only 21% of adolescents with T1D meet the guidelines of the American Diabetes Association for target glycemic regulation (A1c)(Wood et al., 2013). This vulnerable population is at high risk for unfavorable psychosocial outcomes such as stress, diabetes distress, depressive symptoms, and anxiety, which can lead to poor diabetes self-management (DSM) and suboptimal glycemic regulation (A1c) (Helgeson et al., 2010; Helgeson et al., 2009). Protective factors have been documented to improve the well-being of adolescents with T1D by decreasing the risk of stress, depression, and anxiety which could improve DSM and A1c (Hilliard et al., 2016). Mindfulness, either as an individual trait or as a result of training, has been identified as a protective factor against stress (Marks et al., 2010) and is associated with positive well-being (Loucks et al., 2016). However, there has been limited investigation of mindfulness among adolescents with chronic disorders in general and among adolescents with T1D in particular.

Mindfulness, as defined by John Kabat Zinn, is "paying attention in a particular way on purpose, in the present moment, and nonjudgmentally"(Jon Kabat-Zinn, 2009). Trait or dispositional mindfulness is an inherent state of consciousness that varies naturally across individuals (i.e., high states of awareness with attitude of nonjudgmental acceptance to automatic and mindless thoughts or actions)(K. W. Brown & R. M. Ryan, 2003; Shelov et al., 2009) and can be enhanced by training (S. L. Shapiro et al., 2006). In applied psychology, mindfulness is defined by: attention and awareness of one's present moment experience while adopting an attitude of acceptance toward one's experience (Creswell, 2017). In academic psychology, mindfulness has

been described as a multifaceted concept with several dimensions: (1) Observing the present-moment experience, (2) Describing the experiences into words, (3) Acting with Awareness, rather than responding automatically or absent-mindedly, (4) Being nonjudgmental of experience (i.e., taking nonjudging stance toward the experience), and (5) Being nonreactive to inner experience (i.e., nonreactive response toward internal experience such as cognitions, emotions, and bodily sensations)(Baer et al., 2006). Studies have suggested that the stress-reducing capacities of mindfulness is associated with improving health-related outcomes (Creswell & Lindsay, 2014). Furthermore, compelling evidence suggests that specific facets of mindfulness are more predictive of different aspects of well-being.(Hiba Abujaradeh et al., 2020; J. van Son et al., 2015) Thus, there is a need to examine mindfulness as a unidimensional concept and as a multifaceted concept.

Evidence has shown that higher levels of mindfulness are associated with more positive psychosocial variables among adolescents with chronic disorders.(Cillessen et al., 2017; Patterson & McDonald, 2015) For example, higher levels of mindfulness were associated with less psychological distress in adolescents and young adults with cancer, (Patterson & McDonald, 2015) and less stress and better asthma-related quality of life among adolescents with asthma.(Cillessen et al., 2017) Moreover, higher levels of mindfulness have been associated with lower levels of depression and anxiety and could be a potentially protective characteristic against the influence of stressful events on depression and anxiety among adults with T1D and type 2 Diabetes (T2D).(J. van Son et al., 2015) In particular, mindfulness facets of Acting with Awareness, Nonjudgment, and Nonreactivity were significant predictors of depressive symptoms and anxiety.(J. van Son et al., 2015)

Mindfulness has also been beneficial for bio-behavioral variables in adult populations. Mindfulness was identified as a significant predictor of DSM in adults with T2D. (J. Brown, 2014)

A significant association between mindfulness and glucose regulation was also found in participants from the general population.(Loucks et al., 2016) Mixed findings were reported on the relationship between mindfulness and glycemic regulation in adults with diabetes. Nagel et. el., (2020) found that in a group of young adult (18-31 years) with T1D that higher levels of mindfulness were associated with better glycemic regulation among the oldest group only (27-31 years).(Nagel et al., 2020) Fanning et. al., found no association between mindfulness and glycemic regulation after adjusting for covariates in adults with T2D.(Fanning, Osborn, Lagotte, & Mayberry, 2018)While these studies all point to the benefits of mindfulness, more research is needed to expand these findings to other population such as adolescents with T1D. Furthermore, it is imperative to identify which aspects of mindfulness are related to improve mental and physical health in adolescents with T1D. Thus, this study sought to: 1) examine the association of mindfulness (i.e., unidimensional concept) with psychosocial variables (i.e., stress, diabetes distress, and depressive symptoms, and anxiety) and bio-behavioral (i.e., DSM and A1c) variables, adjusting for covariates (i.e., age, gender, and duration of disease, [in addition to this, controlling for DSM for A1c]); and 2) examine which mindfulness facets (Observe, Describe, Act with Awareness, Nonjudgement, and Nonreactivity) are associated with psychosocial and bio-behavioral variables in adolescents with T1D.

5.2.1 Conceptual Framework

This study was guided by the bio-psychosocial stress theory which posits that a protective factor such as mindfulness is associated with positive biological variables (i.e., A1c) through psychological (i.e., reducing stress, diabetes distress, depressive symptoms, and anxiety) and behavioral (i.e., DSM) pathways. In addition, mindfulness-stress-buffering theory, proposed by

Creswell and Lindsay (2014),(Creswell & Lindsay, 2014)·(K. W. Brown et al., 2012) provides additional explanatory evidence for our framework. Mindfulness-stress-buffering theory suggests that mindfulness ability to mitigate stress appraisals and reduce stress-reactivity response explains how mindfulness may improve health outcomes. Thus, mindfulness can be beneficial to individuals with stress-related diseases. Mindfulness tends to have a greater effect among high-stress populations, such as, those with psychological distress and patients with diseases that can be triggered or exacerbate by stress (i.e., poor glycemic regulation in T1D) or stress altering health behaviors (i.e., DSM behaviors).(Creswell & Lindsay, 2014) While T1D is not caused by stress, management of T1D is associated with stress. and stress could lead to unfavorable psychosocial outcomes and poor glycemic regulation.(Hilliard et al., 2016)

5.3 Methods

5.3.1 Participants and Procedures

This observational cross-sectional study took place at the Diabetes Clinic at Children's Hospital of Pittsburgh. Physicians, nurse practitioners, nurses, and diabetes educators referred potentially eligible participants to the study staff (i.e., primary investigator [PI] or trained research assistants [RA]) who explained the study to the potentially eligible participants and screened them for their eligibility. Adolescents were eligible to participate if they were between the ages of 12 and 18 years, had diagnosis of T1D for at least 1 year prior to enrollment, and fluent in English. Adolescents with comorbid conditions that can affect cognitive abilities including autism were excluded. Participants completed the self-report measures on psychosocial and behavioral

variables via secure Qualtrics (Qualtrics LCC, 2018) Offline Application using tablet computer during the clinic visit. For adolescents who could not complete the survey during their visit, a link was sent via email/text message so they could complete the survey at their convenience. The majority (96%) completed the questionnaire during the clinic visit using tablet computer. The remaining participants (4%) received an email/ text message with a link to the survey to be completed. A1c at point-of-care was obtained from medical record. Participants were compensated for their time and participation in the study.

A total of 129 adolescents completed the study and their data were included for the analyses. Assents and informed consents were obtained from adolescents and their parents/guardians. The Institutional Review Board of University of Pittsburgh approved this study.

5.3.2 Measures

Demographic and Clinical Characteristics. Participants self-reported their gender (male, female), race (White, Black or African American, Asian, American Indian/Alaska Native, Native Hawaiian/ Pacific Islander), age (measured in years), and maternal and paternal education, which used as a proxy of socioeconomic status (SES),(Entwislea & Astone, 1994; Jalovaara & Andersson, 2018) with two categories:1: graduated from college (i.e., standard college or university graduation, graduate professional training) as an indicator of high SES and 2: did not completed/ graduated from college (grade 10 or 11, high school graduate, some college: at least one year of specialized training) as an indicator of low SES. Participants also reported duration of T1D (measured in years), use of continuous glucose monitoring (yes, no), and use of insulin pump (yes, no).

Mindfulness. The Child and Adolescent Mindfulness Measure (CAMM) (Greco et al.,

2011) and the Five Facets Mindfulness Questionnaire (FFMQ)- Short Format (Hiba Abujaradeh et al., 2020; Baer et al., 2006; Tran et al., 2013) were used to assess the unidimensional and the multifaceted definitions of mindfulness. The CAMM (Greco et al., 2011) assesses adolescent's unidimensional definition of mindfulness (i.e., attention and attitude of non-judgmental acceptance to the experience). Items were rated on a 5-point Likert scale from "0=*Always true"* to "4=*Never true"*. Higher scores indicating a greater level of mindfulness. Items reflect attention and attitude of non-judgmental acceptance (e.g. "At school, I walk from class to class without noticing what I'm doing" and ''I think that some of my feelings are bad and I shouldn't have them''. The CAMM demonstrated good reliability (Cronbach's α = 0.89) in our sample. In addition, participants completed the 15-item version of the FFMQ.(H. Abujaradeh et al., 2019; Baer et al., 2006; Tran et al., 2013) The FFMQ assesses the multiple facets mindfulness (i.e., Describing, Acting with Awareness, Nonjudgement, Nonreactivity, [Mindfulness facet Observe was dropped for the FFMQ-short format in adolescents]).(Hiba Abujaradeh et al., 2020) Items were answered on a 6-point Likert scale from "1=*never or very rarely" to "*5=*very often or always true*". The FFMQ-15 and its subscales had adequate internal consistencies with Cronbach's αs of FFMQ-15=0.73;Describe=0.46; \Act with Awareness=0.89; Nonjudging=0.88; Nonreactivity=0.67. Reliabilities for the FFMQ and its subscales are very close to FFMQ for teens (Hiba Abujaradeh et al., 2020).

Stress. Participants completed the 4-item Perceived Stress Scale (PSS). The PSS assesses the degree to which participants appraise their life demands as overwhelming, unpredictable, and uncontrollable (Cohen et al., 1994). This instrument has been used extensively among adolescents (5-18 years across studies) with T1D and sufficient reliability (Cronbach's $\alpha \geq .8$) and validity has been demonstrated (Kaitlyn Rechenberg, Whittemore, Holland, & Grey, 2017). Items were

endorsed on a 5-point Likert scale from "0=never" to "4=very often". The sum of all items ranges between 0-16 with higher scores indicating greater levels of stress. The PSS had adequate internal consistency in our sample (Cronbach's α=0.74).

Diabetes Distress. Participants completed the 14-item Problem Areas in Diabetes scale (PAID)—Teen Version (**Error! Hyperlink reference not valid.**). The PAID assesses adolescent's emotional reaction toward having and managing diabetes. This tool consists of three subscales; emotional burden, family and friends distress, and regimen specific distress. Items were answered on a 6-point Likert scale from "1-2=Not a problem" to "5-6= Serious Problem". The sum of all items ranges between 14-84 with higher scores indicating greater diabetes distress. The PAID-SF had good internal consistency in our sample (Cronbach's α=0.94).

Depressive symptoms. Participants completed the 9-item Patient Health Questionnaire 9-Teens (PHQ-9-Teens) (Kroenke, Spitzer, & Williams, 2001). The PHQ-9-Teens screens for depression and severity of depressive symptoms in adolescents. Items were endorsed on a 4-point Likert scale from "0=not at all sure" to "3=nearly every day". The sum of all items ranges between 0-27 with higher scores indicating greater levels of depressive symptoms. The PHQ-9-Teens demonstrated adequate reliability (Cronbach's α=0.91) in our sample. Based on previous validation of the PHQ-9 in adolescents, a total score of $\geq$ 11 represents cutoff of depression (Richardson et al., 2010). The PI or RA assistant screened participants' responses for the PHQ scores before the adolescents left the clinic. If total scores reached threshold for the clinic protocol or suicidality item was checked, the care provider was notified and teen was referred to a social worker/ psychologist per hospital protocol.

Anxiety. Teens completed the Generalized Anxiety Disorders 7-item Scale (GAD- 7) (Spitzer et al., 2006). The GAD-7 measures anxiety symptoms on a 4-point Likert scale from

"0=not at all sure" to "3=nearly every day". The sum of all items ranges between 0-21 with higher scores indicating greater levels of anxiety symptoms. The scale demonstrated adequate reliability in our sample (Cronbach's α=0.93).

Diabetes Self-management. Teens completed the 15-item Self-Care Inventory (SCI) (A. La Greca et al., 1988). The SCI assesses how well the adolescents follow their physician's recommendations for managing diabetes, such as glucose testing, insulin administration, diet, exercise, and other diabetes-related behaviors. Items were answered on a 5-point Likert scale from "1= Never do it" to "5=Always do this as recommended." The total score ranges between 15 and 75 with higher scores indicating better self-care. The scale demonstrated adequate reliability in our sample (Cronbach's α=0.79).

***Glycemic regulation*.** A1c point-of-care was obtained from the medical record for the same day of the survey completion. A1c point-of-care is measured using Siemens DCA Vantage (reference range 4.8-6.0%, HPLC Tosoh method) (Diabetes Research in Children Network Study Group, 2005). According to the ADA guidelines, A1c level is less than 6% of total hemoglobin in healthy people and should be maintained below 7.0% (53 mmol/mol) among children and adolescents with T1D (American Diabetes Association, 2021).

5.3.3 Analytic Approach

Data were analyzed using IBM® SPSS®, version 27.(SPSS). Date were checked for accuracy. Considering that the dataset was very complete with less than 5% of missing data for variables of interest, we assumed that the missing data was completely at random and no imputation was applied. Data were screened for normality and outliers. Descriptive data (mean, standard deviation, frequency, and percentages) for raw data were provided. Pearson's correlations

(Spearman coefficients) were used to examine the bivariate associations of mindfulness and mindfulness facets with demographic and clinical characteristics, and psychosocial (stress, diabetes distress, depressive symptoms, and anxiety) and bio-behavioral (DSM and A1c) variables. To reduce bias, winsorizing method was used to variables with outliers (i.e., depressive symptoms), by substituting outliers with the highest value that is not an outlier (Wilcox, 2005). Dependent variables (i.e., anxiety) with severe skewness were logarithmically transformed for analyses. To examine the association of mindfulness (i.e., unidimensional concept) with psychosocial and bio-behavioral variables while controlling for demographic and clinical variables, several two-step hierarchical linear regression were conducted as stress, diabetes distress, depressive symptoms, anxiety, and DSM and A1c the dependent variable in each model. Demographic and clinical variables were entered in the first block, followed by mindfulness (CAAM) in the second block. To examine the association of mindfulness facets (Describe, Act with Awareness, Nonjudgement, and Nonreactivity) with psychosocial and bio-behavioral variables, several two-step hierarchical linear regression models were conducted. Demographic and clinical variables were entered in the first block, followed by mindfulness facets (Describe, Act with Awareness, Nonjudgement, and Nonreactivity) in the second block. For all regression models, Standardized Beta coefficients, partial r, and P-values as well as the proportion of the variance accounted for CAMM or mindfulness facets were reported.

5.4 Results

5.4.1 Participants Characteristics

Adolescents (n=129) were 59% male and 89% white. Adolescents had a mean age of 14.9±1.8 years and a mean diabetes duration of 7.0±3.9 years. The mean of A1c was 8.3±1.7%. Sixty-eight percent were on CGM and 60% used insulin pump. The characteristics of the participants are detailed in Table 5.

Table 5 Descriptive Statistics for Demographics and Clinical Characteristics of the Participants

	N(%)	M (SD)	Min	Max
Age		14.94 (1.81)	12.00	18.00
Gender				
Male	77(59.2%)			
Female	53(40.8%)			
Race/Ethnicity				
Caucasian	115 (88.5%)			
Minorities				
AA	9 (6.9%)			
Asian	1 (.8%)			
AA/AN	4 (3.1%)			
NH/PI	1 (0.8%)			
Insurance				
Private	70 (53.8%)			
Public	72 (55.4%)			
Others	5 (3.8%)			
Duration of diabetes		7.04 (3.88)	1	16
A1c		8.34 (1.68)	5.40	14.00
Insulin				
Injections	52 (40.0%)			
pump	78 (60.0%)			
CGM				
Yes	88 (67.7%)			
No	42 (32.3%)			
Living with				
Both parents				
Parent and stepparent				
One parent				
Other				
Mother education				
Not applicable/Unknow	2 (1.5%)			
Grade 9 or less	1 (0.8%)			
High school graduate	28 (21.5%)			
Some college; at least 1 yr of specialized training	35 (26.9%)			
Standard college or university graduation	43 (33.1%)			
Graduate/ Professional training	21 (16.2%)			
Father education				
Not applicable/ unknown	8 (6.2%)			
Grade 9 or less	3 (2.3%)			
Grade 10 or 11	1 (0.8%)			
High school graduate	37 (28.5%)			
Some college; at least 1 yr of specialized training	30 (23.1%)			
Standard college or university graduation	34 (26.2%)			
Graduate/ Professional training	17 (13.1%)			

Note: Total *N* = 129 (unless specified)

* AA: African American; AI/AN: American Indian/ Alaska Native; NH/PI: Native Hawaiian/ Pacific Islander; CGM: continuous glucose monitoring

Participants had upper moderate levels of mindfulness using CAMM (mean 30.71± 8.00; range= 10-40) and had low to high levels across mindfulness facets with high levels of Act with Awareness (mean: 4.12±0.94; range=1.25-5.00) and Nonjudgment (mean: 4.34±0.91; range=1.25-5.00); moderate levels of mindfulness facet Describe (mean: 3.62 ±0.54; range=1.33-5.00); and low levels of Non reactivity (mean: 2.22±0.93; range=1.00-4.50). Regarding psychosocial and bio-behavioral variables, participants reported low levels of stress (mean:5.06±3.44; range=0.00-16.00), moderate levels of DD (mean:31.21±15.50; range=14-80), low levels of depression (mean:3.36±4.92; range=0.00-26.00) and anxiety (mean:3.29±4.88; range=0-21) , upper moderate levels of DSM (mean: 57.18±.8.18; range=15-75); and A1c of 8.3±1.69% (range: 5.40 – 14.50). Ten percent had elevated depressive symptoms (cut-off point ≥11) and 23% had elevated levels of DD (cut-off point ≥44). Descriptive of mindfulness, psychosocial, and bio-behavioral variables are presented in Table 6.

Table 6 Descriptive Statistics for Mindfulness, Psychosocial(i.e., stress, diabetes distress, depressive symptoms, and anxiety) and bio-behavioral (i.e., DSM and A1c) Variables

	N(%)	M (SD)	Min	Max
CAMM		30.71(8.00)	10.00	40.00
FFMQ		3.57(0.54)	1.53	4.53
Describe		3.62(0.845)	1.33	5.00
Act with Awareness		4.12(0.94)	1.00	5.00
Nonjudgment		4.34(0.91)	1.25	5.00
Non reactivity		2.22(0.93)	1.00	4.50
Perceived Stress Scale		5.06(3.44)	0.00	16.00
Diabetes related stress		17.65(5.81)	10.00	37.00
Diabetes Distress		31.21(15.50)	14.00	80.00
Clinically significant (≥44)	30(23.3%)			
Nonclinical significant	99(76.7%)			
Depressive Symptoms		3.36±4.92	0.00	26.00
Clinically significant (≥11)	13(10.1%)			
Anxiety		3.29(4.88)	0.00	21.00
DSM		57.18 (8.18)	35.00	75.00
A1c		8.33(1.69)	5.40	14.50

Note: Total *N* = 129 (unless specified)
* CAMM: Child and Adolescents Mindfulness Measure; FFMQ: Five Facets Mindfulness; DSM: diabetes self-management

5.4.2 Correlations between Mindfulness, Mindfulness Facets, Psychosocial, and Bio-behavioral Variables

Regarding demographic and clinical characteristics, mindfulness (CAMM) was associated with gender (r= 0.299**: P<.01), whereby males had significantly higher levels of mindfulness (t(127)=-3.53; 32.66±7.51 vs 27.81±7.91; p=0.001) compared with females; and positively associated with duration of diabetes (r=0.195; P<.05), with longer duration of diabetes was associated with higher levels of mindfulness. Of mindfulness facets, Act with Awareness and Nonjudgment had weak association with gender (P<.01, P<.05, respectively), with males had significantly higher levels of Act with Awareness (t(127)=-3.01; 4.3±0.86 vs 3.8±0.96; p=0.002) and Nonjudgment (t(127)=-2.59; 4.5± 0.8 vs 4.1±1.0; p=0.011) compared with females.

Mindfulness measured by CAMM had positive moderate-to-strong association with Act with Awareness (r=0.664; p<0.001) and Nonjudgment (r=0.764; p<.001).

5.4.3 Correlations of Mindfulness with Psychosocial, and Bio-behavioral Variables

The zero-order correlations between mindfulness as a unidimensional concept (CAMM) and all psychosocial variables were negative and moderate to strong (range: r=-0.554 to r=-0.688, all Ps<.01). Higher levels of mindfulness were associated with lower levels of stress, diabetes distress, depression, and anxiety. Mindfulness had a positive weak association with DSM (r=0.245, P=.05), with high levels of mindfulness scores were associated with higher DSM scores. Mindfulness as unidimensional definition was not associated with A1c (r=-0.107, P=.226). See Table 7.

Table 7 Correlations between Mindfulness (Unidimensional) and Demographics and Clinical Characteristics and Psychosocial (i.e., stress, diabetes distress, depressive symptoms, and anxiety) and bio-behavioral (i.e., DSM and A1c)

	Mindfulness (CAMM)	Gender	Age	DOD	Maternal education	Paternal education	Stress	Diabetes Distress	Depressive symptoms	Anxiety	DSM
Mindfulness	---										
Gender	0.299**	---									
Age	0.038	0.234**	---								
DOD	0.195*	0.086	0.150	---							
Maternal education	0.144	-0.022	-0.095	-0.012	---						
Paternal education	-0.042	-0.034	-0.060	0.063	0.371**						
Stress	-0.554**	-0.124	0.073	-0.067	-0.088	0.143	---				
Diabetes Distress	-0.646**	-0.350**	0.090	-0.054	-0.050	0.019	0.628**	---			
Depressive symptoms	-0.688**	-0.207*	-0.060	-0.126	-0.091	-0.009	0.623**	0.641**	---		
Anxiety	-0.670**	-0.301**	0.053	-0.147	-0.097	-0.005	0.561**	0.681**	0.791**	---	
DSM	0.245**	0.067	-0.223*	0.008	0.157	0.135	-0.310**	-0.396**	-0.265**	-0.242**	---
A1c	-0.099	0.098	0.127	0.216*	-0.177*	-0.130	0.290**	0.236**	0.220*	0.117	-0.328**

CAMM: Child and Adolescents Mindfulness Measure; DOD: duration of diabetes; DSM; diabetes self-management; A1c; glycemic regulation

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

*. Correlation is significant at the 0.05 level (2-tailed)

Total n= 129,

Socioeconomic status as indicated by maternal and paternal education (i.e., not graduated from college such as secondary school, high school, some college vs. completed/ graduated from college such as graduated from university and graduate education [0= not graduated from college , 1= completed/ graduated from college]).

Gender was categorized into male and female (0=female, male=1).

5.4.4 Correlations of Mindfulness Facets with Psychosocial and Bio-behavioral Variables

The zero-order correlations of mindfulness facets Describe, Act with Awareness, and Nonjudgement with stress, diabetes distress, depression, and anxiety were negative and moderate to strong (r's range=-0.467- r=-0.809, all Ps<.001), except for Describe facet that had a small correlation with diabetes distress (r=-0.387, P<.001). This means that higher levels of mindfulness facets Describe, Act with Awareness, and Nonjudgement were associated with lower stress, diabetes distress, depression, and anxiety. Nonreactivity had a weak correlation with depressive symptoms (r=0.211, P<.05).

Regarding bio-behavioral variables, mindfulness facets Describe, Act with Awareness, and Nonjudgement had a minimal positive correlation with DSM (range: r=0.189 to r= 0.290; all Ps <.05), with higher levels of Describe, Act with Awareness, and Nonjudgement were associated with higher DSM scores. Nonreactivity had small negative correlation with A1c (r=-0.243, P<.001), whereby higher levels of Nonreactivity is associated with lower A1c values). See Table 8.

Table 8 Correlations of FFMQ and Mindfulness Facets with Demographics and Clinical Characteristics and Psychosocial (i.e., stress, diabetes distress, depressive symptoms, and anxiety) and bio-behavioral (i.e., DSM and A1c)

	Mindfulness (FFMQ)	Describe	Act with Awareness	Nonjudgment	Nonreactivity
Mindfulness (FFMQ)	---				
Describe	0.754**	---			
Act with Awareness	0.762**	0.467**	---		
Nonjudgment	0.754**	0.509**	0.659**	---	
Non reactivity	0.149	-0.013	-0.320**	-0.353**	---
Gender	0.202*	0.140	0.268**	0.224*	-0.148
Age	0.099	-0.010	0.065	0.060	0.096
DOD	0.056	0.024	0.072	0.122	-0.087
Maternal education	0.106	0.142	0.096	0.041	-0.004
Paternal education	0.034	-0.009	0.000	-0.038	0.118
Stress	-0.661**	-0.513**	-0.467**	-0.627**	-0.001
DD	-0.616**	-0.387**	-0.557**	-0.693**	0.167
Depressive symptoms	-0.785**	-0.527**	-0.757**	-0.809**	0.211*
Anxiety	-0.748**	-0.491**	-0.693**	-0.760**	0.155
DSM	0.239**	0.196*	0.189*	0.290**	-0.089
A1c	-0.239**	-0.171	-0.062	-0.099	-0.243**

FFMQ: Five Facets Mindfulness; DOD: duration of diabetes; SES: socioeconomic status; DSM; diabetes self-management
**. Correlation is significant at the 0.01 level (2-tailed)
*. Correlation is significant at the 0.05 level (2-tailed)
Total n= 129,
Socioeconomic status as indicated by maternal and paternal education (i.e., not graduated from college such as secondary school,
high school, some college vs. completed/ graduated from college such as graduated from university and graduate education
[0= not graduated from college, 1= completed/ graduated from college]).
Gender was categorized into male and female (0=female,1= male).

5.4.5 Regression Models of Mindfulness and Mindfulness Facets and Psychological and Bio-behavioral Variables

Multivariate multiple regression showed there is omnibus significant association between mindfulness (CAMM) and psychosocial: $F(24, 129) = 6.74$;Wilks' Lambda=0.319; $p<.001$)and bio-behavioral variables: $F(12, 129) = 2.65$; Wilks' Lambda=0.781; $p=0.002$. Multivariate

multiple regression also showed there is omnibus significant association between mindfulness facets (Describe, Act with Awareness, Nonjudgment, and Nonreactivity) and psychosocial: F(36, 129) = 9.8; Wilks' Lambda=0.108; p<.001and bio-behavioral: F(18,129) = 2.75; Wilks' Lambda= .683; p<.001) variables. Several multiple hierarchical linear regression models were conducted after to find the significant associations between particular variables of interest.

Two-step hierarchical linear regression models, using enter method, showed that mindfulness as a unidimensional concept (CAMM) was significantly associated with all psychosocial variables, adjusting for demographic and clinical variables. Mindfulness (CAMM) significantly was associated with stress (*ß*= -0.553, Partial r= -0.529, p <.001), diabetes distress (*ß*= -0.612, Partial r= -0.613, p <.001), depressive symptoms (*ß*= -0.705, Partial r= -0.669, p <.001), and anxiety (*ß*= -0.643, Partial r= -0.646, p <.001). In these regression models that adjusted for gender, age, duration of diabetes, and SES (maternal and paternal education), mindfulness (CAMM) accounted uniquely for 25.9 % of the variance in stress (ΔR^2 = 0.259); 31.1% for diabetes distress (ΔR^2 = 0.316), 41.8% depressive symptoms (ΔR^2 = 0.418), and 34.9% anxiety (ΔR^2 = 0.349). Regarding bio-behavioral variables, mindfulness was positively associated with DSM (*ß*= 0.235, Partial r= 0.227, p= 0.011), adjusting for gender, age, duration of diabetes, and SES (i.e., maternal and paternal education). Mindfulness as a unidimensional concept accounted uniquely for 4.7% of the variance in DSM (ΔR^2 = 0.047). Standardized regression coefficients, partial correlations, and p-values of the regression models are represented in Table 9.

Table 9 Linear Regression Models for the Association of Mindfulness (CAMM) with Psychosocial Variables

Diabetes Distress (DD) and Depressive Symptoms with BGM Checks

	Stress			Diabetes Distress			Depressive Symptoms		
	ß	Partial r	p-value	ß	Partial r	p-value	ß	Partial r	p-value
Gender	0.023	-0.026	0.774	-0.209	-0.258	0.004	0.009	0.011	0.903
Maternal Education	-0.053	-0.058	0.519	0.061	0.076	0.403	0.038	0.048	0.600
Paternal Education	0.145	0.161	0.074	-0.030	-0.039	0.671	-0.054	-0.069	0.449
Age	0.157	0.105	0.244	0.157	0.203	0.024	-0.047	-0.063	0.488
DOD	0.062	0.018	0.839	0.062	0.083	0.361	0.025	0.034	0.707
Mindfulness (CAMM)	-0.612	-0.529	<.001	-0.612	-0.613	<.001	-0.705	-0.669	<.001

	LG10Anxiety			DSM			A1c		
	ß	Partial r	p-value	ß	Partial r	p-value	ß	Partial r	p-value
Gender	-0.140	0.183	0.042	0.057	0.057	0.530	0.126	-0.128	0.156
Maternal Education	-0.050	-0.065	0.474	0.062	0.060	0.507	-0.084	-0.120	0.353
Paternal Education	0.024	0.032	0.724	0.111	0.109	0.229	-0.074		0.407
Age	0.128	0.173	0.054	-0.231	-0.231	0.010	-0.012	-0.012	0.891
DOD	-0.040	-0.055	0.541	-0.014	-0.015	0.871	0.233	0.236	0.007
DSM (A1c)							-0.293	-0.298	0.001
Mindfulness (CAMM)	-0.643	-0.646	<.001	0.235	0.227	0.011	-0.101	-0.090	0.271

LG10: Log10; CAMM: Child and Adolescents Mindfulness Measure; DOD: duration of diabetes; SES: socioeconomic status;
DSM; diabetes self-management
**. p<.05. ß Standardized Coefficients*
***. p<.01*
Socioeconomic status as indicated by maternal and paternal education (i.e., not graduated from college such as secondary school, high school, some college vs. completed/ graduated from college such as graduated from university and graduate education [0= not graduated from college, 1= completed/ graduated from college]). Gender was categorized into male and female (0=female,1= male).

Regression models that included mindfulness facets with psychosocial variables, adjusting for demographic and clinical variables, showed that mindfulness facets Act with Awareness, Nonjudgement, and Nonreactivity were significantly negatively associated with psychosocial variables of diabetes related stress (*ß*= -0.169,-0.618,-0.164; Partial r= -0.184,-0.549;-0.217; p=0.044, <.001, =0.017), diabetes distress (*ß*= -0.618, -0.164; Partial r= -0.549, -0.217; p <.001,=0.017; respectively), depressive symptoms (*ß*=-0.396, -0.552, -0.109; Partial r=-0.501, -0.612, -0.192; p <.001, <.001,= 0.035; respectively), and anxiety (*ß*= -0.239, -0.550, -0.163; Partial r= -0.411, -0.582, -0.309, p =.002, <.001,= 0.008, respectively). Stress was significantly

associated with Describe, Nonjudgement, and Nonreactivity (ß= -0.161, -0.566, -0.281; Partial r= -0.106, -0.496, -0.341, p =.039, <.001, <0.001, respectively) . After accounting for demographic and clinical characteristics, mindfulness facets explained 46.3% of the variance in stress (ΔR^2 = 0.463), 42.5% diabetes distress (ΔR^2 = 0.425), 69.8% of depressive symptoms (ΔR^2 = 0.698), and 50.1% of anxiety (ΔR^2 = 0.501).

Regarding bio-behavioral variables, Nonjudgment was significantly positively associated with DSM (ß=0.301, Partial r=0.221; p=0.015) and Nonreactivity was significantly negatively associated with A1c (ß=-0.291, partial r=-0.285; p=.002). See Table 10. After accounting for demographic and clinical characteristics, mindfulness facets explained 8.1% of the variance in DSM (ΔR^2 = 0.08) and 8.0% of the variance in A1c (ΔR^2 = 0.080).

Table 10 Linear Regression Models for the Association of Mindfulness Facets with Psychosocial Variables

Diabetes Distress (DD) and Depressive Symptoms with BGM Checks

	Stress			*Diabetes Distress*			*Depressive Symptoms*		
	ß	Partial r	P-value	ß	Partial r	P-value	ß	Partial r	P-value
Gender	-0.016	-0.022	0.813	-0.246	-0.335	<.001	0.016	0.030	0.741
Maternal education	-0.094	-0.124	0.174	-0.008	-0.012	0.898	-0.006	-0.011	0.902
Paternal education	0.199	0.259	0.004	0.022	0.031	0.732	-0.010	-0.019	0.837
Age	0.153	0.208	0.022	0.211	0.295	0.001	0.001	0.001	0.989
DOD	-0.047	-0.067	0.467	0.006	0.009	0.922	-0.035	-0.070	0.444
Describe	-0.161	-0.188	0.039	0.041	0.051	0.575	-0.069	-0.113	0.216
Act with Awareness	-0.101	-0.106	0.248	-0.169	-0.184	0.044	-0.396	-0.501	<.001
Nonjudgment	-0.566	-0.496	<.001	-0.618	-0.549	<.001	-0.552	-0.612	<.001
Nonreactivity	-0.281	-0.341	<.001	-0.164	-0.217	0.017	-0.109	-0.192	0.035

	Anxiety			DSM			A1c		
		Partial r	p-value	ß	Partial r	p-value	ß	Partial r	p-value
Gender	-0.164	0.241	0.005	0.069	0.071	0.441	0.086	0.093	0.313
Mother education	-0.101	-0.048	0.085	0.085	0.084	0.357	-0.098	-0.103	0.262
Father education	0.074		0.206	0.099	0.099	0.282	-0.033	-0.035	0.707
Age	0.181	0.289	0.002	-0.245	-0.246	0.007	0.037	0.039	0.669
DOD	-0.103	-0.153	0.061	0.001	0.001	0.991	0.200	0.222	0.015
DSM (A1c)							-0.284	-0.289	0.001
Describe	-0.080	-0.033	0.224	0.031	0.027	0.765	-0.047	-0.044	0.630
Act with Awareness	-0.239	-0.411	0.002	-0.025	-0.019	0.834	-0.035	-0.029	0.755
Nonjudgment	-0.550	-0.582	<.001	0.301	0.221	0.015	-0.116	-0.090	0.329
Nonreactivity	-0.163	-0.309	0.008	0.033	0.032	0.731	-0.291	-0.285	0.002

DOD: duration of diabetes; SES: socioeconomic status; DSM; diabetes self-management

**. p<.05. ß Standardized Coefficients*

***. p<.01*

Socioeconomic status as indicated by maternal education (i.e., not graduated from college such as secondary school, high school, some college vs. completed/ graduated from college such as graduated from university and graduate education [0= not graduated from college , 1= completed/ graduated from college]). Gender was categorized into male and female (1= male, 2=female).

5.5 Discussion

In this study, we examined the relationship of mindfulness as unidimensional and multifaceted definition with psychosocial (i.e., stress, diabetes distress, and depressive symptoms, and anxiety) and bio-behavioral (i.e., DSM and A1c) variables in a sample of adolescents with T1D. Our sample had moderate to high levels of mindfulness (CAMM scale: mean 30.71± 8.00; range= 10-40) which is numerically higher than that reported for mindfulness levels for adolescents who finished chemotherapy (Patterson & McDonald, 2015) and community dwelling adolescents in a school setting (de Bruin et al., 2014; Patterson & McDonald, 2015). In regard to mindfulness facets, our adolescents had high levels of Act with Awareness and Nonjudgment that are higher than reported levels for high-schoolers, moderate levels of Describe that is similar to the reported level for high-schoolers, and low levels of Nonreactivity that is lower than reported levels for sample of high-schoolers (Hiba Abujaradeh et al., 2020), Mindfulness facet Describe depicts the adolescents' ability to put the experiences and thoughts into words. Act with Awareness describes the adolescents' tendency to be aware of the current moment and not respond automatically or absent-mindedly. Nonjudgment means taking nonjudging stance toward the experience (Baer et al., 2006). Nonreactivity describes the adolescents' tendency to be aware of the distressing thoughts and emotions without automatically responding to them (Baer et al., 2006) (Brian M. Galla, Tsukayama, Park, Yu, & Duckworth, 2020). For example, adolescents with T1D and low levels of Nonreactivity may blame themselves for high blood glucose readings, may feel they want to give up, feel anger and get frustrated. When adolescents experience these difficult situations, they may react by avoiding these negative thoughts and feelings and may engage in binge eating or other risky behaviors to comfort themselves. When being mindful, adolescents will notice the difficult moment, avoid being judgmental, and focus on how to help themselves in

every moment when managing diabetes.

Results showed that mindfulness as a unidimensional concept was significantly associated with psychosocial variables. Specific mindfulness facets were independently associated with different psychosocial variables. In particular, mindfulness facets of Act with Awareness, Nonjudgement and Nonreactivity were significantly associated with all psychosocial variables, except for Act with Awareness that was not associated with stress. Adolescents who were more aware of their moments and actions; less judgmental of current situation; and more aware of distressing thoughts and feelings without being overtaken by them, had lower levels of emotional distress including diabetes distress, depressive symptoms, and anxiety. Stress was associated with mindfulness facets Describe, Nonjudgement and Nonreactivity. This implies that adolescents with higher propensity to describe experience, in addition, to the high propensity of being less judgmental and more aware of distressing thoughts and feelings without reacting to them, have less stress.

These findings are, to great extent, consistent with previous studies in other populations. For example, van Son et al. (2014) found association between mindfulness facets Act with Awareness, Nonjudgement and Nonreactivity and symptoms of anxiety and depression in a sample of adults with T1D and T2D (J. van Son et al., 2015). Royuela-Colomer & Calvete (2016) found Acting with awareness and Nonreactivity to be predictors of depressive symptoms over time in a sample of adolescents (Royuela-Colomer & Calvete, 2016). Abujaradeh et al. (2019) found Act with Awareness, Nonjudgement and Nonreactivity to be predictors of stress in a sample of high school adolescents (Hiba Abujaradeh et al., 2020). On the other hand, inconsistent with the mentioned studies we found mindfulness facet Describe to be associated with stress. A possible explanation could be that adolescents' propensity to describe their feelings and experiences of

living with and managing diabetes with their parents and healthcare providers help them share their experiences and relieve the stress. In general, these findings highlight the value of considering how specific dimensions of mindfulness may be more predictive of different psychosocial variables and how to develop mindfulness intervention that target specific aspects of mindfulness.

Regarding bio-behavioral variables, mindfulness as a unidimensional concept was significantly associated with DSM but not A1c. Stress may impede individual's ability to engage in self-care behaviors, and mindfulness as a protective factor enhance one's ability to respond adaptively to different situation and adhere to DSM behaviors. When examining mindfulness facets, adolescents with higher levels of Nonjudgment had greater DSM scores and those with higher levels of Nonreactivity had lower A1c. While our finding that Nonjudgement was associated with DSM is consistent with a sample of veterans with either type 1 or type 2 diabetes at three months after receiving a brief mindfulness intervention that was part of diabetes management education class (DiNardo et al., 2017), it was inconsistent with the same study where Nonreactivity was significantly associated with DSM also. It is possible that Nonjudgment is more important than Nonreactivity for DSM in adolescents with T1D. Furthermore, we found nonreactivity to be a significant predictor of A1c, while this is a new finding, it is the first time to be examined in adolescents. However, supporting evidence from young adults with T1D showed that higher level of mindfulness (unidimensional concept) is associated with better glycemic regulation only in adults between 27-31 years old, but not in younger adults (18-26 years) (Nagel et al., 2020).

Our findings support that mindfulness is associated with better psychological, behavioral and phyical health in adolescents' with T1D. Different aspects of mindfulness are particulary asscoiated with different aspects of mental and physcial health. Based on these findings, future

research could assess mindfulness levels of adolescents with T1D at their annual psychological screening caould identify adolescent's mindfulness level, identify which aspect of mindfulness needs to be targeted, and help shape patient-centered mindfulness interventions for adolescents with T1D. In addition, mindfulness based interventions that are tailored to adolescents with T1D could be explored for their feasibility, mode of delivery, and effectiveness in improving adolescents mental and physical health. Considering that adolescents with diabetes are exposed to stressors, mindfulness can be an adjunct therapy to help adolescents with T1D to reduce their stressors and psychological distress and improve DSM and glycemic regulation.

Evidence regarding mindfulness based intervention in adolescents with T1D is needed. However, a recent pilot study among older adolescents and young adults with T1D showed that participation in mindfulness based intervention reduced stress and improved blood glucose levels (Ellis et al., 2018). In addition, a systematic review in adolescents with chronic disorders found mindfulness-based intervention to be effective for psychological symptoms including depression and distress and recommended expanding mindfulness-based intervention to include adolescents with diabetes (H. Abujaradeh, Safadi, et al., 2018). In the clinical setting, mindfulness could be explored as a standard mindfulness-based stress reduction that is tailored toward adolescents with diabetes (H. Abujaradeh, Safadi, et al., 2018), or a brief mindfulness training can be provided as a part of standard diabetes self-management education (DiNardo et al., 2017). Additionally, mindfulness-based intervention that is tailored toward adolescents can be offered through mobile application where adolescents have access to mindfulness practices and track their psychosocial and bio-behavioral variables. Future studies could examine these modes of delivery.

Our study had several strengths, including the use of comprehensive measures for mindfulness, both unidimensional definition and multidimensional aspects; an objective measure

of A1c; and inclusion of developmentally appropriate tools to measure psychosocial variables in adolescents. Despite the many strengths of this study, there are some important limitations that should be considered and therefore, the findings should be interpreted with caution. This study was limited by the use of the cross-sectional design, which prevented us from drawing any causal conclusions about the associations between constructs of interest. The use of convenience sample limited the generalizability of the study. In addition, adolescents could feel judged by their healthcare providers as they completed the survey in the clinic. To decrease the bias, this study can be conducted in a less judgmental setting like outside the clinic. Despite these limitations, the current findings appear to support that mindfulness or some mindfulness facets are associated with better psychological health, DSM, and glycemic regulation in adolescents' with T1D. Furthermore, the findings suggest that targeting particular mindfilness facets in mindfulness-based interventions could be beneficial.

6.0 Results: Exploratory Aims

6.1 Exploratory Aim 5: The association between trait mindfulness and stigma toward chronic disorder

Adolescents with T1D had low anticipated stigma (prejudice, stereotyping, and discrimination) toward people living with chronic disorder (mean= 1.23, SD=0.34, range=1-5). Regarding CIASS subscales, adolescents had low anticipated stigma toward people living with chronic illness if they were family/ friends (mean= 1.13, SD=0.33, range=1-5), low anticipated stigma toward people living with chronic illness if they were other students (mean=1.41, SD=0.61, range=1-5), and low anticipated stigma of healthcare providers toward people living with chronic illness (mean= 1.21, SD=0.41, range=1-5).

Higher levels of mindfulness were associated with lower levels of stigma toward chronic disorder. Mindfulness as measured by CAMM had a moderate correlations with adolescents' anticipated stigma toward people living with chronic illness in general (r_s = -0.403). Mindfulness had a small negative association with adolescents' anticipated stigma toward people living with chronic illness if they were family/ friends (r_s= -0.320), anticipated stigma toward people living with chronic illness if they were other students (r_s= -0.317), and anticipated stigma of healthcare providers toward people living with chronic illness (r_s= -248). Table 11 presents the Spearman correlation analysis among Mindfulness (CAMM) and the Chronic Illness Anticipated Stigma Scale and its subscale. In summary, adolescents in our sample had low levels of anticipated stigma (prejudice, stereotyping, and discrimination) toward people living with chronic disorder.

Adolescents with higher levels (better) of mindfulness were associated with lower levels (better) of stigma toward chronic disorder in the expected direction.

Table 11 Correlations between Mindfulness (CAMM) and the Chronic Illness Anticipated Stigma Scale and its subscale

	Mindfulness (CAMM)	CIASS	CIASS-FF	CIASS-Students
Mindfulness (CAMM)				
CIASS	-0.302**			
CIASS-FF	-0.225*	0.741**		
CIASS-Students	-0.281**	0.813**	0.444**	
CIASS-HCP	-.0192*	0.762**	0.380**	0.372**

6.2 Exploratory Aim 6: The potential moderating and mediating role of shared responsibility on the relationship between trait mindfulness and bio-behavioral variables.

6.2.1 The potential moderating role of shared responsibility on the relationship between trait mindfulness and bio-behavioral variables.

Shared responsibility was tested as a moderator of the relationship of trait mindfulness (CAMM) with DSM and A1c. Shared responsibility did not moderate the relationship between mindfulness and DSM. In the first model, both shared responsibility and trait mindfulness were

associated with DSM (*ß*= 0.210,0.259; Partial r= 0.216, 0.263; p=0.015, 0.003). After entering the interaction term, neither main variable nor interaction term were significantly associated with DSM (ps>05). The first model explained 13.2 % of the variance in DSM. The addition of interaction term was not significant ($\Delta R^2 = 0.001$).

Shared responsibility did not moderate the relationship between mindfulness and A1c. The first model that included mindfulness and shared responsibility was not significantly associated with A1c (all ps>0.05). After entering the interaction term, neither main variable nor interaction term were significantly associated with A1c (ps>05).

6.2.2 The potential mediating role of shared responsibility on the relationship between trait mindfulness and bio-behavioral variables.

Mindfulness had positive significant association with shared responsibility (a-path=0.974, SE=.045, β=.189, R^2=.036, p=.032). Shared responsibility had significant association with DSM (b-path=0.055, SE=.017, β=.275, p=.0015). The direct (c') and total (c) relationships between mindfulness and DSM were significant (c'-path=0.198, SE=.087, β=.193, p=.024; c-path=.251, SE=.088, β=.245, R^2=.06, p=.005). The relationship between mindfulness and DSM was partially mediated by shared responsibility (ab=0.053, SE=0.031 bias-corrected bootstrapped 95% CI = [0.0059, 0.0119]). For the second mediational model, neither mindfulness (CAMM) nor shared responsibility were associated with A1c (p>.05).

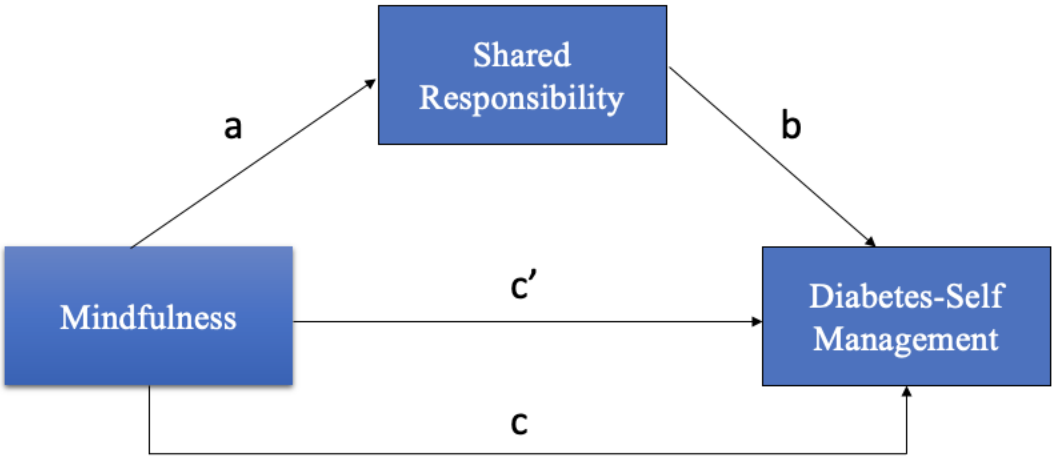

Figure 2 Path model of the mediating role of shared responsibility in the relationship between mindfulness and DSM

7.0 Summary, Discussion, Future Directions

7.1 Summary of the Study

In youth with T1D, achieving optimal glycemic regulation is the key to prevent short and long term complications. Only 16% of adolescents with T1D achieve ADA glycemic goal. Adolescents with T1D experience stress specific to their diabetes as well as general stress related to normal growth and development, family stressors, social life, school work, and peer relationship. Stress is associated with glycemic regulation through biological, psychological, and behavioral pathways. Understanding factors that worsen or buffer stress is important to improve glycemic regulation and other health-related outcomes. Mindfulness has been identified as a protective factor against stress and is associated with broad range of health-related outcomes in adults with diabetes. Limited research has examined mindfulness in adolescents with chronic disorders and in adolescents with T1D in particular. This dissertation was designed to address this gap in the literature by presenting the current literature on mindfulness and mindfulness-based intervention in adolescents with chronic disorders via systematic review (preliminary study; systematic review), describing and comparing trait mindfulness and mindfulness practices on demographic and clinical characteristics, and diabetes-related outcomes (Manuscript #1), and examining the association of trait mindfulness (both unidimensional and multi-faceted concept) with psychosocial and bio-behavioral variables (Manuscript #2). In addition, this dissertation explored the association of mindfulness with stigma toward people with chronic disorder and explored the mediating and moderating role of shared responsibility on the relationship of mindfulness with bio-behavioral variables in adolescents with T1D. In this section, we summarize

the findings and their nursing implications. Finally, we discuss what future studies could be beneficial based on this dissertation study.

The systematic review, in the appendix, presented the state of science of mindfulness-based interventions studies delivered to adolescents with chronic disorders. At the time of the initial search for the systematic review, there were no studies that examined trait mindfulness among adolescents with chronic disorders, and none that were diabetes specific. Thus, we broaden our inclusion to all mindfulness-based interventions studies delivered to adolescents with chronic disorders. A search on three data-bases (PubMed, CINAHL, and PsycINFO) revealed that there were 19 studies that examined the effectiveness of mindfulness-based interventions delivered in clinical setting to adolescents with chronic disorders. Fifteen studies included adolescents with psychiatric or pain disorders, and four included adolescents with a chronic physical disorders including cardiac problems, cancer, and headache. Psychological outcomes and pain were examined in most studies with effect sizes for mindfulness-based interventions ranging from small to large. Only one study examined cortisol as a physiological measure of stress. Our review concluded that mindfulness-based intervention studies conducted in clinical settings mainly engaged adolescents with psychiatric or pain disorders. The effectiveness of mindfulness-based interventions on improving psychological outcomes were inconsistent and only four studies were conducted among adolescents with chronic physical diseases. After we conducted the systematic review, two studies examining trait mindfulness among adolescents with chronic disorders including cancer and asthma were published (Cillessen et al., 2017; Patterson & McDonald, 2015). The findings from the systematic review offered further key validation to the scientific premise of the study and it highlighted the gap in the studies examining trait mindfulness in adolescents with

chronic physical disorders and studies examining trait mindfulness and mindfulness-based interventions among adolescents with T1D.

Using a cross-sectional design, we recruited adolescents (age=12-18 years) with T1D during diabetes clinic appointments. Participants completed measures on demographics, clinical data, trait mindfulness/practices, stress, DD, depressive symptoms, and DSM using secure Qualtrics survey app on a tablet computer. A1c was obtained from medical records.

In manuscript 1, we described mindfulness (trait and practices) and compared levels of trait mindfulness (low/high) and practices (yes/no) on demographic, clinical characteristics and diabetes-related outcomes among adolescents with T1D. T-tests and Chi-square tests were applied for comparative analyses. Our 129 adolescents (12-18yrs; 59% male; 88% white), reported moderately high levels of mindfulness (31± 8, range=10-40) and one third (30%) reported having experience with mindfulness practices (formal, informal, and religious). Based on clinical cutoff adolescents were classified to high and low mindfulness groups. Adolescents who reported higher levels of trait mindfulness had higher insulin pump usage (p=0.048), and less diabetes-specific stress (p=0.010), greater DSM (p=0.006) and less A1c (p=0.013). Adolescents who reported more types of mindfulness practices had greater DSM scores. The findings from this study appear to support the development of mindfulness interventions for adolescents with T1D and targeting adolescents with low mindfulness.

In the second manuscript, using the sample, we examined the association of trait mindfulness with psychosocial (stress, diabetes distress, depressive symptoms, and anxiety) and bio-behavioral (diabetes self-management [DSM] and glycemic regulation [A1c]) variables, and examined which mindfulness facet (Observing, Describing, Act with Awareness, Nonjudgement, and Nonreactivity) is associated with these variables. Participants completed measures on

mindfulness, stress, diabetes distress, depressive symptoms, and DSM using tablet computer. A1c was obtained from medical records. Using multivariate multiple regression, we found omnibus significant association between mindfulness (CAMM) and psychosocial: F (24, 129) = 6.74 ;Wilks' Lambda=0.319; p<.001 and bio-behavioral variables : F(12, 129) = 2.65; Wilks' Lambda=0.781; p=0.002. Multivariate multiple regression also showed there is an omnibus significant association between mindfulness facets (Describe, Act with Awareness, Nonjudgment, and Nonreactivity) and psychosocial: F(36, 129) = 9.8; Wilks' Lambda=0.108; p<.001and bio-behavioral: F(18,129) = 2.75; Wilks' Lambda= .683; p<.001) variables. Hierarchical multiple linear regression modeling was used to examine the associations of overall mindfulness and specific facets with psychosocial and bio-behavioral, adjusting for demographic and clinical characteristics. We found Mindfulness as a unidimensional concept was associated with all psychosocial variables (p<.001) and DSM (p= 0.016). Mindfulness facets of Nonjudgement and Nonreactivity were significantly associated with stress, diabetes distress, depressive symptoms, and anxiety (All Ps<0.01). Act with Awareness was significantly associated with diabetes distress (p=0.044), depressive symptoms (p<.001), and anxiety (p<.001). Mindfulness facet Describe was significantly associated with stress (p=0.026). Nonjudgment was significantly associated with DSM (p=0.015) and Nonreactivity was significantly associated with A1c (p=.001). This further investigation suggested that mindfulness-based interventions should target different mindfulness facets to improve varied aspects of adolescents with T1D mental and physical health.

Our exploratory aim 5 found that higher levels of mindfulness (CAMM) were associated with lower levels stigma toward chronic disorder. Our exploratory aim 6, found that shared responsibility partially mediated the relationship between mindfulness and DSM.

7.2 Study Strengths and Limitations

The first manuscript is novel in that it looked at both trait mindfulness and mindfulness practices. In addition, this study compared adolescents by trait mindfulness (low vs high) and mindfulness practices (presence and types) on bio-behavioral variables. Low trait mindfulness and poor mindfulness skills based on clinical cut-off have the ability to accurately about 80% of adolescents with internalizing disorders such as depressive symptoms and social withdrawal (Oppo et al., 2019). The goal of distinguishing adolescents with high and low mindfulness based on clinical cut-off provides a simple way to target adolescents with low mindfulness skills who are at high risk for psychological problem and facilitates appropriate intervention in clinical setting. To our knowledge, this the first study to use clinical cutoff to identify adolescents with low and high mindfulness. Two studies have used median split (Nagel et al., 2020; Patterson & McDonald, 2015) which may limit their conclusion to populations with similar mindfulness levels.

The second manuscript had several strengths, including but not limited to the use of comprehensive measures for mindfulness, both unidimensional definition and multidimensional aspects; using wide range of health-related measures related to the adolescents' psychological, physical and behavioral aspects, the use of an objective measure of A1c; and inclusion of developmentally appropriate tools to measure psychosocial variables in adolescents.

The exploratory aim 5 was the first to go beyond health-related measures and it included stigma toward people with chronic disorders in a sample of adolescents with chronic disorder. It is important to understand whether adolescents with chronic disorder have prejudice or stereotyping toward having chronic disorder as this would increase our knowledge of this aspect in the literature.

Finally, the exploratory aim 6 was the first to explore both shared responsibility and mindfulness in the same context. Both shared responsibility and mindfulness are associated with health-related outcomes. Share responsibility has been identified as an optimal way of parental involvement in diabetes-self management behaviors and is associated with reducing psychological distress and improving bio-behavioral variables. Exploring the potential moderating and mediating role of shared responsibility in the relationship of mindfulness and bio-behavioral variables provides could provide evidence to investigate interventions that target both mindfulness and shared responsibility.

Despite the many strengths of this study, there are some important limitations that should be considered and therefore, the findings should be interpreted with caution. First**,** this study was limited by the use of the cross-sectional design, which prevented us from drawing any causal conclusions about the associations between constructs of interest. Second, the use of convenient sampling limits the generalizability of the study findings. Third, this study was conducted in a clinical setting at the diabetes clinic which may have influenced adolescents' answers to be at their healthcare providers' expectations; however, we informed the participants that their data will be kept confidential. To decrease this bias, future studies could consider conducting the study in a nonjudgmental space where adolescents will feel less judged about their answers. Forth, the questions regarding mindfulness practices were general and were not sensitive enough to determine whether adolescents were engaged enough in mindfulness practices or not (i.e., where they learned about mindfulness, frequency, duration per practice). Despite these limitations, the current findings appear to support that mindfulness or some mindfulness facets are associated with better psychological health, DSM, and glycemic regulation in adolescents' with T1D. Furthermore,

the findings suggest that targeting particular mindfulness facets in mindfulness-based interventions could be beneficial.

7.3 Future Studies and Implications for Nursing

Future studies could consider examining the association between mindfulness and objective biological parameters of stress including cortisol and heart rates as well as other measures including incidence of hypoglycemia and diabetic keto-acidosis. In addition, examining the predictivity of mindfulness for a broad range of psychosocial and bio-behavioral variables using longitudinal design; also examining parental perspectives in addition to adolescents' perspectives Furthermore, future studies could utilize qualitative methods to obtain deeper understanding of adolescents' mindfulness and inquiring about mindfulness practices in a more detailed and sensitive manner. Moreover, future studies could examine age-appropriate, feasible and cost-effective strategies to develop and deliver mindfulness intervention to adolescents with T1D. For example, different modes of deliveries can be examined such as Telehealth, mobile apps, and in-person mindfulness interventions. Furthermore, the expansion of mindfulness studies could include adolescents with other chronic disorders or those with high stress profile such as those being exposed to abuse or trauma. Furthermore, future studies could compare mindfulness levels among adolescents with and without T1D, adolescents with T1D with and without CGM, and adolescents with T1D with and without insulin pump as well as considering gender, developmental age, and SES differences. Mindfulness interventional studies could be conducted with the above mentioned subgroups to compare health-related outcomes. Considering we found significant association between CAMM and the two related items form the FFMQ Act with

Awareness and Nonjudgment, further psychometric analyses and construct validation between these two measures as well as their correlations to the mindfulness practices in adolescents with chronic disorders are indicated.

Appendix A Systematic Review

Mindfulness-based interventions among adolescents with chronic diseases in clinical settings: a systematic review

Journal of Pediatric Health Care June 22, 2018, Vol. 32(5), 455-472

Mindfulness-Based Interventions Among Adolescents With Chronic Diseases in Clinical Settings: A Systematic Review

Author: Hiba Abujaradeh,Reema Safadi,Susan M. Sereika,Cecilia T. Kahle,Susan M. Cohen

Publication: Journal of Pediatric Health Care

Publisher: Elsevier

Date: September–October 2018

Review Order

Please review the order details and the associated terms and conditions.

Latest Comment: "As per our Sharing Policy, authors are permitted to post the Accepted version of their article on their institutional repository – as long as it is for internal institutional use only.
It can only be shared publicly on that site once the journal-specific embargo period has lapsed. For a list of embargo periods please see: https://www.elsevier.com/open-access/journal-embargo-finder

You are not permitted to post the Published Journal Article (PJA) on the repository."

Previous Comments

No royalties will be charged for this reuse request although you are required to obtain a license and comply with the license terms and conditions. To obtain the license, click the Accept button below.

Licensed Content

Licensed Content Publisher	Elsevier
Licensed Content Publication	Journal of Pediatric Health Care
Licensed Content Title	Mindfulness-Based Interventions Among Adolescents With Chronic Diseases in Clinical Settings: A Systematic Review
Licensed Content Author	Hiba Abujaradeh,Reema Safadi,Susan M. Sereika,Cecilia T. Kahle,Susan M. Cohen
Licensed Content Date	September–October 2018
Licensed Content Volume	32
Licensed Content Issue	5
Licensed Content Pages	18
Journal Type	HS

Order Details

Type of Use	post on a website
Requestor type	academic/educational institute
Portion	full article
Format	electronic
Are you the author of this Elsevier article?	Yes
Will you be translating?	No

About Your Work

Home page URL	ProQuest/UMI
Client / Sponsor	I am a student at University of Pittsburgh
Expected posting date	Aug 2021

Additional Data

Order reference number	D-scholarship@Pitt is the institutional repository for the University of Pittsburgh, and the repository of record for University of Pittsburgh ETDs.

Appendix B Psychometric Properties of FFMQ

Evaluating a short-form Five Facet Mindfulness Questionnaire in adolescents: Evidence for a four-factor structure and invariance by time, age, and gender

International Journal of Behavioral Development 2020, Vol. 44(1) 20–30

(With letter of permission to reprint published article)

RP-5343 Reproduce article in thesis/dissertation in Institutional Repository and ProQuest Dissertations and Thesis

Craig Myles <permissions@sagepub.com>
Wed 5/12/2021 11:53 AM
To: Abujaradeh, Hiba Ahmad Eid Mohammad <HAA77@pitt.edu>

———————
Reply above this line.

Craig Myles commented:

Dear Hiba Abujaradeh,

Thank you for your ticket. As you are the author of "Evaluating a short-form Five Facet Mindfulness Questionnaire in adolescents: Evidence for a four-factor structure and invariance by time, age, and gender" in '*International Journal of Behavioral Development*,' and it is an institutional requirement to post your work both D-scholarship@Pitt and ProQuest, I am pleased to report we can grant your request to include your article without a fee as part of your thesis/dissertation.

Please accept this email as permission for your request as you've detailed below. Permission is granted for the life of the thesis/dissertation on a non-exclusive basis, in the English language, throughout the world in all formats provided full citation is made to the original SAGE publication. Permission does not include any third-party material found within the work.

Please contact us for any further usage of the material.

If you have any questions, or if we may be of further assistance, please let us know.

Best regards,

Craig Myles

Senior Rights Coordinator

SAGE Publishing

2455 Teller Road

Thousand Oaks, CA 91320

USA

www.sagepublishing.com

ijbd
International Journal of Behavioral Development
2020, Vol. 44(1) 20–30

DOI: 10.1177/0165025419873039
journals.sagepub.com/home/jbd
SAGE

Evaluating a short-form Five Facet Mindfulness Questionnaire in adolescents: Evidence for a four-factor structure and invariance by time, age, and gender

Hiba Abujaradeh,[1] Blake A. Colaianne,[2] Robert W. Roeser,[2] Eli Tsukayama,[3] and Brian M. Galla[1]

Abstract

Little is known about whether a widely used mindfulness measure in adults—the Five Facet Mindfulness Questionnaire (FFMQ)—is also reliable and valid in adolescents. The current study evaluated the psychometric properties of a 20-item short-form FFMQ in a sample of 599 high school students (M_{age} ¼ 16.3 years; 49% female) living in the U.S. Students completed the FFMQ and a battery of self-report questionnaires assessing aspects of psychological well-being and social skills 3 times over the course of one academic year. Confirmatory factor analysis indicated that a modified four-factor hierarchical model (excluding the Observe subscale and 1 item from the Describe subscale) best fit the data. This four-factor, hierarchical FFMQ demonstrated evidence of measurement invariance across time, gender, and grade level. Reliabilities for the FFMQ total score and its subscales ranged from .61 to .88. The FFMQ total score, and its subscales (excluding Observe), demonstrated evidence of convergent (e.g., with self-compassion) and discriminant (e.g., with social perspective taking skills) validity. Finally, the FFMQ total score and Act with Awareness, Nonjudgment, and Nonreactivity subscales demonstrated evidence of incremental predictive validity for cross-time changes in psychological well-being outcomes (e.g., perceived stress). Overall, results provide preliminary support for the reliability and validity of a short-form FFMQ for use in high-school-age adolescents.

Keywords

Adolescents, confirmatory factor analysis, Five Facet Mindfulness Questionnaire, mindfulness, psychological well-being, short-form

The topic of mindfulness with adolescents has blossomed in recent years. Mindfulness training is now delivered to numerous adolescents in schools, afterschool programs, and clinics across the U.S. and beyond. Despite enthusiasm for mindfulness training, advances in the assessment of mindfulness in adolescents have lagged somewhat (Goodman, Madni, & Semple, 2017; Pallozzi, Wertheim, Paxton, & Ong, 2017). The development of reliable and valid assessments of mindfulness in adolescents is important for at least three reasons. First, it is important to know whether current conceptualizations of mindfulness—which are rooted in Buddhist philosophy (Analayo, 2003) and clinical science (Baer, 2003) and are geared toward adults—track the expression of mindfulness in adolescents. Second, mindfulness is hypothesized to be a primary mechanism through which mindfulness training is linked to beneficial changes in psychological well-being and health outcomes in children and adolescents (Burke, 2010; Galla, 2016). Thus, measures that examine mediators of treatment effects are critical for testing core theoretical arguments in the field. Third, there is growing interest in understanding naturalistic changes in mindfulness across adolescence and how such changes may impact positive developmental outcomes (Roeser & Eccles, 2015). It is therefore imperative to develop measures that can be used for tracking developmental change across adolescence.

To advance measurement of mindfulness in adolescents, we evaluated the psychometric properties of a short-form version of the Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006) in a longitudinal study of 599 high school adolescents. The FFMQ is among the most widely studied and widely used measures of mindfulness in adults (Goldberg et al., 2016). However, far less work has examined whether this measure is reliable and valid in adolescents. The aims of the current study were to test the factor structure of the FFMQ; to examine measurement invariance across time, gender, and grade level; to assess reliability; and to test evidence for convergent, discriminant, and predictive validity.

What is Mindfulness and How Is It Measured?

Mindfulness can be defined as a sustained and receptive awareness of the present moment (Analayo, 2003). In the psychological literature, it is often conceptualized as involving two core dimensions: self-regulation of attention to present-moment experience and an attitude of nonjudgmental acceptance (Bishop et al., 2004). The

[1] University of Pittsburgh, USA
[2] Pennsylvania State University, USA
[3] University of Hawai'i, West O'ahu, USA

Corresponding author:
Brian M. Galla, Psychology in Education, School of Education, University of Pittsburgh, 5940 Wesley W. Posvar Hall, Pittsburgh, PA 15260, USA.
Email: gallabri@pitt.edu

first dimension involves directing and sustaining attention to present-moment subjective experience, allowing for increased awareness and recognition of ongoing thoughts, feelings, and bodily sensations. Nonjudgmental acceptance refers to the curious and nonreactive orientation taken toward whatever arises in conscious awareness. Mindfulness is characterized as both a trainable mental quality (Shapiro, Carlson, Astin, & Freedman, 2006) and a relatively stable disposition whose expression naturally varies across and within individuals (Brown & Ryan, 2003).

With some exceptions (Levinson, Stoll, Kindy, Merry, & Davidson, 2014), mindfulness is most commonly measured through self-report questionnaires (Bergomi, Tschacher, & Kupper, 2013; Sauer et al., 2013). These instruments differ primarily in their theoretical and philosophical foundations and in the number of mindfulness dimensions they emphasize (Bergomi et al., 2013; Van Dam et al., 2018). Some measures attempt to capture a single dimension of the construct. For example, the Mindful Attention Awareness Scale (Brown & Ryan, 2003), which is rooted in Buddhist philosophy (Bodhi, 2011) and Self-Determination Theory (Ryan & Deci, 2000) assesses the degree to which individuals are attentive and aware of their experience in daily life. Other measures capture a multidimensional characterization of mindfulness. For example, the Kentucky Inventory of Mindfulness Skills (Baer, Smith, & Allen, 2004), which derives mainly from clinical science, assesses four interrelated but separable dimensions of mindfulness, includ- ing some that may not directly overlap with the proposed operationalization by Bishop et al. (2004) (e.g., describing experience with words).

FFMQ

The diverse array of mindfulness measures prompted Baer, Smith, Hopkins, Krietemeyer, and Toney (2006) to examine the factor structure of existing self-report measures. Their aim was to understand whether mindfulness—as it was being measured at the time—was better characterized as a unidimensional or multidimensional construct, and if the latter, the number of its constituent dimensions. Factor analysis of a combined pool of 112 items across five different self-report scales yielded five distinguishable, yet correlated dimensions of mindfulness: Observing present-moment experience, Describing experience with language, Acting with Awareness, Nonjudgment of experience, and Nonreactivity to inner experience. Four of the five dimensions (Describe, Acting with Awareness, Nonjudgment, and Nonreactivity) appeared to capture an overall mindfulness construct, especially among non-meditating adults. The Observe scale (assessed via items such as, "I pay attention to sensations, such as the wind in my hair or sun on my face") did not load onto an overall mindfulness factor and was unexpectedly positively correlated with psychological symptoms and other measures of distress. This suggested that in the absence of formal mindfulness training, the Observe subscale may capture maladaptive forms of self-focused attention (e.g., self-consciousness).

Several studies have since replicated the original finding that a four-factor hierarchical model, excluding Observe, provides optimal fit for the data among non-meditators (Curtiss & Klemanski, 2014; Gu et al., 2016; Williams, Dalgleish, Karl, & Kuyken, 2014). On the other hand, studies have also found support for a five-factor correlated and a five-factor hierarchical model as providing the best fit in individuals with no meditation experience (Bohlmeijer, ten Klooster, Fledderus, Veehof, & Baer, 2011; Veehof, ten Klooster, Taal, Westerhof, & Bohlmeijer, 2011). In addition, Medvedev, Siegert, Kersten, and Krägeloh (2017) suggested that certain items (e.g., Item 32 of the Describe subscale, "My natural tendency is to put my experiences into words") may not function particularly well psychometrically, perhaps due to vague wording of the statements. These authors suggest further that removing such items improves the model fit.

Beyond evaluating its factor structure, studies have also examined reliability and validity of the FFMQ. Studies find evidence for reliabilities > .60 on each of the five subscales (Christopher, Neuser, Michael, & Baitmangalkar, 2012) and test–retest reliability (Veehof et al., 2011). Likewise, studies document evidence for convergent validity with conceptually more closely related constructs (Hollis-Walker & Colosimo, 2011), discriminant validity from less closely related constructs (Gu et al., 2016; Veehof et al., 2011), and incremental predictive validity (Christopher et al., 2012; Veehof et al., 2011). The dimensions of Acting with Awareness, Nonjudgment, and Nonreactivity have repeatedly demonstrated incremental predictive validity for psychological symptoms and well-being (Desrosiers, Klemanski, & Nolen-Hoeksema, 2013; Medvedev, Norden, Krägeloh, & Siegert, 2018; van Son et al., 2014; Veehof et al., 2011).

The original version of the FFMQ is 39 items, which can raise concerns of survey fatigue for large assessment batteries. Attempts to shorten the FFMQ have been developed, with varying numbers of items: 24 items (Bohlmeijer et al., 2011), 20 items (Hou, Wong, Lo, Mak, & Ma, 2013; Tran, Glück, & Nader, 2013), and 15 items (Gu et al., 2016). These scales also demonstrate initial evidence of construct validity (Bohlmeijer et al., 2011), and lower, but adequate reliability (Gu et al., 2016; Tran et al., 2013). Of course, reductions in scale reliabilities are often associated with use of fewer items (Ziegler, Kemper, & Kruyen, 2014). The current study sought to evaluate the 20-item short form developed by Tran, Glück, and Nader (2013).[1] We selected this version of the scale based on the fact that it reduced the FFMQ by about 50%, was validated in nonclinical adult samples (compared to the other short forms that were validated in clinical or subclinical samples and in intervention trials), and retained more than 3 items per facet (thus enabling comparison of model fit statistics).

Is the FFMQ Reliable and Valid in Adolescents?

Although the FFMQ has been used in prior studies with adolescent samples (Calvete, Gámez-Guadix, & Cortazar, 2017; Ciesla, Reilly, Dickson, Emanuel, & Updegraff, 2012; Galla, 2016; Royuela-Colomer & Calvete, 2016), to our knowledge only one study has explicitly sought to evaluate the psychometric properties of the FFMQ (Royuela-Colomer & Calvete, 2016). In this study, 520 Spanish adolescents (age range 13–19 years) completed a translated version of the FFMQ. A five-factor, correlated model provided the best fit to the data in this Spanish-language version of the FFMQ (as ranged from .65 to .83). A random subsample of 247 adolescents completed the same FFMQ 4 months after the first assessment. Test–retest reliability in this subsample was generally adequate (intraclass correlations between .39 and .63). Longitudinal analysis also revealed that Nonreactivity and Acting with Awareness subscales predicted reductions in depressive symptoms 4 months later, controlling for baseline levels. Overall, this study offered an important initial evaluation of the psychometric properties of the FFMQ in adolescents. However, a comparable evaluation has

not yet occurred in adolescents from North America, so it remains unknown whether these results would replicate in other samples. Moreover, the study did not evaluate whether the factor structure of the FFMQ was invariant across time, gender, and grade level—a foundational requirement for tracking longitudinal change and making group comparisons (Widaman, Ferrer, & Conger, 2010).

The Current Study

We examined the reliability and validity of a short-form version of the FFMQ in a longitudinal study of 599 high-school-age adolescents in the U.S. The aims of this study were fourfold: First, we sought to evaluate the factor structure of the 20-item FFMQ. Based on prior research, we anticipated that a four-factor model (excluding Observe) would fit the data better than a five-factor model. Second, we tested measurement invariance in the factor structure across time, gender, and grade level. Third, we examined evidence of convergent validity in terms of closely related psychological constructs (e.g., self-compassion) and discriminant validity in terms of less closely related social skills (e.g., social perspective taking). Finally, we tested incremental predictive validity of mindfulness with regard to cross-time changes in psychological well-being (e.g., life satisfaction).

Method

Participants

The sample included 599 students (M_{age} = 16.27 years, *SD* 1.15, range 13.92–19.67) attending a large suburban public high school in the Northeastern U.S. Students were recruited through a random selection of teachers in each grade level. The majority of students (80%) self-identified as Caucasian, and 49% identified as female, which is representative of the school's population (88% White, 49% female; National Center for Education Statistics, 2018). Data on socioeconomic status were not collected, but according to the National Center for Education Statistics (2018), approximately 12% of the school's students qualify for free or reduced price lunches. The analytic sample represented about one third of the school population. Approximately 19% of the sample were freshmen, 24% were sophomores, 28% were juniors, and 29% were seniors.[2]

Procedure

The study was approved by the University of Pittsburgh Institutional Review Board. Data collection spanned nearly an entire academic calendar year (beginning in September and ending in April). The school sent an informational letter about the study and an opt-out permission form to parents. Students also completed assent forms during the first assessment. Students who were not available during the first assessment were given one more opportunity to provide assent during the second assessment. This means that some students did not provide data for the study until later in the academic year. Students were included in the study as long as they provided data during at least the first or the second assessment wave (and thus provided assent).

Students completed self-report measures assessing study constructs 3 times during the academic year. The three assessment waves, henceforth referred to as T1, T2, and T3, were spaced approximately 3 months apart (September, January, April). All measures were completed using Qualtrics Survey System on school computers during regular school hours. Students' responses to a single attention check embedded in each survey ("For this question, select 'rarely true'") suggest that they were mostly attentive when completing the survey (percent correct responses: T1 = 90%, T2 = 85%, and T3 = 83%).

Approximately 66% (n = 395) of students took all three surveys, 27% (n = 163) took two surveys, and 7% (n = 41) took one survey. Survey completion rates did not differ by gender (girls versus boys), $w^2(2) = 1.37$, $p = .503$, or race (Caucasian versus other races/ethnicities), $w^2(2) = 2.78$, $p = .249$, but they did differ by grade level (lower level [freshmen, sophomores] versus upper level [juniors, seniors] students), $w^2(2) = 24.28$, $p < .001$, with older students being more likely to have taken fewer surveys.

Measures

Mindfulness. Students completed a 20-item version of the FFMQ taken from prior research (Tran et al., 2013). The FFMQ assesses individual differences in five facets of mindfulness, including Acting with Awareness (Items 5, 8, 13, and 18; see Baer et al., 2006), Describe (Items 16, 22, 32, and 37), Observe (Items 15, 20, 26, and 31), Nonjudgment (Items 14, 25, 30, and 35), and Nonreactivity (Items 9, 19, 21, and 24). Items were rated from 1 = *never or very rarely true* to 5 = *very often or always true*. The Online Supplementary material provides content for each FFMQ item used.

Convergent and discriminant validity measures

Self-compassion. Participants completed the 12-item Self-Compassion Scale, Short Form (Raes, Pommier, Neff, & Van Gucht, 2011). This scale taps facets related to self-compassion, including self-kindness, self-judgment, common humanity, balanced awareness, isolation, and overidentification. Items were endorsed from 1 = *strongly disagree* to 6 = *strongly agree* (as = .86, .88, .86 across three time points, respectively).

Social perspective taking. Students also reported their tendency to adopt the point of view of others using 4 items taken from the Interpersonal Reactivity Index (Davis, 1980). Items (e.g., "Before criticizing somebody, I try to imagine how I would feel if I were in their place") were rated from 1 = *does not describe me well* to 5 = *describes me very well* (as = .80, .82, .84).

Empathic concern. Students reported their tendency to experience feelings of sympathy and compassion for individuals who are less fortunate using 3 items taken from the Interpersonal Reactivity Index (Davis, 1980). Items (e.g., "I often have tender, concerned feelings for people less fortunate than me") were rated from 1 = *does not describe me well* to 5 = *describes me very well* (as = .76, .79, .82).

Prosocial behavior. Students reported how often they engage in prosocial interpersonal behaviors using items adapted from prior research (Caprara, Steca, Zelli, & Capanna, 2005; Segal, Cimino, Gerdes, Harmon, & Wagaman, 2013). Items (e.g., "I try to help others who are in need," "I help others even if it does not personally benefit me") were rated from 1 = *never/almost never true* to 5 = *almost always/always true* (as = .87, .87, .89).

Psychological well-being outcomes

Satisfaction with life. Students reported on their global cognitive judgments of life satisfaction using the 5-item Satisfaction with

Life Scale (Diener, Emmons, Larsen, & Griffin, 1985). Items (e.g., "In most ways my life is close to my ideal") were rated from 1 ¼ *strongly disagree* to 7 ¼ *strongly agree* (as ¼ .86, .88, .86).

Perceived stress. Students reported on the degree to which they have recently felt their life was stressful, unpredictable, and uncontrollable using the 4-item Perceived Stress Scale (e.g., During the past month "… how often have you felt that you were unable to control the important things in your life?"; Cohen, Kamarck, & Mermelstein, 1983). Items were endorsed using a 5-point scale from 1 ¼ *never* to 5 ¼ *very often* (as ¼ .71, .68, .69).

Positive and negative affect. Students reported their positive and negative affect in the past month using the 10-item Positive and Negative Affectivity Schedule, Short Form (Mackinnon et al., 1999). Five items were used to capture positive affect (i.e., alert, excited, enthusiastic, inspired, and determined; as .76, .79, .79) and 5 items were used to capture negative affect (i.e., distressed, upset, scared, nervous, and afraid; as ¼ .85, .85, .87). Items were endorsed from 1 ¼ *not at all* to 5 ¼ *extremely*.

Rumination. Students completed 4 items adapted from the Multidimensional Measure of Academic Coping (Skinner, Pitzer, & Steele, 2013). The rumination subscale assesses the tendency to dwell on negative or stressful life events. Items (e.g., When something bad or stressful happens to me, "I keep thinking about it over and over") were endorsed from 1 ¼ *not at all true for me* to 4 ¼ *very true for me* (as ¼ .95, .95, .95).

Demographic covariates. Because research has shown gender and age differences in traits related to mindfulness (e.g., self-compassion, Bluth, Campo, Futch, & Gaylord, 2017), we included students' self-reported gender (0 ¼ *male*, 1 ¼ *female*) and grade level as covariates in analyses. In the current study, grade level was treated as a dichotomous variable (lower level [freshmen, sopho- mores] vs. upper level [juniors, seniors] students) to provide ade- quate sample size for multigroup measurement invariance tests.

Data analysis. Descriptive statistics were conducted using SPSS v24 (IBM Corp, 2016). All other analyses were completed in Mplus v7.2 (Muthén & Muthén, 2012). Students with missing data were included in all models using full information maximum likelihood (FIML), which produces less biased and more reliable results than listwise or pairwise deletion (Baraldi & Enders, 2010; Schafer & Graham, 2002). FIML was enabled by treating demographic characteristics as missing data correlates (i.e., auxiliary variables). All analyses used MLR estimation (maximum likelihood estimation with robust standard errors).

Model fit was assessed using standard indices and their corresponding cutoffs. Values of .90 or higher for the comparative fit index (CFI) indicate acceptable fit to the data, and values of .95 or higher indicate excellent fit (Bentler & Bonett, 1980; Hu & Bentler, 1999; Schumacker & Lomax, 2010). Root mean square error of approximation (RMSEA) values of .08 or less indicate acceptable fit, and values of .05 or less indicate excellent fit (Browne & Cudeck, 1993; Schumacker & Lomax, 2010). We also used Bayesian information criteria (BIC) values to compare models, where lower values indicate better fit.

To test for differences in fit across nested models, we followed recommendations where a change in model fit of ≤.010 in CFI and a change of ≤.015 in RMSEA would indicate that the more restrictive model does not fit worse than the unrestricted model (Chen, 2007). We supplemented these indices with w^2 difference tests using MLR correction (Satorra & Bentler, 2001).

Results

Structural Analysis of the FFMQ

We examined the factor structure of the FFMQ through a series of confirmatory factor analyses using T1 data. Following prior research (Baer et al., 2006; Gu et al., 2016; Williams et al., 2014), we tested five measurement models: (1) a single-factor model in which all items served as indicators of an overall, latent mindfulness factor; (2) a five-factor correlated model in which items served as indicators of five separate but correlated factors; (3) a five-factor hierarchical model in which items served as indicators of five factors that in turn served as indicators for an overall, higher order mindfulness factor; (4) a four-factor correlated model in which items served as indicators of four separate but correlated factors (excluding Observe subscale); and (5) a four-factor hierarchical model in which items served as indicators of four factors that in turn served as indicators for an overall, higher order mindfulness factor (excluding Observe subscale).

Table 1 presents fit indices for all models testing the factor structure of the 20-item FFMQ. The single-factor model demonstrated poor fit to the data. The five-factor correlated and five-factor hierarchical models demonstrated adequate fit to the data (see Online Supplementary material for standardized loadings in the five-factor hierarchical model). In the five-factor correlated model, however, Observe demonstrated either negative ($r_{\text{Acting with Awareness}}$ ¼ .18, p ¼ .007; $r_{\text{Nonjudgment}}$ ¼ .17, p ¼ .007) or nonsignificant (r_{Describe} .02, p .790; $r_{\text{Nonreactivity}}$ .10, p ¼ .227) correlations with the remaining four factors. Likewise, in the five-factor hierarchical model, Observe loaded negatively onto the second-order mindfulness factor (standardized loading ¼ .17, *SE* ¼ .08, p .039). Excluding the Observe factor qualitatively improved model fit for both the four-factor correlated and four- factor hierarchical models, although doing so still did not result in excellent fit to the data.

To explore the factor structure further, we examined the standardized factor loadings for each indicator in the four-factor hierarchical model. All items, except for Item 32 on the Describe subscale, showed moderate-to-strong loadings on their respective factors (standardized loadings ¼ .37 to .86, ps < .001). By contrast, the standardized factor loading for Item 32 was considerably smaller (standardized loading .18, p ¼ .002). Moreover, it was the only item whose latent factor did not account for statistically significant variance (R^2 .03, *SE* .02, p .125).

Based on these results, we refitted the above set of measurement models, but excluded the Observe factor and Item 32 in the Describe factor. This resulted in 15 items in total. Both the four- factor correlated and four-factor hierarchical models provided excellent fit to the data. We retained the 15-item four-factor hier- archical model in all remaining analyses, since it fit the data as well as the four-factor correlated model, $\Delta w^2(2)$ 4.33, p .115, and represented a theorized conceptualization of the FFMQ.

Measurement Invariance

We next examined measurement invariance of the 15-item, four-factor hierarchical model.[3] We tested configural, metric, and scalar invariance across (1) time (assessment wave), (2) gender (girls

Table 1. Testing Alternate Factor Structures for the FFMQ.

Model	w^2	*df*	MLR scaling correction factor	CFI	RMSEA	SRMR	BIC
FFMQ 20 items							
One factor	1,544.10	170	1.161	.468	.116	.121	32,490.57
Five factor	411.14	160	1.157	.903	.051	.068	31,237.06
Five factor, hierarchical	429.28	165	1.160	.898	.052	.072	31,227.28
Four factor (no Observe)	249.37	98	1.176	.930	.051	.056	24,997.48
Four factor, hierarchical (no Observe)	252.80	100	1.177	.930	.051	.057	24,989.03
FFMQ 19 items (excluding Item 32)							
One factor	1,434.38	152	1.164	.484	.119	.120	30,884.61
Five factor	315.08	142	1.159	.930	.045	.059	29,644.20
Five factor, hierarchical	333.26	147	1.161	.925	.046	.064	29,633.85
Four factor (no Observe)	170.33	84	1.178	.959	.041	.045	23,405.93
Four factor, hierarchical (no Observe)	174.67	86	1.179	.958	.041	.047	23,398.41

Note. $N = 599$. FFMQ = Five Facet Mindfulness Questionnaire; w^2 = chi-square; *df* = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; BIC = Bayesian information criterion. Gender (0 = *male*; 1 = *female*) and grade level (0 = *lower level [freshmen and sophomores] grades*; 1 = *higher level [juniors, seniors] grades*) were included as auxiliary variables (missing data correlates). Item 32 ("My natural tendency is to put my experiences into words") is from the Describe subscale.

Table 2. Tests of Measurement Invariance Across Time, Gender, and Grade Level.

	Model fit indices						Model fit comparisons				
Model	w^2	*df*	MLR scaling correction factor	CFI	RMSEA	Model Comparisons	Dw^2	D*df*	*p*	DCFI	DRMSEA
Time (assessment wave)											
Model 1	1,152.91	873	1.118	.968	.023						
Model 2	1,178.53	895	1.115	.968	.023	M2 versus M1	25.24	22	.286	.000	.000
Model 3	1,181.24	901	1.116	.968	.023	M3 versus M2	2.97	6	.812	.000	.000
Model 4	1,227.58	923	1.113	.965	.023	M4 versus M3	48.36	22	.001	.003	.000
Model 5	1,243.98	929	1.112	.964	.024	M5 versus M4	17.59	6	.007	.001	.001
Girls versus boys											
Model 1	290.77	172	1.140	.946	.048						
Model 2	296.20	183	1.142	.948	.045	M2 versus M1	5.67	11	.894	.002	.003
Model 3	299.35	186	1.144	.948	.045	M3 versus M2	3.33	3	.343	.000	.000
Model 4	333.59	197	1.135	.937	.048	M4 versus M3	36.81	11	<.001	.011	.003
Model 5	348.60	200	1.133	.932	.050	M5 versus M4	16.23	3	.001	.005	.002
Lower level (freshmen, sophomores) versus upper level (juniors, seniors) students											
Model 1	265.73	172	1.143	.956	.043						
Model 2	279.57	183	1.144	.954	.042	M2 versus M1	13.89	11	.239	.002	.001
Model 3	280.71	186	1.148	.955	.041	M3 versus M2	1.68	3	.642	.001	.001
Model 4	286.40	197	1.140	.958	.039	M4 versus M3	4.32	11	.960	.003	.002
Model 5	292.33	200	1.139	.956	.039	M5 versus M4	6.06	3	.109	.002	.000

Note. $N = 599$. w^2 = chi-square; *df* = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; D = change in parameter; w^2 and *p*-values for model fit comparisons are based on Satorra and Bentler's (2001) scaled w^2 difference test for MLR estimation. Gender (0 = male; 1 female) and grade level (0 = *lower level [freshmen and sophomores] grades*; 1 = *higher level [juniors, seniors] grades*) were included as auxiliary variables (missing data correlates). Model 1 (M1) = baseline model (without invariance); Model 2 (M2) = invariant first-order factor loadings; Model 3 (M3) = invariant first-order and second-order factor loadings; Model 4 (M4) = invariant first-order and second-order factor loadings and item intercepts; and Model 5 (M5) = invariant first-order and second-order factor loadings, item intercepts, and first-order factor intercepts.

[*n* = 293] vs. boys [*n* = 306]), and (3) grade level (lower level [*n* = 260] vs. upper level [*n* = 339] students). Measurement invariance tests for gender and grade level were conducted using T1 data. Following prior research (Dimitrov, 2010; Rudnev, Lytkina, Davidov, Schmidt, & Zick, 2018), we fit a series of five models: (1) *No invariance* (Model 1): This is the baseline model in which no invariance is assumed (i.e., all model parameters are freely estimated; (2) *Invariant first-order loadings* (Model 2): Model 2 is obtained from Model 1 by adding equality constraints to all first-order factor loadings across groups; (3) *Invariant first-order and second-order factor loadings* (Model 3): Model 3 is obtained from Model 2 by adding equality constraints to all second-order factor loadings across groups; (4) *Invariant first-order and second-order factor loadings and item intercepts* (Model 4): Model 4 is created from Model 3 by adding equality constraints to all item intercepts across groups; and (5) *Invariant first-order and second-order factor loadings, item intercepts, and first-order factor intercepts* (Model 5): Model 5 is created from Model 4 by adding equality constraints to all first-order factor intercepts across groups. Full results of these models are summarized in Table 2.

Time (assessment wave). All models provided excellent fit to the data. The four-factor hierarchical model demonstrated evidence of both metric (i.e., factor loadings equal) invariance (Model 1 vs.

Table 3. Descriptive Statistics for the FFMQ Across Three Assessment Waves.

Variable	*n*	*M*	*SD*	Range	a
Act Aware T1	532	3.06	.91	1.0–5.0	.88
Nonjudge T1	532	3.67	.88	1.0–5.0	.81
Nonreact T1	532	3.17	.74	1.0–5.0	.62
Describe T1	532	3.38	.83	1.0–5.0	.66
Full FFMQ T1	532	3.32	.57	1.6–5.0	.82
Act Aware T2	538	2.96	.88	1.0–5.0	.86
Nonjudge T2	536	3.57	.93	1.0–5.0	.85
Nonreact T2	537	3.12	.71	1.0–5.0	.61
Describe T2	537	3.38	.80	1.0–5.0	.67
Full FFMQ T2	539	3.25	.58	1.6–5.0	.83
Act Aware T3	469	2.95	.87	1.0–5.0	.85
Nonjudge T3	468	3.58	.93	1.0–5.0	.88
Nonreact T3	468	3.18	.72	1.0–5.0	.68
Describe T3	469	3.33	.78	1.0–5.0	.69
Full FFMQ T3	469	3.26	.59	1.1–4.9	.85

Note. Total *N* ¼ 599. T1 ¼ September assessment; T2 ¼ January assessment; T3
¼ April assessment; FFMQ: Five Facet Mindfulness Questionnaire.

Model 2: DCFI ¼ 0; DRMSEA ¼ 0; Model 2 vs. Model 3: DCFI ¼ 0; DRMSEA ¼ 0) and scalar (i.e., intercepts equal) invariance (Model 3 vs. Model 4: DCFI ¼ .003; DRMSEA ¼ .001; Model 4 vs. Model 5: DCFI ¼ .001; DRMSEA .001). Thus, the factor structure of the FFMQ was equivalent across the September, January, and April assessment waves.

Gender. All models provided adequate-to-excellent fit to the data. The data showed that metric invariance (Model 1 vs. Model 2: DCFI ¼ .002; DRMSEA ¼ .003; Model 2 vs. Model 3: DCFI ¼ 0; DRMSEA ¼ 0), but not scalar invariance (Model 3 vs. Model 4: DCFI ¼ .011; DRMSEA ¼ .003; Model 4 vs. Model 5: DCFI ¼ —.005; DRMSEA .002), could be established. Thus, the data support metric invariance for the FFMQ across girls and boys.

Grade level. The configural, metric, and scalar invariance models all provided excellent fit to the data. The four-factor hierarchical model demonstrated evidence of both metric (Model 1 vs. Model 2: DCFI ¼ .002; DRMSEA ¼ .001; Model 2 vs. Model 3: DCFI ¼ .001; DRMSEA ¼ .001) and scalar (Model 3 vs. Model 4: DCFI ¼ .003; DRMSEA ¼ .002; Model 4 vs. Model 5: DCFI ¼ .002; DRMSEA 0) invariance. Thus, the factor structure of the FFMQ was equivalent for lower level (freshmen, sophomores) and upper level (juniors, seniors) high school students.

Descriptive Statistics and Bivariate Correlations

Table 3 provides descriptive statistics for the four subscale scores and the overall FFMQ score at each assessment wave. Acting with Awareness, Nonjudgment, and the overall score showed higher internal reliability consistency estimates, with as ranging from .81 to .88. Estimates of internal reliability were lower for Nonreactivity and Describe, with as ranging from .61 to .69.

Table 4 presents the bivariate correlations among the four FFMQ subscales within and across each assessment wave. All cor-relations were in the expected direction and were statistically sig- nificant at $p < .01$. However, the magnitude of the correlations within assessment wave varied considerably, ranging from r ¼ .16 to .43.

Table 4. Bivariate Correlations Between Mindfulness Subscales.

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Describe T1											
2. Acting with Awareness T1	.29										
3. Nonjudgment T1	.39	.34									
4. Nonreactivity T1	.16	.21	.21								
5. Describe T2	.54	.31	.36	.23							
6. Acting with Awareness T2	.17	.68	.32	.19	.37						
7. Nonjudgment T2	.23	.24	.62	.14	.35	.40					
8. Nonreactivity T2	.18	.25	.21	.55	.22	.26	.18				
9. Describe T3	.54	.30	.30	.18	.64	.29	.27	.20			
10. Acting with Awareness T3	.19	.65	.30	.23	.32	.66	.32	.21	.38		
11. Nonjudgment T3	.31	.27	.62	.15	.30	.33	.65	.14	.39	.43	
12. Nonreactivity T3	.19	.21	.19	.44	.21	.14	.17	.59	.32	.22	.24

Note. N ¼ 599. T1 ¼ September assessment; T2 ¼ January assessment; T3 ¼ April assessment. All correlations are significant at $p < .01$. Gender (0 ¼ *male*;1 *female*) and grade level (0 ¼ *lower level [freshmen and sophomores] grades*; 1 *higher level [juniors, seniors] grades*) were included as auxiliary variables (missing data correlates).

Evidence of Convergent and Discriminant Validity

Table S2 in the Online Supplementary material shows bivariate correlations between the FFMQ and self-compassion, social perspective taking, empathic concern, and prosocial behavior. As expected, the FFMQ subscales and total score demonstrated convergent validity with self-compassion (rs ¼ .25 to .68) and discriminant validity from less closely related constructs (perspective taking, rs ¼ .14 to .28; empathic concern, rs ¼ .11 to .11; prosocial behavior, rs ¼ .07 to .18).

Evidence of Incremental Predictive Validity

Finally, we tested incremental predictive validity of FFMQ subscales for each psychological well-being outcome. We fit a series of multiple regression analyses in which each T2 psycho- logical well-being outcome was simultaneously regressed on T1 FFMQ subscales, demographic covariates (gender, grade level), and T1 psychological well-being. As presented in Table 5, FFMQ subscales were differentially associated with changes in each outcome. Acting with Awareness predicted significant decreases in perceived stress and negative affect. Nonjudgment predicted significant decreases in rumination, perceived stress, and negative affect. Nonreactivity predicted significant decreases in perceived stress and increases in positive affect. Describe did not demonstrate evidence of incremental predictive validity for any outcome.

We then reran the analyses using the FFMQ total score as a predictor of outcomes. Controlling for T1 levels of the outcome and demographic covariates, the FFMQ total score demonstrated evidence of incremental predictive validity for all five outcomes: life satisfaction (B ¼ .31, 95% CI ¼ [.11, .50], p ¼ .003, b ¼ .13); perceived stress (B ¼ .30, 95% CI ¼ [.41, .18], $p < .001$, b ¼ .25); positive affect (B ¼ .13, 95% CI ¼ [.02, .24], p ¼ .024, b ¼ .10); negative affect (B ¼ .17, 95% CI ¼ [.30, .04], p ¼ .010, b ¼ .11); and rumination (B ¼ .19, 95% CI ¼ [.30, .09], $p < .001$, b ¼ .12).

Table 5. Incremental Predictive Validity Tests: Results of Multiple Regressions Predicting 3-Month Changes in Psychological Well-Being From Mindfulness Subscales.

	Life satisfaction T2				Perceived stress T2				Positive affect T2				Negative affect T2				Rumination T2			
Predictors	*B*	LCI	UCI	b	*B*	LCI	UCI	b	*B*	LCI	UCI	b	*B*	LCI	UCI	b	*B*	LCI	UCI	b
Outcome T1	.58***	.49	.66	.56	.45***	.36	.55	.46	.46***	.38	.55	.46	.59***	.49	.69	.58	.59***	.51	.67	.60
Describe T1	.11	.02	.24	.07	.03	.10	.04	.03	.02	.10	.06	.02	.03	.05	.11	.03	.02	.05	.10	.02
Act Aware T1	.01	.13	.15	.01	.09**	.15	.03	.12	.08	.00	.16	.09	.09*	.16	.01	.09	.03	.10	.04	.03
Nonjudge T1	.07	.06	.20	.04	.07*	.14	.01	.09	.04	.12	.05	.04	.10*	.20	.01	.10	.13**	.21	.06	.13
Nonreact T1	.15	.02	.33	.08	.12**	.19	.04	.13	.15**	.05	.25	.14	.00	.09	.09	.00	.07	.15	.01	.06
Gender	.02	.17	.21	.01	.04	.05	.13	.03	.04	.07	.15	.03	.10	.03	.21	.05	.11	.01	.22	.06
Grade level	.14	.05	.33	.05	.08	.17	.01	.06	.07	.04	.18	.04	.06	.18	.06	.03	.00	.11	.11	.00

Note. $N = 599$. T1 September assessment; T2 January assessment; LCI/UCI lower and upper 95% confidence intervals for the unstandardized regression coefficient (*B*); b standardized regression coefficient. Gender (0 *male*;1 *female*) and grade level (0 *lower level [freshmen and sophomores] grades*;1 *higher level [juniors, seniors] grades*) were included as covariates.
*$p < .05$. **$p < .01$. ***$p < .001$.

Discussion

In a study of 599 high school students, we evaluated the psychometric properties of a short-form version of the Five Factor Mindfulness Questionnaire. Results revealed that a modified four-factor hierarchical model, excluding the Observe subscale and 1 item from the Describe subscale, best fit the data. This 15-item four-factor model demonstrated evidence of configural, metric, and scalar invariance across time and grade level, and configural and metric invariance across gender. Reliabilities for the FFMQ total score and Nonjudgment and Acting with Awareness subscales were higher (.81 to .88), while the reliabilities for Nonreactivity and Describe subscales were lower (between .61 and .69). These four subscales were positively correlated with one another within and across assessment waves. Likewise, the FFMQ total score and the four subscales demonstrated evidence of convergent validity with conceptually more closely related constructs (self-compassion) and discriminant validity from conceptually less closely related constructs (e.g., social perspective taking, empathic concern).[4] Finally, Acting with Awareness, Nonjudgment, and Nonreactivity subscales showed evidence of incremental predictive validity for 3-month changes in psychological well-being outcomes, above and beyond demographic covariates and baseline levels of psychological well-being.

The current results suggest that a mindfulness measure originally intended for use with adults can also be reliable and valid in adolescent samples that share demographic characteristics with this sample. In particular, the four-factor hierarchical structure of the FFMQ in our adolescent sample replicates findings from numerous other studies with adult samples (Baer et al., 2006; Curtiss & Klemanski, 2014; Gu et al., 2016; Williams et al., 2014). Likewise, reliability estimates and correlations among mindfulness facets are consistent with prior validation studies in adults (Gu et al., 2016; Tran et al., 2013). Interestingly, our results also align with other studies showing that certain items (Item 32; Medvedev et al., 2017), perhaps due to ambiguous wording, may not load properly onto the factor scores. Importantly, our results also replicate prior work showing that Acting with Awareness, Nonjudgment, and Nonreactivity incrementally predict psychological well-being outcomes (Bohlmeijer et al., 2011; Veehof et al., 2011).

Our results did not fully replicate those of Royuela-Colomer and Calvete (2016), who undertook the only other formal evaluation (at the time of this study) of the FFMQ in adolescents. Despite the samples being roughly equivalent in terms of age and gender, they found that a five-factor correlated model best fit the data. Another key difference is that our results showed that Acting with Awareness, Describe, Nonjudgment, and Nonreactivity were all positively and significantly correlated, whereas they found that Nonreactivity was uncorrelated with Acting with Awareness and Nonjudgment. In both studies, Nonreactivity and Acting with Awareness showed incremental predictive validity for changes in psychological well-being; we found associations with positive and negative affect and perceived stress and they found associations with depression symptoms. However, we found additional evidence for the predictive validity of Nonjudgment on changes in negative affect, perceived stress, and rumination. Replication studies are needed to parse these results, but it is possible that cultural differences can explain some of the discrepant findings. Our sample was drawn from a high school in the U.S. composed primarily of Caucasian students from middle and higher income households, whereas Royuela-Colomer and Calvete sampled high school students from Spain who were more socioeconomically diverse.

Theoretical and Practical Implications

What are the scientific implications of this study? The current investigation contributes to evidence that the FFMQ reflects a hierarchical model of mindfulness in adolescents. This is notable because the original derivation of the FFMQ was based on adult samples and conceptualizations of mindfulness rooted in both clinical science and Buddhism (Baer et al., 2006). Replicating the factor structure in adolescents was therefore not a forgone conclu- sion. Future research should study whether a five-factor model, with Observe, fits the data better following mindfulness training programs, as has been found in adult samples.

This study also contributes to evidence that mindfulness, as assessed through the FFMQ, predicts psychological well-being in adolescents. This is one of a growing number of studies in adolescents to show that different dimensions of mindfulness (Acting with Awareness, Nonreactivity, Nonjudgment) prospectively predict incremental changes in various aspects of psychological well-being. Adolescents with higher scores on Acting with Awareness, Nonjudgment, and Nonreactivity all reported reductions in perceived stress 3 months later. Our data showed a pattern of differential predictive validity for other outcomes: Acting with

Awareness and Nonjudgment incrementally predicted reductions in negative affect, but only Nonjudgment predicted reductions in rumination, and only Nonreactivity predicted increases in positive affect. These results affirm the value of considering how specific dimensions of mindfulness may be more predictive of different aspects of well-being.

This research makes an important advance by showing that the FFMQ is invariant across time and grade level. Our data suggest that the FFMQ reflects the same underlying construct regardless of whether it is administered in fall, winter, or spring and regardless of whether participants are in lower level (9th, 10th) or upper level (11th, 12th) grades in high school. Thus, this scale may be useful for researchers interested in charting change in mindfulness across time and age (Roeser & Eccles, 2015). At the same time, when looking across gender, our data revealed equivalent item loadings (metric invariance) but not intercepts (scalar invariance). This suggests that it is possible to compare the magnitude of correlations between the latent FFMQ factors and other outcomes (e.g., perceived stress) across boys and girls, but that comparing latent means of the FFMQ across boys and girls (e.g., do boys have higher mindfulness than girls) may not be yet warranted with this scale.

What are the practical implications of the current findings? The results indicate that the Observe subscale may not be a valid indicator of mindfulness in adolescents. It did not load onto the hierarchical mindfulness factor, and it was negatively or nonsignificantly correlated with the remaining four factors. Consistent with prior work in adults (Baer et al., 2006; Veehof et al., 2011; Williams et al., 2014), this suggests that even during adolescence, individuals may interpret Observe items as being more reflective of self-conscious attention rather than dispassionate awareness of ongoing perceptual experience. We therefore caution against its use in either the total mindfulness score or as a separate facet of mindfulness.

The lower reliabilities among Nonreactivity and Describe suggest room for improving the content of these scales. Withshort-form scales, lower reliabilities are expected and may be an acceptable trade-off for other advantages they bring to basic research (e.g., efficiency of measurement) (Ziegler et al., 2014). We are quick to note too, that despite the low reliabilities, both the Nonreactivity and Describe scales did load significantly onto a hierarchical mindfulness factor (suggesting evidence of construct validity) and also demonstrated evidence of convergent and discriminant validity. Describe did not demonstrate evidence of incremental predictive validity for changes in psychological well-being outcomes. Of course, this may be due to the outcomes assessed, but overall, the utility of Describe for predicting life outcomes remains to be seen with this short-form scale.

While our analysis shows the theoretical value of considering FFMQ scales separately for testing specific mechanisms of mindfulness, researchers may also use the FFMQ total score. It too demonstrated excellent reliability and showed evidence for convergent, discriminant, and incremental predictive validity. Moreover, confirmatory factor analysis indicated that the subscales do form a hierarchical "mindfulness" factor. In situations where researchers are not interested in testing incremental predictive validity of specific subscales, it appears that the FFMQ total score may be substituted.

Limitations

This study has several limitations that suggest useful directions for future research. Time constraints for school testing did not permit inclusion of other mindfulness measures (e.g., Child and Adolescent Mindfulness Measure; Greco, Baer, & Smith, 2011), so future research should examine the strength of relationships with this short-form FFMQ. Future studies should also evaluate whether the psychometric properties of this short-form FFMQ replicate across more diverse samples of adolescents. Although the FFMQ demonstrated initial evidence of measurement invariance across time, grade level, and gender, more research is required to determine whether it is invariant before and after mindfulness training. Additionally, tests of incremental predictive validity relied on self-report questionnaires of psychological well-being. Future research should include behavioral measures, informant ratings, and experience-sampling methods to further assess the predictive validity of the FFMQ and its factors.

Conclusion

The current study provides preliminary evidence that a short-form adaptation of the FFMQ may be reliable and valid in adolescents. A four-factor hierarchical model, excluding the Observe subscale and one of the Describe subscale items, demonstrated excellent fit to the data. This factor structure was invariant across time, grade level, and (partially) gender, making it a potentially useful tool for longitudinal studies charting developmental change, and for studies interested in making comparisons across grade level and developmental time. This multidimensional scale also enables researchers to test theoretical questions to understand which aspects of mindfulness are associated with improving psychological and health outcomes.

Acknowledgments

The authors are grateful to the students who participated in this research and to the school administrators, teachers, and staff who helped to facilitate it. They are also grateful to Hannah M. Fiore for her help with study coordination and data collection.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by University of Pittsburgh School of Education departmental funds to Brian M. Galla, by the Bennett Pierce Chair in Caring and Compassion at Pennsylvania State University to Robert W. Roeser, and by the Compassion Graduate Student Fellowship from the Prevention Research Center at Pennsylvania State University to Blake Colaianne.

ORCID iD

Hiba Abujaradeh https://orcid.org/0000-0003-1061-1481
Blake A. Colaianne https://orcid.org/0000-0001-5111-5527

Supplemental material

Supplemental material for this article is available online.

Notes

1. Beyond evaluating the factor structure of a 20-item short-form Five Facet Mindfulness Questionnaire (FFMQ) mostly in accordance with Baer et al. (2006), Tran et al. (2013) also assessed an exploratory two-factor hierarchical model (with "self-regulated attention" and "orientation to experience" as the higher order factors). Our aim was to adhere to the Baer et al. (2006) FFMQ

validation study, and thus, we did not explicitly evaluate the two-factor hierarchical model described in the work of Tranet al. (2013).

1. We slightly oversampled juniors and seniors for a separate formative evaluation study on a social psychology elective course that introduced students to basic principles of mindfulness and compassion. Including a dummy variable to account for enrollment in this course ($n = 46$, 8%) did not substantively alter the results. Thus, it is not described further.
2. The Online Supplementary material also includes tests of measurement invariance using the four-factor correlated models.
3. We note that while our FFMQ measure demonstrated evidence of discriminant validity from aspects of social skills (e.g., social perspective taking), this does not mean that mindfulness is not relevant in the prediction or cultivation of these skills (Berry et al., 2018; Condon, Desbordes, Miller, & DeSteno, 2013; Roeser, Colaianne, & Greenberg, 2018). Rather, this may mean that the measurement of mindfulness (which places a stronger emphasis on intra-personal experiences) is distinct from the measurement of social skills (which places a stronger emphasis on intra-personal experiences).

References

Analayo, B. (2003). *Satipat.t.ha¯na: The direct path to realization*. Birmingham, UK: Windhorse.

Baer, R. A. (2003). Mindfulness training as a clinical intervention: A conceptual and empirical review. *Clinical Psychology: Science and Practice*, *10*, 125–143. doi:10.1093/clipsy/bpg015

Baer, R. A., Smith, G. T., & Allen, K. B. (2004). Assessment of mindfulness by self-report: The Kentucky inventory of mindfulness skills. *Assessment*, *11*, 191–206. doi:10.1177/1073191104268029

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment*, *13*, 27–45. doi:10.1177/1073191105283504

Baraldi, A. N., & Enders, C. K. (2010). An introduction to modern missing data analyses. *Journal of School Psychology*, *48*, 5–37. doi:10.1016/j.jsp.2009.10.001

Bentler, P. M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, *88*, 588–606. doi:10.1037/0033-2909.88.3.588

Bergomi, C., Tschacher, W., & Kupper, Z. (2013). The assessment of mindfulness with self-report measures: Existing scales and open issues. *Mindfulness*, *4*, 191–202. doi:10.1007/s12671-012-0110-9

Berry, D. R., Cairo, A. H., Goodman, R. J., Quaglia, J. T., Green, J. D., & Brown, K. W. (2018). Mindfulness increases prosocial responses toward ostracized strangers through empathic concern. *Journal of Experimental Psychology: General*, *147*, 93–112. doi:10.1037/xge0000392

Bishop, S. R., Lau, M., Shapiro, S. L., Carlson, L. E., Anderson, N. D., Carmody, J., … Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, *11*, 230–241. doi:10.1037/0033-2909.88.3.588

Bluth, K., Campo, R. A., Futch, W. S., & Gaylord, S. A. (2017). Age and gender differences in the associations of self-compassion and emotional well-being in a large adolescent sample. *Journal of Youth and Adolescence*, *46*, 840–853. doi:10.1007/s10964-016-0567-2

Bodhi, B. (2011). What does mindfulness really mean? A canonical perspective. *Contemporary Buddhism*, *12*, 19–39. doi:10.1080/14639947.2011.564813

Bohlmeijer, E., ten Klooster, P. M., Fledderus, M., Veehof, M., & Baer, R. (2011). Psychometric properties of the Five Facet Mindfulness Questionnaire in depressed adults and development of a short form. *Assessment*, *18*, 308–320. doi:10.1177/1073191111408231

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*, 822–848. doi:10.1037/0022-3514.84.4.822

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural models* (pp. 136–162). Newbury Park, CA: Sage.

Burke, C. A. (2010). Mindfulness-based approaches with children and adolescents: A preliminary review of current research in an emergent field. *Journal of Child and Family Studies*, *19*, 133–144. doi:10.1007/s10826-009-9282-x

Calvete, E., Gámez-Guadix, M., & Cortazar, N. (2017). Mindfulness facets and problematic Internet use: A six-month longitudinal study. *Addictive Behaviors*, *72*, 57–63. doi:10.1016/j.addbeh.2017.03.018

Caprara, G. V., Steca, P., Zelli, A., & Capanna, C. (2005). A new scale for measuring adults' prosocialness. *European Journal of Psychological Assessment*, *21*, 77–89. doi:10.1027/1015-5759.21.2.77

Chen, F. F. (2007). Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling*, *14*, 464–504. doi:10.1080/10705510701301834

Christopher, M., Neuser, N., Michael, P., & Baitmangalkar, A. (2012). Exploring the psychometric properties of the Five Facet Mindfulness Questionnaire. *Mindfulness*, *3*, 124–131. doi:10.1007/s12671-011-0086-x

Ciesla, J. A., Reilly, L. C., Dickson, K. S., Emanuel, A. S., & Updegraff, J. A. (2012). Dispositional mindfulness moderates the effects of stress among adolescents: Rumination as a mediator. *Journal of Clinical Child and Adolescent Psychology*, *41*, 760–770. doi:10.1080/15374416.2012.698724

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24*, 385–396. doi:10.2307/2136404

Condon, P., Desbordes, G., Miller, W. B., & DeSteno, D. (2013). Meditation increases compassionate responses to suffering. *Psychological Science*, *24*, 2125–2127. doi:10.1177/0956797613485603

Curtiss, J., & Klemanski, D. H. (2014). Factor analysis of the Five Facet Mindfulness Questionnaire in a heterogeneous clinical sample. *Journal of Psychopathology and Behavioral Assessment*, *36*, 683–694. doi:10.1007/s10862-014-9429-y

Davis, M. H. (1980). A multidimensional approach to individual differences in empathy. *JSAS Catalog of Selected Documents in Psychology*, *10*, 85.

Desrosiers, A., Klemanski, D. H., & Nolen-Hoeksema, S. (2013). Mapping mindfulness facets onto dimensions of anxiety and depression. *Behavior Therapy*, *44*, 373–384. doi:10.1016/j.beth.2013.02.001

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, *49*, 71–75.

Dimitrov, D. M. (2010). Testing for factorial invariance in the context of construct validation. *Measurement and Evaluation in Counseling and Development*, *43*, 121–149. doi:10.1177/0748175610373459

Galla, B. M. (2016). Within-person changes in mindfulness and self-compassion predict enhanced emotional well-being in healthy, but stressed adolescents. *Journal of Adolescence*, *49*, 204–217. doi:10.1016/j.adolescence.2016.03.016

Goldberg, S. B., Wielgosz, J., Dahl, C., Schuyler, B., MacCoon, D. S., Rosenkranz, M., … Davidson, R. J. (2016). Does the Five Facet

Mindfulness Questionnaire measure what we think it does? Construct validity evidence from an active controlled randomized clinical trial. *Psychological Assessment, 28*, 1009–1014. doi:10.1037/pas0000233

Goodman, M. S., Madni, L. A., & Semple, R. J. (2017). Measuring mindfulness in youth: Review of current assessments, challenges, and future directions. *Mindfulness, 8*, 1409–1420. doi:10.1007/s12671-017-0719-9

Greco, L. A., Baer, R. A., & Smith, G. T. (2011). Assessing mindfulness in children and adolescents: Development and validation of the Child and Adolescent Mindfulness Measure (CAMM). *Psychological Assessment, 23*, 606–614. doi:10. 1037/a0022819

Gu, J., Strauss, C., Crane, C., Barnhofer, T., Karl, A., Cavanagh, K., & Kuyken, W. (2016). Examining the factor structure of the 39-item and 15-item versions of the Five Facet Mindfulness Questionnaire before and after mindfulness-based cognitive therapy for people with recurrent depression. *Psychological Assessment, 28*, 791–802. doi:10.1037/pas0000263

Hollis-Walker, L., & Colosimo, K. (2011). Mindfulness, self-compassion, and happiness in non-meditators: A theoretical and empirical examination. *Personality and Individual Differences,50*, 222–227. doi:10.1016/j.paid.2010.09.033

Hou, J., Wong, S. Y. S., Lo, H. H. M., Mak, W. W. S., & Ma, H. S. W. (2013). Validation of a Chinese version of the Five Facet Mindfulness Questionnaire in Hong Kong and development of a short form. *Assessment, 21*, 363–371. doi:10.1177/1073191113485121

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1–55. doi:10.1080/10705519909540118

IBM Corp. (2016). *IBM SPSS statistics for Windows (version 24)*. Armonk, NY: Author.

Levinson, D. B., Stoll, E. L., Kindy, S. D., Merry, H. L., & Davidson, R. J. (2014). A mind you can count on: Validating breath counting as a behavioral measure of mindfulness. *Frontiers in Psychology, 5*, 1–10. doi:10.3389/fpsyg.2014.01202

Mackinnon, A., Jorm, A. F., Christensen, H., Korten, A. E., Jacomb, P. A., & Rodgers, B. (1999). A short form of the Positive and Negative Affect Schedule: evaluation of factorial validity and invariance across demographic variables in a community sample. *Personality and Individual Differences, 27*, 405–416. doi:10.1016/ S0191-8869(98)00251-7

Medvedev, O. N., Norden, P. A., Krägeloh, C. U., & Siegert, R. J. (2018). Investigating unique contributions of dispositional mindfulness facets to depression, anxiety, and stress in general and student populations. *Mindfulness, 9*, 1757–1767. doi:10.1007/ s12671-018-0917-0

Medvedev, O. N., Siegert, R. J., Kersten, P., & Krägeloh, C. U. (2017). Improving the precision of the Five Facet Mindfulness Questionnaire using a Rasch approach. *Mindfulness, 8*, 995–1008. doi:10.1007/s12671-016-0676-8

Muthén, L. K., & Muthén, B. O. (2012). *Mplus user's guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.

National Center for Education Statistics. (2018). *Common Core of Data (CCD): Public school data 2015-16, 2017-18 school years*. Retrieved from https://nces.ed.gov/ccd/schoolsearch/index.asp

Pallozzi, R., Wertheim, E., Paxton, S., & Ong, B. (2017). Trait mindfulness measures for use with adolescents: A systematic review. *Mindfulness, 8*, 110–125. doi:10.1007/s12671-016-0567-z

Raes, F., Pommier, E., Neff, K. D., & Van Gucht, D. (2011). Construction and factorial validation of a short form of the Self-Compassion Scale. *Clinical Psychology & Psychotherapy, 18*, 250–255. doi:10.1002/cpp.702

Roeser, R. W., Colaianne, B. A., & Greenberg, M. T. (2018). Compassion and human development: Current approaches and future directions. *Research in Human Development, 15*, 238–251. doi:10.1080/15427609.2018.1495002

Roeser, R. W., & Eccles, J. S. (2015). Mindfulness and compassion in human development: Introduction to the special section. *Developmental Psychology, 51*, 1–6. doi:10.1037/a0038453

Royuela-Colomer, E., & Calvete, E. (2016). Mindfulness facets and depression in adolescents: Rumination as a mediator. *Mindfulness, 7*, 1092–1102. doi:10.1007/s12671-016-0547-3

Rudnev, M., Lytkina, E., Davidov, E., Schmidt, P., & Zick, A. (2018). Testing measurement invariance for a second-order factor. A cross-national test of the Alienation Scale. *Methods, Data, Analy- ses, 12*, 47–76. doi:10.12758/mda.2017.11

Ryan, R. M., & Deci, E. L. (2000). Self-determination theoryand the facilitation of intrinsic motivation, social development,and well-being. *American Psychologist, 55*, 68–78. doi:10. 1037110003-066X.55.1.68

Satorra, A., & Bentler, P. M. (2001). A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika, 66*, 507–514. doi:10.1007/BF02296192

Sauer, S., Walach, H., Schmidt, S., Hinterberger, T., Lynch, S., Büssing, A., & Kohls, N. (2013). Assessment of mindfulness: Review on state of the art. *Mindfulness, 4*, 3–17. doi:10.1007/ s12671-012-0122-5

Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods, 7*, 147–177. doi:10.1037//1082-989X.7.2.147

Schumacker, R. E., & Lomax, R. G. (2010). *A beginner's guide to structural equation modeling* (3rd ed.). New York, NY: Routledge.

Segal, E. A., Cimino, A. N., Gerdes, K. E., Harmon, J. K., & Wagaman, M. A. (2013). A confirmatory factor analysis of the interpersonal and social empathy index. *Journal of the Society for Social Work and Research, 4*, 131–153. doi:10.5243/jsswr.2013.9

Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of mindfulness. *Journal of Clinical Psychology, 62*, 373–386. doi:10.1002/jclp.20237

Skinner, E., Pitzer, J., & Steele, J. (2013). Coping as part of motivational resilience in school: A multidimensional measure of families, allocations, and profiles of academic coping. *Journal of Educational and Psychological Measurement, 73*, 803–835. doi:10.1177/0013164413485241

Tran, U. S., Glück, T. M., & Nader, I. W. (2013). Investigating the Five Facet Mindfulness Questionnaire (FFMQ): Construction of a short form and evidence of a two-factor higher order structure of mindfulness. *Journal of Clinical Psychology, 69*, 951–965. doi:10.1002/jclp.21996

Van Dam, N. T., van Vugt, M. K., Vago, D. R., Schmalzl, L., Saron, C. D., Olendzki, A., … Meyer, D. E. (2018). Mind the hype: A critical evaluation and prescriptive agenda for research on mindfulness and meditation. *Perspectives on Psychological Science, 13*, 36–61. doi:10.1177/1745691617709589

van Son, J., Nyklíček, I., Nefs, G., Speight, J., Pop, V. J., & Pouwer, F. (2014). The association between mindfulness and emotional distress in adults with diabetes: Could mindfulness serve as a buffer? Results from Diabetes MILES: The

Netherlands. *Journal of Behavioral Medicine*, *38*, 251–260. doi: 10.1007/s10865-014-9592-3

Veehof, M. M., ten Klooster, P. M., Taal, E., Westerhof, G. J., & Bohlmeijer, E. T. (2011). Psychometric properties of the Dutch Five Facet Mindfulness Questionnaire (FFMQ) in patients with fibromyalgia. *Clinical Rheumatology*, *30*, 1045–1054. doi:10.1007/s10067-011-1690-9

Widaman, K. F., Ferrer, E., & Conger, R. D. (2010). Factorial invariance within longitudinal structural equation models: Measuring the same construct across time. *Child Development Perspectives*, *4*, 10–18. doi:10.1111/j.1750-8606.2009.00110.x

Williams, M. J., Dalgleish, T., Karl, A., & Kuyken, W. (2014). Examining the factor structures of the Five Facet Mindfulness Questionnaire and the Self-Compassion Scale. *Psychological Assessment*, *26*, 407–418. doi:10.1037/a0035566

Ziegler, M., Kemper, C. J., & Kruyen, P. (2014). Short scales–Five misunderstandings and ways to overcome them. *Journal of Individual Differences*, *35*, 185–189. doi:10.1027/1614-0001/a000148

Appendix C Abstract American Diabetes Association

American Diabetes Association Scientific Sessions (ADA 2021), Virtual.

81st American Diabetes Association Scientific Sessions, June 24-26, 2021, Virtual (Poster Presentation)

The mediating role of shared responsibility in the relationship of trait mindfulness and diabetes-related outcomes

In youth with T1D, mindfulness and parental involvement (i.e., shared responsibility) of diabetes self-management (DSM) behaviors are associated with positive diabetes-related outcomes. This study explored the mediating role of shared responsibility in the relationship of mindfulness with DSM and A1c. A cross-sectional study was conducted among 129 adolescents aged 12-18 years with T1D at a tertiary medical center. Adolescents completed a survey on mindfulness (Child Acceptance & Mindfulness Measure), shared responsibility (Diabetes Family Responsibility Questionnaire-Short) and DSM (Self-care Inventory). A1c was obtained from medical records. The PROCESS SPSS macro by Hayes (v3.5) was used to assess mediation. Unstandardized and standardized path coefficients (β), SE, p-value, and 10,000 bias-corrected bootstraps 95% CI reported.

Results: Mindfulness had positive significant association with shared responsibility (a-path=0.974, SE=.045, β=.189, R^2=.036, p=.032). Shared responsibility had significant association with DSM (b-path=0.055, SE=.017, β=.275, p=.0015). The direct (c') and total (c) relationships between mindfulness and DSM were significant (c'=0.198, SE=.087, β=.193, p=.024; c=.251,

SE=.088, β=.245, R^2=.06, p=.005). The relationship between mindfulness and DSM was partially mediated by shared responsibility (ab=0.053, SE=0.031 bias-corrected bootstrapped 95% CI = [0.0059, 0.0119]). For the second mediational model, neither mindfulness nor shared responsibility were associated with A1c (p>.05).

Mindfulness and shared responsibility had positive association with DSM but not A1c. Shared responsibility partially mediated the relationship between mindfulness and DSM, whereby youth with higher levels of trait mindfulness had greater shared responsibility and better DSM. Temporal inferences should be interpreted with caution. Interventions targeting both mindfulness and shared responsibility should be explored.

Appendix D Institutional Review Board (IRB) Approval

APPROVAL OF SUBMISSION (Expedited)

Date:	September 30, 2020
IRB:	CR19090004-001
PI:	Hiba Abujaradeh
Title:	The Association of Trait Mindfulness with Psychosocial Variables, Diabetes-related Outcomes, and Implicit Bias among Adolescents with Type 1 Diabetes
Funding:	Name: Sigma Theta Tau International; Name: NAPNAP Foundation

The Institutional Review Board reviewed and approved the above referenced study. The study may continue as outlined in the University of Pittsburgh approved application and documents.

Approval Documentation

Review type:	Continuing Review
Approval Date:	9/30/2020
Expedited Category	(5) Data, documents, records, or specimens, (7)(b) Social science methods, (7)(a) Behavioral research

---

As the Principal Investigator, you are responsible for the conduct of the research and to ensure accurate documentation, protocol compliance, reporting of possibly study-related adverse events and unanticipated problems involving risk to participants or others. The HRPO Reportable Events policy, Chapter 17, is available at http://www.hrpo.pitt.edu/.

Clinical research being conducted in an UPMC facility cannot begin until fiscal approval is received from the UPMC Office of Sponsored Programs and Research Support (OSPARS).

If you have any questions, please contact the University of Pittsburgh IRB Coordinator, Emily Bird.

Please take a moment to complete our Satisfaction Survey as we appreciate your feedback.

Appendix E Informed consent

University of Pittsburgh

School of

3500 Victoria Street

Pittsburgh, Pennsylvania 15261

Fax: 412-624-2401

Consent to be a Research Subject

Title: Mindfulness and Health-related Outcome among Adolescents with Type 1 Diabetes

Principal Investigator: Hiba Abujaradeh PhD (s), MSN, RN, CPNP

University of Pittsburgh School of Nursing

412-436-6805

Mentor: Denise Charron-Prochownik, PHD, RN, CPNP, FAAN

University of Pittsburgh School of Nursing

412-624-6953

Source of funding: School of Nursing Swigart/Gold Doctoral Award, NAPNAP Foundation

Study Overview: Your child is being invited to participate in this study because he/she is an adolescent between 12-18 years with type 1 diabetes. This study is focused on understanding

the protective role of being mindful on health related-outcome among teens (age 12-18 years) with type 1 diabetes. We want to know if being more mindfulness is associated with less stress, anxiety and better diabetes-care and blood sugar. **In order to find that out, your child will answer a survey of questions on mental health and diabetes-related issues. The survey will be presented on an iPad during your presence at the clinic today and it will take around one hour.**

Procedures: Your child will be asked to fill out several questionnaires, including one on depressive symptoms, diabetes distress, and stress, diabetes care, mindfulness as well as a demographic form that will ask you general questions about age and education. We are also requesting your authorization to review your child's medical chart for their age, date of last hospitalization, blood sugar value and number of previous hospitalizations. This identifiable medical record information will be made available to members of the research team for an indefinite period of time. The questionnaires may take you 60 minutes to fill out.

Risk and Discomforts: There may be some small risk involved if you participate in this study. There may be a risk from disclosing information for research if there is a breach in confidentiality.

Benefits : There are no direct benefits, however an indirect benefit may be that information obtained in this study may inform developing a mindfulness program to help adolescents with type 1 diabetes to cope with their stress, anxiety, feeling sad, and improve their diabetes-selfcare and glycemic control.

Reimbursement for Time: Your child will be offered a $20.00 gift card at the completion of the survey. In addition, your child will enter into a drawing to win one iPad at the of the study.

Confidentiality: Every effort will be made to ensure that you and your child's information is kept confidential. Records will be kept in a locked filing cabinet in a locked office, and any identifying information will be removed to the extent possible. Your information will be assigned a participant ID number for all of your documents so we do not need your name. The University of Pittsburgh policy for all research records states that we must maintain them for at least 7 years following final reporting or publication of a project.

Your Child's medical information, as well as information obtained during this research study, may be shared with other groups, possibly including authorized officials from the Food and Drug Administration, School of Nursing University of Pittsburgh Doctoral Award, and NAPNAP foundation, and the University of Pittsburgh Research Conduct and Compliance Office, for the purpose of monitoring the study. Authorized representatives of UPMC or affiliated health care providers may also have access to this information to provide services and address billing and operational issues.

We will make every attempt to protect your child's privacy and the confidentiality of your records, as described in this document, but cannot guarantee the confidentiality of your child's research records, including information obtained from your child's medical records, once your personal information is disclosed to others outside UPMC or the University. This authorization is valid for an indefinite period of time. However, you can always withdraw your authorization to allow the research team to review your child's medical records by contacting the investigator listed on the first page and making the request in writing. If you do so, you/your child will no longer be permitted to participate in this study. Any information obtained from you up to that point will continue to be used by the research team. By signing this form I consent to participate in this

research study and provide my authorization to share my child's medical records with the research team.

The University of Pittsburgh will keep any research records we create private to the extent we are required to do so by law. A study number rather than your name will be used on study records wherever possible. Your name and other facts that might point to you will not appear when we present this study or publish its results. Study records can be opened by court order. They may also be produced in response to a subpoena or a request for production of documents.

If the researchers learn that you or someone with whom you are involved is in serious danger of harm they will need to inform the appropriate agencies as required by Pennsylvania law.

Voluntary Participation: You and your child's participation in this research study is entirely voluntary. You may want to discuss this study with your family and friends and your personal physician before agreeing to participate. If there are any words you do not understand, feel free to ask us. The investigators will be available to answer your current and future questions. Whether or not you provide your consent for your child's participation in this research study will have no effect on your current or future relationship with the University of Pittsburgh. Whether or not you provide your consent for participation in this research study will have no effect on your current or future medical care at a UPMC hospital or affiliated health care provider or your current or future relationship with a health care insurance provider. To formally withdraw your consent for participation in this research study you should inform the researcher listed on the first page of this form.

Right to withdraw: I understand that my child is free to withdraw from this study at any time. To do so, please inform the investigators. Any information collected up to the time of withdrawal may continue to be used.

Voluntary consent: I certify that I have read the preceding and that I understand its contents. The above information has been explained to me and all of my current questions have been answered. I understand that I am encouraged to ask questions, voice concerns or complaints about any aspect of this research study during the course of this study, and that such future questions, concerns or complaints will be answered by a qualified by the investigator Ms. Abujaradeh (412-436-6805). I understand that I may always request that my questions, concerns or complaints be addressed by a listed investigator. I understand that I may contact the Human Subjects Protection Advocate of the IRB Office, University of Pittsburgh (1-866-212-2668) to discuss problems, concerns, and questions; obtain information; offer input; or discuss situations that occurred during my participation. By signing this form I agree to participate in this research study. A copy of this consent form will be given to me.

_____

Participant's (Child's) Name (Print)

I understand that, as a minor (age less than 18 years), the above-named child is not permitted to participate in this research study without my consent. Therefore, by signing this form, I give my consent for his/her participation in this research study.

_____ _____

Parent's or Guardian's Name Relationship to Participant (Child)

Parent's or Guardian's Signature Date

CERTIFICATION OF INFORMEDCONSENT:

I certify that I have explained the nature and purpose of this research study to the above-named individual(s}, and I have discussed the potential benefits and possible risks of study participation. Any questions the individual(s) have about this study have been answered, and we will always be available to address future questions as they arise.

Name of Person Obtaining Consent Role in Research Study

Signature of Person Obtaining Consent Date

Adolescent Assent

Why are you asking me?

I am being asked to be in the study because I am a teen between the age of 12 and 18 year. I have been diagnosed with type 1 diabetes for at least one year and I speak English fluently.

If I am in the study, I will be asked to complete a survey of questions on mental and physical health issues on iPad during my presence at the clinic today. I will spend extra time in the clinic to complete the survey.

Will this hurt?

This study will not cause pain. But there is a risk of breach of confidentiality. To prevent this from occur,

any information obtained from this study will be kept confidential by the investigators. Data will be identified by a code number known only to the investigators.

Do I get anything fir being in the study?

If I am in the study, I will be given a gift card of $20 at the end of completing the questions. . In addition, I will enter into a drawing to win one iPad at the of the study.

Can I ask Questions?

I asked any questions I have now about the study, All my questions were answered.

I know that if I have a questions later, I can ask and get an answer.

Do I have to do this?

I know that I do not have to be in this study. No one will be mad at me if I say no.

I want to be in the study. ----- Yes ----- No

ASSENT FOR PARTICIPATING ADOLESCENT:

_____ _____

Signature of Adolescent Date

VERIFICATION OF EXPLANATION:

I certify that I have carefully explained the purpose and nature of this research to the above-named child in age appropriate language. He/she has had an opportunity to discuss it with me in detail. I have answered all his/her questions and he/she provided affirmative agreement (i.e., assent) to participate in this research.

_____ _____

Signature of Person Obtaining Consent Date

Appendix F Measures

Child and Adolescent Mindfulness Measure (CAMM)

We want to know more about what you think, how you feel, and what you do. **Read** each sentence. Then, circle the number that tells **how often each sentence is true for you.**

	Never True	Rarely True	Some-times True	Often True	Always True
1. I get upset with myself for having feelings that don't make sense.	0	1	2	3	4
2. At school, I walk from class to class without noticing what I'm doing.	0	1	2	3	4
3. I keep myself busy so I don't notice my thoughts or feelings.	0	1	2	3	4
4. I tell myself that I shouldn't feel the way I'm feeling.	0	1	2	3	4
5. I push away thoughts that I don't like.	0	1	2	3	4
6. It's hard for me to pay attention to only one thing at a time.	0	1	2	3	4
7. I get upset with myself for having certain thoughts.	0	1	2	3	4
8. I think about things that have happened in the past instead of thinking about things that are happening right now.	0	1	2	3	4
9. I think that some of my feelings are bad and that I shouldn't have them.	0	1	2	3	4
10. I stop myself from having feelings that I don't like.	0	1	2	3	4

Five Facet Mindfulness Questionnaire

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, please indicate with a check how often you felt or thought a certain way.

	Never or very rarely true	Rarely true	Sometimes true	Often true	Very often or always true
1. When I do things, my mind wanders off and I'm easily distracted.	0	1	2	3	4
2. I don't pay attention to what I'm doing because I'm daydreaming, worrying, or otherwise distracted.	0	1	2	3	4
3. I watch my feelings without getting lost in them.	0	1	2	3	4
4. I am easily distracted.	0	1	2	3	4
5. I believe some of my thoughts are abnormal or bad and I shouldn't think that way.	0	1	2	3	4
6. I pay attention to sensations, such as the wind in my hair or sun on my face.	0	1	2	3	4
7. I have trouble thinking of the right words to express how I feel about things.	0	1	2	3	4
8. I find it difficult to stay focused on what's happening in the present.	0	1	2	3	4
9. When I have distressing thoughts or images, I "step back" and am aware of the thought or image without getting taken over by it.	0	1	2	3	4
10. I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.	0	1	2	3	4
11. In difficult situations, I can pause without immediately reacting.	0	1	2	3	4

12. When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words	0	1	2	3	4
13. When I have distressing thoughts or images, I feel calm soon after.	0	1	2	3	4
14. I tell myself that I shouldn't be thinking the way I'm thinking.	0	1	2	3	4
15. I notice the smells and aromas of things.	0	1	2	3	4
16. I think some of my emotions are bad or inappropriate and I shouldn't feel them.	0	1	2	3	4
17. I notice visual elements in art or nature, such as colors, shapes, textures, or patterns of light and shadow.	0	1	2	3	4
18. My natural tendency is to put my experiences into words.	0	1	2	3	4
19. When I have distressing thoughts or images, I judge myself as good or bad depending on what the thought or image is about	0	1	2	3	4
20. I can usually describe how I feel at the moment in considerable detail.	0	1	2	3	4

Sum total after reverse scoring for items in describe, act with awareness, and non-judge subscales.

(H. Abujaradeh et al., 2019; Tran et al., 2013)

Perceived Stress Scale- 4 item

In each case, please indicate with a check how often you felt or thought a certain way during the last month.

	Never	Almost never	Some-times	Fairly Often	Very often
1. How often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
2. How often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
3. How often have you felt that things were going your way?	0	1	2	3	4
4. How often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

DIABETES STRESS QUESTIONNAIRE FOR YOUTHS—Short Version

Instructions: Please read the following situations and rate how stressful it is; in other words, rate how upsetting, difficult, or how much of a problem each one is for you by checking one of the following: NOT AT ALL; A LITTLE; PRETTY MUCH; VERY MUCH. There are no right or wrong answers, only what is true for you.

	Not at all	A little much	Pretty much	Very
1. My family keeping and eating foods at home that aren't healthy for me.	1	2	3	4
2. Having an insulin reaction while I'm with my friends.	1	2	3	4
3. Disagreements with my parents about taking my insulin shots on time.	1	2	3	4
4. Having a high Alc.	1	2	3	4
5. Thinking about health problems that I might have when I'm older.	1	2	3	4
6. Thinking of myself as a diabetic	1	2	3	4
7. Talking with my friends about my diabetes.	1	2	3	4
8. Thinking that it’s unfair that I got diabetes.	1	2	3	4
9. Going to the doctor for a check-up	1	2	3	4
10. Not being able to go on overnight trips or stay overnight at my friends' house because I have diabetes.	1	2	3	4

DSQY-SV Scale

To score the scale, simply compute the sum of the 10 items. Higher scores reflect higher levels of diabetes stress

Problem Areas in Diabetes: Teen Version (PAID-T)

Age: _____ Sex: M__ F__
How old were you when your diabetes was diagnosed? _____

DIRECTIONS: Living with diabetes can sometimes be difficult. In day-to-day life, there may be many problems and hassles with your diabetes. The problems may range from minor hassles to major life difficulties. Listed below are a variety of possible problem areas which people with diabetes may have. Think about how much each of the items below may have upset or bothered you DURING THE PAST MONTH and circle the appropriate number.

Please note that we are asking you how much each item may be bothering you in your life, NOT whether the item is merely true for you. If you feel that an item is not a bother or a problem for you, you would circle ‘‘1’’. If it very bothersome to you, you would circle ‘‘6’’.

	Not A Problem		Moderate Problem		Serious Problem	
1. Feeling sad when I think about having and living with diabetes.	1	2	3	4	5	6
2.Feeling overwhelmed by my diabetes regimen.	1	2	3	4	5	6
3.Feeling angry when I think about having and living with diabetes.	1	2	3	4	5	6
4.Feeling ‘‘burned-out’’ by the constant effort to manage diabetes.	1	2	3	4	5	6
5.Feeling that I am not checking my blood sugars often enough.	1	2	3	4	5	6
6.Not feeling motivated to keep up with my daily diabetes tasks.	1	2	3	4	5	6
7. Feeling that my friends or family act like ‘‘diabetes police’’ (e.g. nag about eating properly, checking blood sugars, not trying hard enough	1	2	3	4	5	6
8. Feeling like my parents don’t trust me to care for my diabetes.	1	2	3	4	5	6
9. Missing or skipping blood sugar checks.	1	2	3	4	5	6
10. Feeling that I am often failing with my diabetes regimen.	1	2	3	4	5	6
11. Feeling like my parents blame me for blood sugar numbers they don’t like.	1	2	3	4	5	6
12. Feeling that my friends or family don’t understand how difficult living with diabetes can be.	1	2	3	4	5	6

13. Worrying that diabetes gets in the way of having fun and being with my friends.	1	2	3	4	5	6
14. Feeling like my parents worry about complications too much.	1	2	3	4	5	6

PAID-T Scoring
To score the scale, compute the sum of the 14 items. Higher scores reflect higher levels of diabetes distress.

Self-Care Inventory-Revised Version (SCI-R)

This survey measures what you actually do, not what you are advised to do. How have you followed your diabetes treatment plan in the past 1-2 months?

	Never	Rarely	Some-times	Usually	Always
1. Check blood glucose with monitor	1	2	3	4	5
2. Record blood glucose results	1	2	3	4	5
3. If type 1: Check ketones when glucose level is high	1	2	3	4	5
4. Take the correct dose of diabetes pills or insulin	1	2	3	4	5
5. Take diabetes pills or insulin at the right time	1	2	3	4	5
6. Eat the correct food portions	1	2	3	4	5
7. Eat meals/snacks on time	1	2	3	4	5
8. Keep food records	1	2	3	4	5
9. Keep food records	1	2	3	4	5
10. Treat low blood glucose with just the recommended amount of carbohydrate	1	2	3	4	5
11. Carry quick acting sugar to treat low blood glucose	1	2	3	4	5
12. Come in for clinic appointments	1	2	3	4	5
13. Wear a Medic Alert ID	1	2	3	4	5

14. Exercise	1	2	3	4	5
15. If on insulin: Adjust insulin dosage based on glucose values, food, and exercise	1	2	3	4	5

The Diabetes Family Responsibility Questionnaire (DFRQ)

For each question, circle which one of the three statements that best describes the way each task or situation was handled in your family.

Parent: Parent(s) took or initiated responsibility for this almost all of the time
Both: Parent(s) and I shared responsibility for this about equally
Child: I took or initiated responsibility for this almost all of the time

	parent	Both	child
Insulin administration	3	2	1
Blood glucose monitoring	3	2	1

DIABETES STRESS QUESTIONNAIRE FOR YOUTHS—Short Version

Please read the following situations and rate how stressful it is; in other words, rate how upsetting, difficult, or how much of a problem each one is for you by checking one of the following: NOT AT ALL; A LITTLE; PRETTY MUCH; VERY MUCH. There are no right or wrong answers, only what is true for you.

	Not at all	A little	Pretty much	Very much
1. My family keeping and eating foods at home that aren't healthy for me.	1	2	3	4
2. Having an insulin reaction while I'm with my friends	1	2	3	4

3. Disagreements with my parents about taking my insulin shots on time.	1	2	3	4
4. Having a high Alc.	1	2	3	4
5. Thinking about health problems that I might have when I'm older.	1	2	3	4
6. Thinking of myself as a diabetic	1	2	3	4
7. Talking with my friends about my diabetes.	1	2	3	4
8. Thinking that it's unfair that I got diabetes.	1	2	3	4
9. Going to the doctor for a check-up	1	2	3	4
10. Not being able to go on overnight trips or stay overnight at my friends' house because I have diabetes.	1	2	3	4

Bibliography

Abujaradeh, H., Colaianne, B., Roeser, R. W., & Galla, B. M. (2019). *Measuring Adolescents' Mindfulness: Psychometric Properties of 20-item Five Facet Mindfulness Questionnaire.* Paper presented at the Society for Research in Child Development Biennial Meeting, Baltimore, Maryland, USA.

Abujaradeh, H., Colaianne, B. A., Roeser, R. W., Tsukayama, E., & Galla, B. M. (2020). Evaluating a short-form Five Facet Mindfulness Questionnaire in adolescents: Evidence for a four-factor structure and invariance by time, age, and gender. *International Journal of Behavioral Development, 44*(1), 20-30.

Abujaradeh, H., Helgeson, V., Cohen, S., & Sereika, S. (2018a). Shared Responsibility Moderates Relations between Psychological Distress and Self-Care among Adolescents with T1D. In *The 78th annual conference of the American Diabetes Association 2018, June*. Orlando, FL: American Diabetes Association

Abujaradeh, H., Helgeson, V., Cohen, S., & Sereika, S. (2018b). *Shared Responsibility Moderates Relations between Psychological Distress and Self-Care among Adolescents with T1D*. Paper presented at the The 78th annual conference of the American Diabetes Association 2018, June, Orlando, FL.

Abujaradeh, H., Safadi, R., Sereika, S. M., Kahle, C. T., & Cohen, S. M. (2018). Mindfulness-Based Interventions among Adolescents with Chronic Diseases in Clinical Settings: A Systematic Review. *J Pediatr Health Care*. doi:10.1016/j.pedhc.2018.04.001

Abujaradeh, H., Sereika, S. M., Cohen, S. M., & Helgeson, V. (2018). Does Gender Moderate the Relations between Shared Responsibility and Health Outcomes among Adolescents with T1D? In: Am Diabetes Assoc.

American Diabetes Association. (2021). 13. Children and Adolescents: Standards of Medical Care in Diabetes—2021. *Diabetes Care, 44*(Supplement 1), S180-S199.

American Psychological Association. (2014). Stress in America: Are teens adopting adults' stress habits. *Stress in America Surveys* Retrieved from http://www.apa.org/news/press/releases/stress/2013/stress-report.pdf

Ames, C. S., Richardson, J., Payne, S., Smith, P., & Leigh, E. (2014). Mindfulness-based cognitive therapy for depression in adolescents. *Child and Adolescent Mental Health, 19*(1), 74-78.

Anderson, B., Ho, J., Brackett, J., Finkelstein, D., & Laffel, L. (1997). Parental involvement in diabetes management tasks: relationships to blood glucose monitoring adherence and metabolic control in young adolescents with insulin-dependent diabetes mellitus. *J Pediatr, 130*(2), 257-265.

Anderson, B. J., Auslander, W. F., Jung, K. C., Miller, J. P., & Santiago, J. V. (1990). Assessing family sharing of diabetes responsibilities. *J Pediatr Psychol, 15*(4), 477-492.

Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*(1), 27-45.

Bernstein, C. M., Stockwell, M. S., Gallagher, M. P., Rosenthal, S. L., & Soren, K. (2013). Mental health issues in adolescents and young adults with type 1 diabetes: prevalence and impact on glycemic control. *Clin Pediatr (Phila), 52*(1), 10-15. doi:10.1177/0009922812459950

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., . . . Velting, D. (2004). Mindfulness: A proposed operational definition. *Clinical psychology: Science and practice, 11*(3), 230-241.

Brown, J. (2014). *The relationships between mindfulness, diabetes-related distress, selected demographic variables, and self-management in adults with type 2 diabetes* PhD, Proquest. Retrieved from http://pitt.idm.oclc.org/login?url=http://search.proquest.com/docview/1553208038?accountid=14709 (3624174)

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: mindfulness and its role in psychological well-being. *J Pers Soc Psychol, 84*(4), 822.

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: mindfulness and its role in psychological well-being. *J Pers Soc Psychol, 84*(4), 822-848.

Brown, K. W., Ryan, R. M., & Creswell, J. D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological inquiry, 18*(4), 211-237.

Brown, K. W., Weinstein, N., & Creswell, J. D. (2012). Trait mindfulness modulates neuroendocrine and affective responses to social evaluative threat. *Psychoneuroendocrinology, 37*(12), 2037-2041. doi:10.1016/j.psyneuen.2012.04.003

Buchberger, B., Huppertz, H., Krabbe, L., Lux, B., Mattivi, J. T., & Siafarikas, A. (2016). Symptoms of depression and anxiety in youth with type 1 diabetes: A systematic review and meta-analysis. *Psychoneuroendocrinology, 70*, 70-84. doi:10.1016/j.psyneuen.2016.04.019

Burgess, D. J., Beach, M. C., & Saha, S. (2017). Mindfulness practice: A promising approach to reducing the effects of clinician implicit bias on patients. *Patient Educ Couns, 100*(2), 372-376.

Burke, C. A. (2009). Mindfulness-Based Approaches with Children and Adolescents: A Preliminary Review of Current Research in an Emergent Field. *J Child Fam Stud, 19*(2), 133-144. doi:10.1007/s10826-009-9282-x

Calvete, E., Orue, I., & Sampedro, A. (2017). Does the acting with awareness trait of mindfulness buffer the predictive association between stressors and psychological symptoms in adolescents? *Personality and individual differences, 105*, 158-163.

CDC. (2017). *National Diabetes Statistics Report, 2017*. Retrieved from Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services:

Centers for Disease Control and Prevention. (2014). Diabetes report card 2014. *Atlanta, GA: Centers for Disease Control and Prevention, US Department of Health and Human Services*.

Chadi, N., McMahon, A., Vadnais, M., Malboeuf-Hurtubise, C., Djemli, A., Dobkin, P. L., . . . Haley, N. (2016). Mindfulness-based Intervention for Female Adolescents with Chronic Pain: A Pilot Randomized Trial. *Journal of the Canadian Academy of Child and Adolescent Psychiatry, 25*(3), 159.

Chao, A. M., Minges, K. E., Park, C., Dumser, S., Murphy, K. M., Grey, M., & Whittemore, R. (2016). General Life and Diabetes-Related Stressors in Early Adolescents With Type 1 Diabetes. *J Pediatr Health Care, 30*(2), 133-142. doi:10.1016/j.pedhc.2015.06.005

Ciesla, J. A., Reilly, L. C., Dickson, K. S., Emanuel, A. S., & Updegraff, J. A. (2012). Dispositional mindfulness moderates the effects of stress among adolescents: rumination as a mediator. *J Clin Child Adolesc Psychol, 41*(6), 760-770. doi:10.1080/15374416.2012.698724

Cillessen, L., van de Ven, M. O., & Karremans, J. C. (2017). The role of trait mindfulness in quality of life and asthma control among adolescents with asthma. *J Psychosom Res, 99*, 143-148. doi:10.1016/j.jpsychores.2017.06.014

Cohen, S., Kamarck, T., & Mermelstein, R. (1994). Perceived stress scale. *Measuring stress: A guide for health and social scientists*.

Cohen, S., Kessler, R. C., & Gordon, L. U. (1997). *Measuring stress: A guide for health and social scientists*: Oxford University Press on Demand.

Cotton, S., Luberto, C. M., Sears, R. W., Strawn, J. R., Stahl, L., Wasson, R. S., . . . Delbello, M. P. (2016). Mindfulness-based cognitive therapy for youth with anxiety disorders at risk for bipolar disorder: a pilot trial. *Early Interv Psychiatry, 10*(5), 426-434. doi:10.1111/eip.12216

Creswell, J. D. (2017). Mindfulness Interventions. *Annu Rev Psychol, 68*, 491-516. doi:10.1146/annurev-psych-042716-051139

Creswell, J. D., & Lindsay, E. K. (2014). How does mindfulness training affect health? A mindfulness stress buffering account. *Current Directions in Psychological Science, 23*(6), 401-407.

Dabelea, D., Mayer-Davis, E. J., Saydah, S., Imperatore, G., Linder, B., Divers, J., . . . Hamman, R. F. (2014). Prevalence of type 1 and type 2 diabetes among children and adolescents from 2001 to 2009. *Jama, 311*(17), 1778-1786. doi:10.1001/jama.2014.3201

DCCT. (1994). Effect of intensive diabetes treatment on the development and progression of long-term complications in adolescents with insulin-dependent diabetes mellitus: Diabetes Control and Complications Trial. Diabetes Control and Complications Trial Research Group. *J Pediatr, 125*(2), 177-188.

de Bruin, E. I., Zijlstra, B. J., & Bögels, S. M. (2014). The meaning of mindfulness in children and adolescents: further validation of the Child and Adolescent Mindfulness Measure (CAMM) in two independent samples from the Netherlands. *Mindfulness, 5*(4), 422-430.

Delamater, A. M., Patino-Fernandez, A. M., Smith, K. E., & Bubb, J. (2013). Measurement of diabetes stress in older children and adolescents with type 1 diabetes mellitus. *Pediatr Diabetes, 14*(1), 50-56. doi:10.1111/j.1399-5448.2012.00894.x

Delamater, A. M., Pulgaron, E., & Niel, K. (2017). Evaluation of the Diabetes Stress Questionnaire-Short Form in ethnic minority children with type 1 diabetes. . In *Poster presented at annual meeting of the International Society of Pediatric and Adolescent Diabetes*. Innsbruck, Austria.

Diabetes Research in Children Network Study Group. (2005). Comparison of fingerstick hemoglobin A1c levels assayed by DCA 2000 with the DCCT/EDIC central laboratory assay: results of a Diabetes Research in Children Network (DirecNet) Study. *Pediatr Diabetes, 6*(1), 13-16.

DiNardo, M., Saba, S., Greco, C. M., Broyles, L., Terhorst, L., Chasens, E. R., . . . Cohen, S. (2017). A Mindful Approach to Diabetes Self-Management Education and Support for Veterans. *Diabetes Educ, 43*(6), 608-620. doi:10.1177/0145721717738019

Earnshaw, V. A., Quinn, D. M., & Park, C. L. (2012). Anticipated stigma and quality of life among people living with chronic illnesses. *Chronic illness, 8*(2), 79-88.

Ellis, D. A., Carcone, A., Slatcher, R., & Sibinga, E. (2018). Feasibility of Mindfulness-Based Stress Reduction for older adolescents and young adults with poorly controlled type 1 diabetes. *Health Psychology and Behavioral Medicine, 6*(1), 1-14.

Endler, N. S., & Kocovski, N. L. (2001). State and trait anxiety revisited. *J Anxiety Disord, 15*(3), 231-245.

Entwislea, D. R., & Astone, N. M. (1994). Some practical guidelines for measuring youth's race/ethnicity and socioeconomic status. *Child Development, 65*(6), 1521-1540.

Esbitt, S. A., Tanenbaum, M. L., & Gonzalez, J. S. (2013). Disentangling Clinical Depression from Diabetes-Specific Distress: Making Sense of the Mess We've Made. 27-46. doi:10.1007/978-0-85729-751-8_2

Fanning, J., Osborn, C., Lagotte, A., & Mayberry, L. (2018). Relationships between dispositional mindfulness, health behaviors, and hemoglobin A1c among adults with type 2 diabetes. *J Behav Med, 41*(6), 798-805.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior research methods, 41*(4), 1149-1160.

Fisher, L., Hessler, D. M., Polonsky, W. H., & Mullan, J. (2012). When is diabetes distress clinically meaningful?: establishing cut points for the Diabetes Distress Scale. *Diabetes Care, 35*(2), 259-264. doi:10.2337/dc11-1572

Freedenberg, V. A., Thomas, S. A., & Friedmann, E. (2015). A pilot study of a mindfulness based stress reduction program in adolescents with implantable cardioverter defibrillators or pacemakers. *Pediatric cardiology, 36*(4), 786-795.

Galla, B. M. (2016). Within-person changes in mindfulness and self-compassion predict enhanced emotional well-being in healthy, but stressed adolescents. *J Adolesc, 49*, 204-217. doi:10.1016/j.adolescence.2016.03.016

Galla, B. M., Tsukayama, E., Park, D., Yu, A., & Duckworth, A. L. (2020). The mindful adolescent: Developmental changes in nonreactivity to inner experiences and its association with emotional well-being. *Developmental Psychology, 56*(2), 350-363. doi:http://dx.doi.org/10.1037/dev0000877

Ganguly, S., Samanta, M., Roy, P., Chatterjee, S., Kaplan, D. W., & Basu, B. (2013). Patient health questionnaire-9 as an effective tool for screening of depression among Indian adolescents. *Journal of Adolescent Health, 52*(5), 546-551.

Garrison, J., & Burklo, J. A Short Interfaith Guide to Meditation Practices. Retrieved from https://orsl.usc.edu/life/meditation/a-short-interfaith-guide-to-meditation-practices/

Gonzalez, J. S., Fisher, L., & Polonsky, W. H. (2011). Depression in diabetes: have we been missing something important? *Diabetes Care, 34*(1), 236-239. doi:10.2337/dc10-1970

Greco, L. A., Baer, R. A., & Smith, G. T. (2011). Assessing mindfulness in children and adolescents: development and validation of the Child and Adolescent Mindfulness Measure (CAMM). *Psychol Assess, 23*(3), 606-614. doi:10.1037/a0022819

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. (1998). Measuring individual differences in implicit cognition: the implicit association test. *J Pers Soc Psychol, 74*(6), 1464.

Gregg, J. A., Callaghan, G. M., Hayes, S. C., & Glenn-Lawson, J. L. (2007). Improving diabetes self-management through acceptance, mindfulness, and values: a randomized controlled trial. *J Consult Clin Psychol, 75*(2), 336-343. doi:10.1037/0022-006x.75.2.336

Haenen, S., Nyklíček, I., van Son, J., Pop, V., & Pouwer, F. (2016). Mindfulness facets as differential mediators of short and long-term effects of mindfulness-based cognitive therapy in diabetes outpatients: findings from the DiaMind randomized trial. *J Psychosom Res, 85*, 44-50.

Hagger, V., Hendrieckx, C., Sturt, J., Skinner, T. C., & Speight, J. (2016). Diabetes Distress Among Adolescents with Type 1 Diabetes: a Systematic Review. *Curr Diab Rep, 16*(1), 9. doi:10.1007/s11892-015-0694-2

Hamlin, J. K., Mahajan, N., Liberman, Z., & Wynn, K. (2013). Not like me= bad: Infants prefer those who harm dissimilar others. *Psychol Sci, 24*(4), 589-594.

Hartmann, M., Kopf, S., Kircher, C., Faude-Lang, V., Djuric, Z., Augstein, F., . . . Humpert, P. M. (2012). Sustained effects of a mindfulness-based stress-reduction intervention in type 2 diabetic patients. *Diabetes Care, 35*(5), 945-947.

Helgeson, V. S., Escobar, O., Siminerio, L., & Becker, D. (2010). Relation of stressful life events to metabolic control among adolescents with diabetes: 5-year longitudinal study. *Health Psychol, 29*(2), 153-159. doi:10.1037/a0018163

Helgeson, V. S., Reynolds, K. A., Siminerio, L., Escobar, O., & Becker, D. (2008). Parent and adolescent distribution of responsibility for diabetes self-care: links to health outcomes. *J Pediatr Psychol, 33*(5), 497-508. doi:10.1093/jpepsy/jsm081

Helgeson, V. S., Siminerio, L., Escobar, O., & Becker, D. (2009). Predictors of metabolic control among adolescents with diabetes: a 4-year longitudinal study. *J Pediatr Psychol, 34*(3), 254-270. doi:10.1093/jpepsy/jsn079

Hilliard, M. E., Joyce, P., Hessler, D., Butler, A. M., Anderson, B. J., & Jaser, S. (2016). Stress and A1c among people with diabetes across the lifespan. *Curr Diab Rep, 16*(8), 1-10.

Hollingshead, A. B. (1975). *Four factor index of social status*.

Holmbeck, G. N., Friedman, D., Abad, M., Jandasek, B., & Wolfe, D. A. (2006). Development and Psychopathology in Adolescence. In E. J. Mash (Ed.), *Behavioral and emotional disorders in adolescents: Nature, assessment, and treatment* ([ed.] ed., pp. 21-55). New York, NY, US: Guilford Publications, xvi, 719 pp.

Hood, K. K., Huestis, S., Maher, A., Butler, D., Volkening, L., & Laffel, L. M. (2006). Depressive symptoms in children and adolescents with type 1 diabetes: association with diabetes-specific characteristics. *Diabetes Care, 29*(6), 1389-1391. doi:10.2337/dc06-0087

Ingerski, L. M., Laffel, L., Drotar, D., Repaske, D., & Hood, K. K. (2010). Correlates of glycemic control and quality of life outcomes in adolescents with type 1 diabetes. *Pediatr Diabetes, 11*(8), 563-571. doi:10.1111/j.1399-5448.2010.00645.x

Iturralde, E., Adams, R. N., Barley, R. C., Bensen, R., Christofferson, M., Hanes, S. J., . . . Hood, K. K. (2017). Implementation of Depression Screening and Global Health Assessment in Pediatric Subspecialty Clinics. *J Adolesc Health, 61*(5), 591-598. doi:10.1016/j.jadohealth.2017.05.030

Jalovaara, M., & Andersson, G. (2018). Disparities in children's family experiences by mother's socioeconomic status: The case of Finland. *Population research and policy review, 37*(5), 751-768.

Jaser, S. S. (2010). Psychological problems in adolescents with diabetes. *Adolesc Med State Art Rev, 21*(1), 138-151, x-xi.

Jastrowski Mano, K. E., Salamon, K. S., Hainsworth, K. R., Anderson Khan, K. J., Ladwig, R. J., Davies, W. H., & Weisman, S. J. (2013). A randomized, controlled pilot study of mindfulness-based stress reduction for pediatric chronic pain. *Altern Ther Health Med, 19*(6), 8-14.

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. . *Clinical Psychology: Science and Practice, 10*(2), 144–156. doi:10.1093/clipsy.bpg016

Kabat-Zinn, J. (2009). *Wherever you go, there you are: Mindfulness meditation in everyday life*: Hachette Books.

Kosa, M., & Uysal, A. (2018). *Does Mindfulness Affect Wellbeing and Physical Activity Levels of Pervasive Game Players? The Case of Ingress.* Paper presented at the 2018 IEEE Games, Entertainment, Media Conference (GEM).

Kovacs, M. (1985). The Children's Depression, Inventory (CDI). *Psychopharmacol Bull, 21*(4), 995-998.

Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med, 16*(9), 606-613.

La Greca, A., Swales, T., Klemp, S., & Madigan, S. (1988). Self care behaviors among adolescents with diabetes. *Ninth Annual Sessions of the Society of Behavioral Medicine*, A42.

La Greca, A. M., Follansbee, D., & Skyler, J. S. (1990). Developmental and behavioral aspects of diabetes management in youngsters. *Children's Health Care, 19*(3), 132-139.

Lawrence, J. M., Standiford, D. A., Loots, B., Klingensmith, G. J., Williams, D. E., Ruggiero, A., . . . McKeown, R. E. (2006). Prevalence and correlates of depressed mood among youth with diabetes: the SEARCH for Diabetes in Youth study. *Pediatrics, 117*(4), 1348-1358. doi:10.1542/peds.2005-1398

Lazarus, R. S., & Folkman, S. (1986). Cognitive theories of stress and the issue of circularity. *Dynamics of stress: Physiological, psychological, and social perspectives*, 63-80.

Lazarus, R. S., & Folkman, S. (1987). Transactional theory and research on emotions and coping. *European Journal of personality, 1*(3), 141-169.

Lewin, A. B., LaGreca, A. M., Geffken, G. R., Williams, L. B., Duke, D. C., Storch, E. A., & Silverstein, J. H. (2009). Validity and reliability of an adolescent and parent rating scale of type 1 diabetes adherence behaviors: The Self-Care Inventory (SCI). *J Pediatr Psychol, 34*(9), 999-1007.

Lewin, A. B., LaGreca, A. M., Geffken, G. R., Williams, L. B., Duke, D. C., Storch, E. A., & Silverstein, J. H. (2009). Validity and reliability of an adolescent and parent rating scale of type 1 diabetes adherence behaviors: the Self-Care Inventory (SCI). *J Pediatr Psychol, 34*(9), 999-1007. doi:10.1093/jpepsy/jsp032

Li, W., & Rukavina, P. (2011). Implicit and Explicit Obesity Bias in Pre-adolescents and their Relations to Self-Reported Body Mass Index. *Stigma Research and Action, 1*(1), 18-26.

Loucks, E. B., Gilman, S. E., Britton, W. B., Gutman, R., Eaton, C. B., & Buka, S. L. (2016). Associations of Mindfulness with Glucose Regulation and Diabetes. *Am J Health Behav, 40*(2), 258-267. doi:10.5993/ajhb.40.2.11

Lueke, A., & Gibson, B. (2015). Mindfulness meditation reduces implicit age and race bias: The role of reduced automaticity of responding. *Social Psychological and Personality Science, 6*(3), 284-291.

Malboeuf-Hurtubise, C., Achille, M., Muise, L., Beauregard-Lacroix, R., Vadnais, M., & Lacourse, É. (2016). A mindfulness-based meditation pilot study: lessons learned on acceptability and feasibility in adolescents with cancer. *Journal of Child and Family Studies, 25*(4), 1168-1177.

Marks, A. D., Sobanski, D. J., & Hine, D. W. (2010). Do dispositional rumination and/or mindfulness moderate the relationship between life hassles and psychological dysfunction in adolescents? *Aust N Z J Psychiatry, 44*(9), 831-838. doi:10.3109/00048674.2010.487478

Mayer-Davis, E. J., Lawrence, J. M., Dabelea, D., Divers, J., Isom, S., Dolan, L., . . . Pettitt, D. J. (2017). Incidence trends of type 1 and type 2 diabetes among youths, 2002–2012. *New England Journal of Medicine, 376*(15), 1419-1429.

Mayer-Davis, E. J., Lawrence, J. M., Dabelea, D., Divers, J., Isom, S., Dolan, L., . . . Wagenknecht, L. (2017). Incidence Trends of Type 1 and Type 2 Diabetes among Youths, 2002-2012. *N Engl J Med, 376*(15), 1419-1429. doi:10.1056/NEJMoa1610187

McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *New England journal of medicine, 338*(3), 171-179.

McMahon, S. D., Grant, K. E., Compas, B. E., Thurm, A. E., & Ey, S. (2003). Stress and psychopathology in children and adolescents: is there evidence of specificity? *J Child Psychol Psychiatry, 44*(1), 107-133.

Medina, W. L., Wilson, D., de Salvo, V. L., Vannucchi, B., de Souza, E. L., Lucena, L., . . . Demarzo, M. M. (2016). Effects of Mindfulness on Diabetes Mellitus: rationale and overview. *Curr Diabetes Rev*.

Miller, K. M., Foster, N. C., Beck, R. W., Bergenstal, R. M., DuBose, S. N., DiMeglio, L. A., . . . Tamborlane, W. V. (2015). Current state of type 1 diabetes treatment in the U.S.: updated data from the T1D Exchange clinic registry. *Diabetes Care, 38*(6), 971-978. doi:10.2337/dc15-0078

Moksnes, U. K., Espnes, G. A., & Haugan, G. (2013). Stress, sense of coherence and emotional symptoms in adolescents. *Psychol Health, 29*(1), 32-49. doi:10.1080/08870446.2013.822868

Mossman, S. A., Luft, M. J., Schroeder, H. K., Varney, S. T., Fleck, D. E., Barzman, D. H., . . . Strawn, J. R. (2017). The Generalized Anxiety Disorder 7-item scale in adolescents with generalized anxiety disorder: Signal detection and validation. *Ann Clin Psychiatry, 29*(4), 227-234a.

Nagel, K. E., Dearth-Wesley, T., Herman, A. N., Smith, H. G., Gandica, R. G., Golden, L. H., . . . Whitaker, R. C. (2020). The association between dispositional mindfulness and glycemic control in type 1 diabetes during early adulthood: Differences by age and adverse childhood experiences. *Pediatr Diabetes, 21*(4), 681-691.

Ni, Y. x., Ma, L., & Li, J. p. (2020). Effects of mindfulness-based intervention on glycemic control and psychological outcomes in people with diabetes: A systematic review and meta-analysis. *Journal of Diabetes Investigation*.

Noordali, F., Cumming, J., & Thompson, J. L. (2017). Effectiveness of mindfulness-based interventions on physiological and psychological complications in adults with diabetes: a systematic review. *J Health Psychol, 22*(8), 965-983.

Northam, E. A., Matthews, L. K., Anderson, P. J., Cameron, F. J., & Werther, G. A. (2005). Psychiatric morbidity and health outcome in Type 1 diabetes--perspectives from a prospective longitudinal study. *Diabet Med, 22*(2), 152-157. doi:10.1111/j.1464-5491.2004.01370.x

Nosek, B. A., Smyth, F. L., Hansen, J. J., Devos, T., Lindner, N. M., Ranganath, K. A., . . . Greenwald, A. G. (2007). Pervasiveness and correlates of implicit attitudes and stereotypes. *European Review of Social Psychology, 18*(1), 36-88.

Oppo, A., Schweiger, M., Ristallo, A., Presti, G., Pergolizzi, F., & Moderato, P. (2019). Mindfulness skills and psychological inflexibility: Two useful tools for a clinical assessment for adolescents with internalizing behaviors. *Journal of Child and Family Studies, 28*(12), 3569-3580.

Patterson, P., & McDonald, F. E. (2015). "Being Mindful": Does it Help Adolescents and Young Adults Who Have Completed Cancer Treatment? *J Pediatr Oncol Nurs, 32*(4), 189-194. doi:10.1177/1043454214563401

Patterson, P., McDonald, F. E., Ciarrochi, J., Hayes, L., Tracey, D., Wakefield, C. E., & White, K. (2015). A study protocol for Truce: a pragmatic controlled trial of a seven-week acceptance and commitment therapy program for young people who have a parent with cancer. *BMC Psychol, 3*, 31. doi:10.1186/s40359-015-0087-y

Petter, M., Chambers, C. T., McGrath, P. J., & Dick, B. D. (2013). The role of trait mindfulness in the pain experience of adolescents. *J Pain, 14*(12), 1709-1718. doi:10.1016/j.jpain.2013.08.015

Plante, T. G. (2008). What do the spiritual and religious traditions offer the practicing psychologist? *Pastoral Psychology, 56*(4), 429-444.

Project Implicit. Preliminary Information. Retrieved from https://implicit.harvard.edu/implicit/takeatest.html Qualtrics LCC. (2018). In. Provo, Utah.

Rechenberg, K., Whittemore, R., & Grey, M. (2017). Anxiety in Youth With Type 1 Diabetes. *J Pediatr Nurs, 32*, 64-71. doi:10.1016/j.pedn.2016.08.007

Rechenberg, K., Whittemore, R., Holland, M., & Grey, M. (2017). General and diabetes-specific stress in adolescents with type 1 diabetes. *Diabetes research and clinical practice, 130*, 1-8.

Reynolds, K. A., & Helgeson, V. S. (2011). Children with diabetes compared to peers: depressed? Distressed? A meta-analytic review. *Ann Behav Med, 42*(1), 29-41. doi:10.1007/s12160-011-9262-4

Richardson, L. P., McCauley, E., Grossman, D. C., McCarty, C. A., Richards, J., Russo, J. E., . . . Katon, W. (2010). Evaluation of the Patient Health Questionnaire-9 Item for detecting major depression among adolescents. *Pediatrics, 126*(6), 1117-1123. doi:10.1542/peds.2010-0852

Rosenzweig, S., Reibel, D. K., Greeson, J. M., Edman, J. S., Jasser, S. A., McMearty, K. D., & Goldstein, B. J. (2007). Mindfulness-based stress reduction is associated with improved glycemic control in type 2 diabetes mellitus: a pilot study. *Altern Ther Health Med, 13*(5), 36-38.

Royuela-Colomer, E., & Calvete, E. (2016). Mindfulness facets and depression in adolescents: Rumination as a mediator. *Mindfulness, 7*(5), 1092-1102.

Ruskin, D., Kohut, S. A., & Stinson, J. (2014). The development of a mindfulness-based stress reduction group for adolescents with chronic pain. *Journal of Pain Management, 7*(4), 301.

Schilling, L. S., Grey, M., & Knafl, K. A. (2002). The concept of self-management of type 1 diabetes in children and adolescents: an evolutionary concept analysis. *J Adv Nurs, 37*(1), 87-99.

Schilling, L. S., Grey, M., & Knafl, K. A. (2002). A review of measures of self-management of type 1 diabetes by youth and their parents. *The Diabetes Educator, 28*(5), 796-808.

Schroevers, M. J., Tovote, K. A., Keers, J. C., Links, T. P., Sanderman, R., & Fleer, J. (2015). Individual mindfulness-based cognitive therapy for people with diabetes: A pilot randomized controlled trial. *Mindfulness, 6*(1), 99-110.

Seiffge-Krenke, I., & Stemmler, M. (2003). Coping with everyday stress and links to medical and psychosocial adaptation in diabetic adolescents. *Journal of Adolescent Health, 33*(3), 180-188.

Shapiro, J. B., Vesco, A. T., Weil, L. E., Evans, M. A., Hood, K. K., & Weissberg-Benchell, J. (2017). Psychometric Properties of the Problem Areas in Diabetes: Teen and Parent of Teen Versions. *J Pediatr Psychol*.

Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of mindfulness. *J Clin Psychol, 62*(3), 373-386. doi:10.1002/jclp.20237

Shelov, D. V., Suchday, S., & Friedberg, J. P. (2009). A pilot study measuring the impact of yoga on the trait of mindfulness. *Behav Cogn Psychother, 37*(5), 595-598. doi:10.1017/s1352465809990361

Shirk, S. R., DePrince, A. P., Crisostomo, P. S., & Labus, J. (2014). Cognitive behavioral therapy for depressed adolescents exposed to interpersonal trauma: An initial effectiveness trial. *Psychotherapy, 51*(1), 167.

Sibinga, E. M., Perry-Parrish, C., Chung, S. E., Johnson, S. B., Smith, M., & Ellen, J. M. (2013). School-based mindfulness instruction for urban male youth: a small randomized controlled trial. *Prev Med, 57*(6), 799-801. doi:10.1016/j.ypmed.2013.08.027

Sibinga, E. M., Webb, L., Ghazarian, S. R., & Ellen, J. M. (2016). School-Based Mindfulness Instruction: An RCT. *Pediatrics, 137*(1). doi:10.1542/peds.2015-2532

Silverstein, J., Klingensmith, G., Copeland, K., Plotnick, L., Kaufman, F., Laffel, L., . . . Clark, N. (2005). Care of children and adolescents with type 1 diabetes: a statement of the American Diabetes Association. *Diabetes Care, 28*(1), 186-212.

Spielberger, C. D. (1966). *Anxiety and Behavior, Theory and Research on Anxiety* (Vol. 1).

Spitzer, R. L., Kroenke, K., Williams, J. B., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of internal medicine, 166*(10), 1092-1097.

SPSS, I. v. 20.0, IBM Corp, Armonk, NY, USA; 2011. In.

Staats, C. (2014). State of the science: Implicit bias review 2014, Kirwan Institute. In.

Staats, C., Capatosto, K., Wright, R. A., & Contractor, D. (2015). *State of the science: Implicit bias review 2015* (Vol. 3): Kirwan Institute for the Study of Race and Ethnicity, The Ohio State University.

Stark, K. D., & Laurent, J. (2001). Joint factor analysis of the children's depression inventory and the revised children's manifest anxiety scale. *Journal of clinical child psychology, 30*(4), 552-567.

Tomlinson, E. R., Yousaf, O., Vittersø, A. D., & Jones, L. (2018). Dispositional Mindfulness and Psychological Health: a Systematic Review. *Mindfulness (N Y), 9*(1), 23-43. doi:10.1007/s12671-017-0762-6

Tovote, K. A., Fleer, J., Snippe, E., Peeters, A. C., Emmelkamp, P. M., Sanderman, R., . . . Schroevers, M. J. (2014). Individual mindfulness-based cognitive therapy and cognitive behavior therapy for treating depressive symptoms in patients with diabetes: results of a randomized controlled trial. *Diabetes Care, 37*(9), 2427-2434. doi:10.2337/dc13-2918

Tran, U. S., Glück, T. M., & Nader, I. W. (2013). Investigating the Five Facet Mindfulness Questionnaire (FFMQ): Construction of a short form and evidence of a two-factor higher order structure of mindfulness. *J Clin Psychol, 69*(9), 951-965.

Urwin, J., & Flick, C. (2019). AR games as a potential source of improved mental well being: Implications for self-help and individual support. *Journal of Gaming & Virtual Worlds, 11*(3), 309-328.

van Son, J., Nyklicek, I., Nefs, G., Speight, J., Pop, V. J., & Pouwer, F. (2015). The association between mindfulness and emotional distress in adults with diabetes: could mindfulness

serve as a buffer? Results from Diabetes MILES: The Netherlands. *J Behav Med, 38*(2), 251-260. doi:10.1007/s10865-014-9592-3

van Son, J., Nyklíček, I., Nefs, G., Speight, J., Pop, V. J., & Pouwer, F. (2015). The association between mindfulness and emotional distress in adults with diabetes: Could mindfulness serve as a buffer? Results from Diabetes MILES: The Netherlands. *Journal of behavioral medicine, 38*(2), 251-260.

van Son, J., Nyklíček, I., Pop, V. J., Blonk, M. C., Erdtsieck, R. J., Spooren, P. F., . . . Pouwer, F. (2013). The effects of a mindfulness-based intervention on emotional distress, quality of life, and HbA1c in outpatients with diabetes (DiaMind). *Diabetes Care, 36*(4), 823-830.

Weinger, K., Butler, H. A., Welch, G. W., & La Greca, A. M. (2005). Measuring diabetes self-care: a psychometric analysis of the Self-Care Inventory-Revised with adults. *Diabetes Care, 28*(6), 1346-1352.

Weinstein, N., Brown, K. W., & Ryan, R. M. (2009). A multi-method examination of the effects of mindfulness on stress attribution, coping, and emotional well-being. *Journal of Research in Personality, 43*(3), 374-385.

Weissberg-Benchell, J., & Antisdel-Lomaglio, J. (2011). Diabetes-specific emotional distress among adolescents: feasibility, reliability, and validity of the problem areas in diabetes-teen version. *Pediatr Diabetes, 12*(4pt1), 341-344.

Wilcox, R. (2005). Trimming and winsorization. *Encyclopedia of biostatistics, 8*.

Wood, J. R., Miller, K. M., Maahs, D. M., Beck, R. W., DiMeglio, L. A., Libman, I. M., . . . Network, T. D. E. C. (2013). Most youth with type 1 diabetes in the T1D Exchange Clinic Registry do not meet American Diabetes Association or International Society for Pediatric and Adolescent Diabetes clinical guidelines. *Diabetes Care, 36*(7), 2035-2037.

Wright, R. (2018). On Being Project: How Mindfulness Meditation Can Save America. Retrieved from https://onbeing.org/blog/robert-wright-how-mindfulness-meditation-can-save-america/

Zenner, C., Herrnleben-Kurz, S., & Walach, H. (2014). Mindfulness-based interventions in schools-a systematic review and meta-analysis. *Front Psychol, 5*, 603. doi:10.3389/fpsyg.2014.00603

Zoogman, S., Goldberg, S. B., Hoyt, W. T., & Miller, L. (2014). Mindfulness Interventions with Youth: A Meta-Analysis.

Zoogman, S., Goldberg, S. B., Hoyt, W. T., & Miller, L. (2015). Mindfulness interventions with youth: A meta-analysis. *Mindfulness, 6*(2), 290-302.