Risk Factors of Prolonged Grief Disorder: The moderating role of age

Raphael Rheinländer (s2804069)

Faculty of Behavioural, Management and Social Sciences (BMS), University of Twente

M12 BSc Thesis PSY

First supervisor: Lieke Nijborg

Second supervisor: Justina Pociunaite

June 25, 2024

Abstract

Background: Recent meta-analyses investigating the risk factors of Prolonged Grief Disorder (PGD) among individuals who experienced the death of a close person due to violent causes showed inconsistent findings concerning the age of the bereaved as a potential risk factor for PGD. It is unclear what may contribute to these different findings of the association between age and PGD. A recent meta-analysis by Buur et al. (2024) was the first to estimate the potential impact of age on other loss-related risk factors, such as the relationship to the deceased and gender of the bereaved among naturally bereaved individuals. This study aims to expand the understanding of age in terms of its direct association with PGD as well as expand on Buur et al.´s approach to explore possible other impact of age on the risk factors of gender and the relationship to the deceased that may contribute to the development of PGD among violently bereaved individuals. The study also aims to explore the direct associations of gender and the relationship to the disease with PGD levels.

Methods: This study investigated the influence of age, gender, and relationship to the deceased on PGD levels among 47 individuals who experienced violent bereavement. Multiple linear regression analyses were employed to examine direct associations and moderation effects of age on the association between the relationship to the deceased (e.g., child, partner) and gender on PGD levels.

Results: Gender significantly predicted higher PGD levels (B = 6.44, SE = 2.73, $t(43)$ = 2.36, $p < .05$, 95% CI [0.94, 11.95]), whereas age did not show a significant association (B = 0.08, SE = 0.10, $t(43) = 0.82$, $p = .42$, 95% CI [-0.12, 0.28]). The relationship with the deceased (e.g., child, partner) did not significantly influence PGD levels (B = 2.84, SE = 2.25, $t(43)$ = 1.26, p = .21, 95% CI [-1.7, 7.39]). Age did not moderate the association between the relationship to the deceased and PGD (B = 0.18, SE = 0.21, $t(41) = 0.84$, p = .41, 95% CI [-0.25, 0.60]) as well as did not show moderation for the association between gender and PGD (B = -0.35, SE = 0.33, $t(41)$ = -1.06, p = 0.30, 95% CI [-1.01, 0.32]).

Conclusion: Age may not have an influence on the risk factors of gender and the relationship to the deceased for the development of PGD. Future research should focus on exploring contextual factors of age groups such as the economic status and health of the bereaved, exploring a potential non-linear relationship between age and PGD, and exploring whether it is the closeness or quality of a relationship to the deceased that may lead to PGD.

Introduction

The death of someone close is an inevitable event that everyone will experience, and yet bereavement is one of the most painful emotions that humans can endure. Although individuals may experience great distress following a loss, research suggests that grief symptoms often decrease over time as people learn to live with the loss (Jordan and Litz, 2014; Lundorff et al., 2020; Prigerson et al., 2009). However, Lundorff et al. (2017) demonstrated that approximately 10% of adults experience prolonged, elevated grief, known as Prolonged Grief Disorder (PGD; American Association, 2022). Core symptoms of PGD include preoccupation with memories and thoughts of the deceased as well as intense yearning for the deceased (American Psychiatric Association, 2022). These symptoms often are accompanied by, amongst others, emotional pain, intense loneliness, and difficulty accepting the loss of the deceased beyond cultural, social, and religious norms (American Psychiatric Association, 2022). According to the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition Text Revised (DSM-5-TR), PGD can be diagnosed when individuals experience symptoms nearly every day for at least a month prior to the diagnosis, and the loved one died over a year ago. Furthermore, individuals must experience social, occupational, and functional impairment (American Psychiatric Association, 2022).

Grief is a complex process, and each person approaches bereavement differently but scientific research has advanced in exploring why some people may develop PGD while others do not (Cherblanc et al., 2023; Eisma et al., 2021). Among the various potential risk factors that have been studied, one of the most well-known risk factors for PGD is the loss of a loved one due to unnatural and violent causes (Buur et al., 2024; Djelantik et al., 2020). In cases of sudden or violent loss, such as accidents, homicide, suicide, or terror, the number of individuals suffering from PGD rises from 10% to 49%, and are often considered to be more traumatic than natural deaths (Boelen et al., 2019; Djelantik et al., 2020). It is postulated that the loss of a loved one to a violent cause may give rise to the perception that the death could have been prevented and may often be accompanied by a search for meaning, blame, and an explanation for the death (Rynearson, 2006). Based on this reasoning Heeke et al. (2019) argue that violent bereavement is distinct from bereavement due to natural causes and is associated with more adverse mental health outcomes. Empirical studies showed when an individual is violently bereaved, factors such as the loss of a partner or child and female gender increase the likelihood of PGD symptomatology (Djelantik et al., 2020; Heeke et al., 2017; Hibbert et al., 2010; Kokou-Kpolou et al., 2020; Kokou-Kpolou et al., 2017; Kristensen et al., 2012).

Scientific literature consistently showed that PGD is associated with the relationship the bereaved has with the deceased (Djelantik et al., 2020; Heeke et al., 2019; Kokou-Kpolou et al., 2020). Particularly, “losing a member of the nuclear family is associated with higher PGD severity than losing a distantly related family member or friend” (Heeke et al., 2019 p.10). However, in contrast to research on bereavement following natural causes by Buur et al. (2024), which found that losing a child or a partner, in particular, is associated with higher PGD levels, only a few studies focused on these relationships to the deceased (Kokou-Kpolou et al., 2017; Kokou-Kpolou et al., 2020). Furthermore, research investigating the association between the relationship to the deceased and PGD among violently bereaved advocates for more research concerning particularly close relationships to the deceased, such as losing a child or a partner and PGD (Djelantik et al., 2020; Heeke et al., 2019; Kokou-Kpolou et al., 2020). Nevertheless, losing a child or a partner appears to be one of the most painful and stressful experiences an individual can endure and is related to additional stressful experiences, such as adapting to new roles, legal affairs, responsibility change and economic changes, which contributes to the distress experienced by the bereaved person (Eisma et al., 2021; Keesee et al.,2008; Rubin & Malkinson, 2001).

The recently found association between gender and PGD levels among violently bereaved people may be related to personality traits, as proposed by Heeke et al. (2019). Regarding personality traits such as neuroticism and openness to emotions, which are associated with the development of negative mental health outcomes, women score higher than men. Those with this personality types are more prone to react anxiously and avoidantly to stressful life events (Bienvenu et al., 2004; Costa et al., 2001). Consequently, it is probable that women are more prone to mental health issues than men (Olff et al., 2007; Tolin & Foa, 2006). Furthermore, it can be posited that men may mourn in a manner that differs from women, given that social standards of masculinity tend to restrict emotional expression (Creighton et al., 2013). While the association between gender and PGD levels was supported by a recent meta-analysis among naturally bereaved individuals conducted by Buur et al. (2024), studies specifically focusing on bereavement following violent bereavement did not find a similar association (Djelantik et al., 2020; Kokou-Kpolou et al., 2020). Therefore, more research regarding a potential association between gender and PGD among violently bereaved people is needed.

Research examining the association between the age of the bereaved and PGD also shows inconsistent findings, leading to varying estimates of the predictive value of age on PGD and the direction of the relationship between the age of the bereaved and PGD among

violently bereaved individuals. While Djelantik et al. (2020) found no significant relationship between age and PGD, Heeke et al. (2019) found that age was significantly negatively related to PGD for the violent death of a single person at a time. Nevertheless, a comparable effect could not be identified in the context of collective violence, such as in the case of a plane crash (Heeke et al., 2019). Furthermore, older traumatically bereaved refugees appear to exhibit greater PGD symptoms than younger refugees (Craig et al., 2008; Kokou-Kpolou et al., 2017; Kokou-Kpolou et al., 2020; Nickerson et al., 2014). Inconsistent findings have also been observed for the effect of age in the context of general bereavement. While some studies did not find age to be a significant predictor of PGD (Buur et al., 2024), others found older age to be predictive of higher PGD (Lundorff et al., 2017). Contrastingly, some earlier work suggested that younger people may be more vulnerable to experience negative bereavement consequences, such as a higher grief intensity and less social engagement (Archer, 1999; Kersting et al., 2011; Stroebe et al., 2006). Taking all findings together, the association between age and PGD remains unclear, underscoring the need for further research (Buur et al., 2024). This is particularly evident in the context of violent bereavement, It may be where the existing body of research is limited but also demonstrates inconsistencies.

One potential explanation for the inconsistent findings regarding the association between the age of the bereaved and PGD may be that age is not a directly associated risk factor of PGD but may contribute to the development of PGD in different ways, such as having an impact on other risk factors of PGD rather than being directly associated to PGD levels. It may be that the experience of grief and the coping mechanisms available to individuals can vary significantly across different age groups (Lundorff et al., 2017). For example, losing a child or a partner could lead to worse grieving outcomes, such as PGD, for younger individuals as they often have not experienced the death of a close loved one before and thus may not be familiar with managing their grief. (Buur et al., 2024). The potential impact of age on other risk factors of PGD was tested in a recent meta-analysis by Buur et al. (2024). Buur et al. (2024) The meta-analysis showed that the age of the participants had no impact on the relationship between the relationship with the deceased (e.g. having lost a child or a partner) and PGD levels as well as on the association between gender and PGD. While Buur et al. (2024) did not find that age influenced other risk factors of PGD, the authors argue for the need for further research into the interactions between risk factors, as illustrated by Stroebe et al.'s (2006) framework, to verify their findings and further estimate possible associations between risk factors. Additionally, Stroebe et al. (2006) and Cherblanc et al. (2023) also advocate for further research into possible interactions between risk factors of

PGD. Furthermore, the study by Buur et al. (2024) was, to the best of my knowledge, the only study to investigate the possible moderation of age on the relationship between the relationship with the deceased and gender on PGD levels. The study was conducted in naturally bereaved individuals. As violent bereavement may differ from natural bereavement in how the death is coped with, the age and gender of the bereaved may show different associations with bereavement related stressors and thus moderation in violently bereaved individuals of age and gender on the relationship of having lost a child or partner has yet to be explored (Raynearson, 2006).

An understanding of the risk factors for PGD following a violent loss, such as age, gender, and the relationship to the deceased may assist in the identification of individuals who require support and increase the likelihood that they will receive it in a more timely manner (Kraemer et al., 1997). Furthermore, exploring the associations between age, gender, and the relationship to the deceased on PGD levels may contribute to the understanding of recent research on violently bereaved individuals. Therefore, the first aim of the current study was to explore the association between age and PGD levels among violently bereaved individuals. Secondly, the association between gender and PGD levels among violently bereaved individuals should be estimated. The third aim was to estimate the association between the relationship to the deceased (having lost a child or a partner) and PGD levels among violently bereaved individuals. Based on previous literature, it was hypothesized that being female and losing a child or partner would be associated with higher PGD levels (Buur et al., 2024; Djelantik et al., 2020; Heeke et al., 2019). Due to inconsistent findings in recent research on the association between age and PGD, the goal was to explore this association. Similarly, the exploration of the potential influence of age on other risk factors of PGD could help to expand on the findings of Buur et al. (2024) and contribute to a more nuanced understanding of how bereavement among different age groups may contribute to a higher likelihood of developing PGD after violent loss. Therefore, the fourth goal of this study was to expand on the investigations of Buur et al. (2024) and explore the potential impact of age on the association between the relationship to the deceased and PGD levels. Similarly, the fifth and final goal of this study was to explore the potential impact of age on the association between gender and PGD levels to expand on Buur et al. (2024) findings.

Methods

Design

This study is part of the Grief in Daily Life (Grief-ID) project, which has the objective of assessing PGD and how it changes in daily life using Experience Sampling Methodology (ESM). The current study was approved by the Ethics Committee of the University of Twente (number: 240186). Individuals who expressed interest in participating in research after completing a survey to test their symptoms of PGD on the web.rouwmeter.nl website for bereaved individuals were invited to participate in this study. A brief information e-mail was provided at the outset of the study with a link to the study. The study comprised three phases. The initial phase, called Time Point One (T1), entailed the completion of a survey by participants. During T1, an information letter was provided after which the participants were asked for written consent. Upon completion of T1 participants were provided with an instructional video on the installation and utilization of the Avicenna (Ethica) smartphone application, which was employed by the participants during the second phase. During the second phase, called the ESM phase, the Avicenna app was used by participants to answer five brief surveys comprising over 20 items on a daily basis for a period of two weeks. The completion of surveys required approximately one to two minutes. In the event of a participant failing to complete more than half of the surveys in a day, a researcher would send a reminder message via email or telephone to the participant. Additionally, the app would send two reminder notifications to the participant's smartphone (after 10 and 20 minutes). The ESM surveys comprised questions pertaining to DSM-5-TR PGD symptoms and the participant's context, such as location and type of activity participants were exhibiting during their day. The third phase, called Time Point two (T2), occurred one week after the conclusion of the ESM phase and required the participants to complete a second survey that was similar to the survey completed at T1. The data collection period spanned from 15 April to 3 May 2024. Only data from T1 was utilized in this study.

Participants

The sample consisted of adults, defined as individuals 18 years and older, who had experienced the loss of a significant other (i.e. partner, family member, or friend) in a potentially traumatic manner, including violent death, accidents, suicide, murder, or manslaughter, at least one year prior to participation. To be eligible for participation, individuals were required to own a smartphone and be fluent in Dutch. Furthermore, individuals at high risk of suicide or diagnosed with a psychotic disorder were excluded from

the study. A total of 52 participants participated in T1. Following the application of exclusion criteria, five participants were excluded from the original dataset. All five participants were excluded due to the missing data on the DSMR-5-TR-relevant TGI-SR+ items. This resulted in a final sample of 47 traumatically bereaved individuals. No participants were excluded on the grounds of missing consent, suicidality, or psychotic disorders, as those indicating such characteristics were excluded at the T1 survey.

Measures

Traumatic Grief Inventory – Self Report Plus (TGI-SR+)

The TGI-SR+ was used to assess prolonged grief disorder symptoms according to four diagnostic criteria including the DSM-5-TR (Lenferink et al., 2022b). The Questionnaire consists of 22 items about grief reactions of which items 1, 2, 3, 6, 8, 9, 10, 11, 18, 19, and 21 will be used to measure PGD according to the DMSR-5-TR. Each item is scored on a 5-point Likert scale from 1 (never) to 5 (always), asking participants to estimate the frequency of a particular symptom during the last month (Lenferink et al., 2022b). An example item is: "During the past month, I had intrusive thoughts or images related to the person who died". Items 2 and 8 assess the same symptom. Therefore, the highest of the two scores was used for symptom estimation. Item 13 "During the past month, I noticed significant reduction in social, occupational, or other important areas of functioning (e.g., domestic responsibilities as a result of his/her death)" was excluded for PGD level estimation as suggested by Lenferink et al., (2022b). All 10 items are summed representing a DSMR-5-TR PGD total score (Lenferink et al., 2022b). A DSM-5-TR PGD total score of ≥ 33 is used as a cut-off score as emphasized by Lenferink et al. (2022b). The TGI-SR+ is a reliable and valid measure of PGD and is freely available in multiple languages (Lenferink et al., 2022b). It also possesses good psychometric properties with an internal consistency for items measuring PGD symptoms according to the DSM-5-TR of a McDonald´s omega 0.92 and good temporal stability (r = 0.78) (Lenferink et al., 2022b). In the current study, the reliability of the TGI-SR+ was assessed using Cronbach´s alpha. The total measure showed excellent reliability ($\alpha = 0.92$), as well as good reliability for the DSM-5-TR PGD items ($\alpha = 0.85$).

Background and loss-related characteristics

The study collected information on background characteristics, including the participants' gender (1 = male, 2 = female, 3 = other), and date of birth. Subsequently, the age of the participant (in years) was calculated using their date of birth and the date they filled in

the questionnaire at T1. Loss-related characteristics were assessed, including the relationship to the deceased (1 = partner, 2 = child, 3 = parent, 4 = sibling, 5 = grandparent, 6 = grandchild, 7 = friend, 8 = other) and the cause of death (1 = physical illness, 2 = accident, 3 = suicide, 4 = homicide, 5 = other).

Statistical analyses

The data were analyzed using RStudio version R 4.4.0 statistical software. In particular, the packages tidyverse, foreign, broom, stats, stringr, forcats and modelr were used (see Appendix A). Prior to conducting analyses, participants were excluded if they had missing information on TGI-SR+ items, which was achieved using the is.na() function in Rsudio. For the remaining participants, their age was calculated using their date of birth and the date they filled in the questionnaire at T1. The PGD total score was then calculated using the mutate() and rowSums() functions. Descriptive statistics were used to gain insight into the characteristics of the sample. In addition, the reliability of the TGI-SR+ measure in this study was assessed using the alpha() function from the psych function in Rstudio.

Before running analyses, the following assumptions were tested: linearity, normality of residuals, homoscedasticity and independence of observations. Linearity was assessed using graphical representations of the relationship between the predictors and the dependent variable. The assumption of normality was tested using graphical methods, including histograms of residuals. In addition, the Shapiro-Wilk test was used to assess the normality of the data (Shapiro & Wilk, 1965). Residual plots and the Breusch-Pagan test (Breusch & Pagan, 1979) were used to assess the assumption of homoscedasticity. The assumption of independence of observations was assessed using the Durbin-Watson test (Kutner & Neter, 2004) and residual versus predictor plots. All linear assumptions were met for the first multiple linear regression analysis, which tested the associations between the independent variables age, gender, and the relationship to deceased and the dependent variable PGD levels. However, for the moderation analysis of age using a second multiple linear regression model, the homoscedasticity assumption was close to being violated ($BP = 10.23$, df = 5, $p = 0.07$).

To explore whether age, gender and relationship to the deceased (i.e., having lost a child or partner) were associated with PGD levels among those who had experienced violent bereavement, a multiple linear regression analysis was conducted with age, gender and relationship to the deceased as independent predictors and total DSM-5-TR PGD scores as the dependent variable in the model (significance level $\alpha = 0.05$, confidence interval = 95%).

Prior to this, a dummy variable was created to represent the relationship to the deceased, called Dummy_Partner_Child. The variable Dummy_Partner_child indicates whether the individual had lost another close person (= 0), such as a parent, sibling, grandparent, grandchild or friend, or whether the individual had lost a partner or child (= 1). Gender was recorded as male = 0 and female = 1.

A second multiple linear regression model was employed to investigate the moderating effect of age on the relationship between relationship to the deceased (having lost a child or partner) and PGD levels. Additionally, this second multiple regression model was used to explore the moderating effect of age on the relationship between gender and PGD levels. To this end, the model included the independent variables age, gender, and Dummy_Partner_child as well as the interaction effects of age and Dummy_Partner_child and age and gender. Total DSM-5-TR PGD scores were used as the dependent variable in the model (significance level $\alpha = 0.05$, confidence interval = 95%).

Results

Sample characteristics

Table 1 presents the characteristics of the sample. The majority of the sample was female, obtained a university degree, and lost a child. The most frequently stated causes of death were accidents and suicide. On average participants were 52 years old (*SD* = 10.4) and had a total DSM-5-TR PGD score 35.5 (*SD* = 6.6). The average age of the lost loved one was 37 years (*SD* = 17.3). Thirty participants (63,8%) had a total DSM-5-TR PGD score above or equal to 33, indicating probable caseness of PGD (Lenferink et al., 2022).

Table 1

Violently Bereaved Sample Background and Loss-related Characteristics (N = 47)

Background and loss-related characteristics	T1	
	n	%
Gender		
Male	7	14.9
Female	40	85.1
Cause of death		
Accident	20	42.6
Suicide	23	48.9
Homicide	3	6.4
Other	1	2.1
Relationship to the deceased		
Partner	12	25.5
Child	19	40.4
Parent	5	10.6
Sibling	5	10.6
Friend	2	4.3
Other	4	8.5
Education		
High school	6	12.8
Vocational education	13	27.7
Collage/University	28	59.6

The Associations between Age, Gender, and the Relationship to the Deceased and DSM-5-TR PGD Total Scores

The association between age and total DSM-5-TR PGD scores was found to be non-significant ($B = 0.08$, $SE = 0.10$, $t(43) = 0.82$, $p = .42$, 95% CI [-0.12, 0.28]). Similarly, the association between the relationship to the deceased and total DSM-5-TR PGD scores was

also found to be non-significant (B = 2.84, SE = 2.25, t(43) = 1.26, p = .21, 95% CI [-1.7, 7.39]). The results indicate that the difference in PGD levels between those who lost a partner or child and those who lost other people was non-significant. Furthermore, the results of the multiple regression analysis indicate that gender was significantly associated with total DSM-5-TR PGD scores (B = 6.44, SE = 2.73, t(43) = 2.36, p < .05, 95% CI [0.94, 11.95]). Specifically, women reported higher PGD levels than men.

The Moderation Effect of Age on the Association between the Relationship to the Deceased and Total DSM-5-TR PGD Scores as well as the Association between Gender and Total DSM-5-TR PGD Scores

The results of the second multiple linear regression analysis indicate that age was a non-significant moderator of the relationship between losing a child or a partner and total DSM-5-TR PGD scores (B = 0.18, SE = 0.21, t(41) = 0.84, p = .41, 95% CI [-0.25, 0.60]). Furthermore, age was also found to be a non-significant moderator of the association between gender and total DSM-5-TR PGD scores (B = -0.35, SE = 0.33, t(41) = -1.06, p = 0.30, 95% CI [-1.01, 0.32]).

Discussion

The first three aims of this study were to investigate whether age, gender, and the relationship to the deceased would be associated with PGD levels in individuals who have experienced violent bereavement. The fourth and fifth aims were to explore the potential moderating effect of age on the association between the relationship to the deceased and PGD levels as well as to explore a potential moderation of age on the association between gender and PGD levels. The analyses were conducted on a sample of 47 individuals who had experienced violent bereavement.

The findings indicate that age was not associated with PGD levels. One potential explanation for the non-significant results of age is that the variable may not be linearly associated with PGD (Buur et al., 2024). Buur et al. (2024) propose that individuals in the younger and older age groups may be at a higher risk of developing PGD symptoms than those in the middle age bracket, resulting in a U-shaped relationship between age and PGD levels. Older individuals are often physically less healthy than younger individuals, which may restrict their ability to deal with and cope with grief as they may be ill themselves (Hanson & Stroebe, 2007; Lundorff et al., 2017; Richardson et al., 2003). The presence of diseases may act as an additional stressor alongside bereavement-related stressors, potentially leading to a state of stressor overload (Fiore, 2019; Stroebe & Schut, 2016). This, in turn, may increase the risk of developing PGD (Stroebe & Schut, 2016). It could be the older participants in the current study did not suffer from lower physical health than younger participants and therefore no association of age and PGD levels was observed. Further research is needed to explore the relationship between lower physical health and PGD levels in more detail. Furthermore, older age is also associated with a decline in social interaction, which can result in a withdrawal from the surrounding environment and a focus on the deceased. This, in turn, may contribute to the development and maintenance of PGD symptoms over time (Edmondson, 2013; Vanderwerker & Prigerson, 2004). However, older participants in the current study may have been well socially connected leading to lower PGD scorings and thus the non-significant finding of the association between age and PGD levels. In contrast, younger individuals may not yet have encountered the death of a close loved one and thus may often be inexperienced in managing grief, which may increase their risk of experiencing severe bereavement outcomes such as PGD (Buur et al., 2024; Eisma et al., 2021). A non-linear relationship between age and PGD levels would also contribute to explaining the inconsistencies in age effects found by previous literature, as most prior studies focused on examining a direct linear relationship between age and PGD (e.g., Djelanik et al.

2020; Buur et al. 2024; Heeke et al. 2019; Lundorff et al. 2017; and Kokou-Kpolou et al. 2020). Future studies should therefore investigate the potential existence of a non-linear relationship between age and PGD, after violent bereavement. Another avenue for future research could be to examine the reasons behind the non-significant association between age and PGD levels by focusing on the surroundings of the loss. As Heeke et al. (2019) found that age was significantly related to PGD in studies where individuals lost a loved one due to an individual death (homicide, suicide, or accident), but not for deaths due to collective violence like a plane crash, future research could examine whether the type of loss may overshadow the association of age on PGD levels.

A positive correlation between female gender and PGD levels was identified, which was consistent with previous literature by Heeke et al. (2019) and therefore supported their findings. The findings of the present study may suggest a need to place greater focus on gender as a factor in PGD development following violent bereavement. This is in contradiction to the meta-analyses by Djelantik et al. (2020) and Kokou-Kpolou et al. (2020), who found female gender to be non-significantly associated with PGD. It must be acknowledged, however, that the high percentage of female participants (85%) in the current studies sample may not be representative of PGD in males. This is a potential limitation of this study, and the results of the association between gender and PGD should, therefore, be interpreted with caution. To verify the current study's findings and further explore the role of gender in PGD, further research is needed with an equally distributed sample of genders.

The non-significant association found between the relationship to the deceased and PGD levels contradicts previous research. A number of factors may account for this discrepancy. Firstly, the sample size of the current study (N = 47) was relatively small. A smaller sample size may not be sufficient to provide reliable inferences about the population (Cohen, 1992). Consequently, the statistical power of the current study may have been insufficient to detect a potentially significant association between the relationship to the deceased and PGD levels. Secondly, discrepancies in measurement between prior research and the current study may also be a contributing factor. While the TGI-SR+ was employed in this study to assess PGD levels, several other studies included in the prior reviews have employed different instruments, such as the Inventory of Complicated Grief (ICG) or the 13-item Prolonged Grief Questionnaire (PG-13) (e.g., Heeke et al. 2017; Kokou-Kpolou et al. 2020; and Buur et al. 2024). This may result in discrepancies in the findings due to the fact that the PG-13 and ICG are older measures of PGD that may not align with the DSM-5-TR PGD symptoms (Pohlkamp et al., 2018; Prigerson et al., 1995). Further examination of the

non-significant association between the relationship to the deceased and PGD levels in the current study could also focus on exploring whether PGD levels are associated with the closeness of the kinship relationship (such as the loss of a child or partner) or whether it is more the interpersonal quality of the relationship (emotional closeness, depth, conflict) that is associated with PGD levels (Heeke et al., 2019).

The moderating effect of age on the association between the relationship to the deceased and PGD levels was found to be non-significant, which was in line with the findings among naturally bereaved individuals by Buur et al. (2024). The exploration of age as a potential moderator of the association between the relationship to the deceased and PGD by Buur et al. (2024) and the current study was deemed promising also partly due to the integrative risk factor framework by Stroebe et al. (2006). The framework described age-related frailty as a moderator of the association between the relationship to the deceased and PGD levels. The term 'age-related frailty' was not defined by Stroebe et al. (2006) and was rather generally associated with financial insecurity and increased health problems for the elderly. Buur et al. (2024) simplified age-related frailty to biological age. However, the non-significant finding of age being a moderator of the relationship between the relationship to the deceased and PGD levels may indicate that this was a misinterpretation. Stroebe et al. (2006) described the context surrounding age groups in terms of physical health position and economic situation. Therefore, it may be important to consider the situation of people in different age groups rather than focusing on the biological age of the bereaved. Consequently, future research may want to focus on the exploration of contextual factors related to age, such as health problems or financial insecurities, and assess whether these factors are associated with PGD or if they show potential moderation effects of the association between the relationship to the deceased and PGD.

Similarly to the non-significant moderation of age on the association between the relationship to the deceased and PGD levels age did also not show to be moderating the association between gender and PGD levels. This finding is in line with Buur et al. (2024). The consistent non-significant moderation effect of age on the association between gender and PGD levels suggests that age may not have an impact on gender as a risk factor for developing PGD. Therefore, the non-significant moderation of age suggests that gender-specific grief interventions do not need to be adjusted for different age groups. As gender did show a direct association with higher PGD levels, clinicians may focus on the specific needs of different genders when addressing PGD following violet bereavement, without necessarily tailoring interventions based on age.

This study represents next to the meta-analysis by Buur et al. (2024), to the best of my knowledge, the only quantitative exploration of a moderation effect of age on the relationship between bereavement-related stressors (in this case, the relationship to the deceased and gender) and PGD levels. A particular strength of this study was the investigation of a sample of violently bereaved individuals. Previous research among violently bereaved individuals is limited and some potential risk factors of PGD, such as the age of the bereaved and gender showed inconsistent findings (Djelantik et al., 2020; Heeke et al., 2019; Kokou-Kpolou et al. 2020). The current study aimed at expanding the understanding of gender, the relationship to the deceased, and age as potential risk factors for the development of PGD among violently bereaved individuals. Furthermore, the current study presents, to the best of my knowledge, the first exploration of a potential impact of age on the development of PGD among violently bereaved individuals other than a direct association. Furthermore, the PGD was quantified using the total DSM-5-TR PGD score from the TGI-SR+, which enables the assessment of PGD on four different grief symptom sets, such as Persistent Complex Bereavement Disorder DSM-5 and Prolonged Grief Disorder as defined by the ICD-11. This is advantageous as the assessment of PGD from the current study can be compared to other studies that may have employed one of the other four definitions of PGD. This facilitates the comparison and transferability of findings (Lenferink et al., 2022).

However, the findings of the current study must be interpreted with caution due to certain limitations in the study design. Firstly, the relatively small sample size of 47 may limit the generalizability and statistical power of the current study (Cohen, 1992; Field, 2013; van den Berg, 2021). Specifically, a small sample size increases the probability of a Type 2 error. Secondly, the assumption testing revealed that for the second multiple linear regression analysis to explore a potential moderation effect of age on the association between the relationship to the deceased, gender and PGD levels, the assumption of homoscedasticity was close to being violated. Consequently, the standard errors of the age moderation analysis model may be inaccurate, which could result in reduced statistical power and the introduction of bias in parameter estimates (van den Berg, 2021). Finally, the questionnaire T1, which was used to for the data collection was retrospective. It is possible that recall bias may have been introduced, which could have influenced the outcomes. To elaborate, individuals currently experiencing minimal distress may recall past stressors as being less intense, whereas those who have encountered stressors more recently may be more inclined to report them (Eisma et al., 2021).

In conclusion, the objective of this study was to investigate the relationship between age, gender, and the relationship to the deceased with PGD levels in individuals who have experienced violent bereavement. In addition, possible moderation effects of age on the association between the relationship to the deceased and PGD levels as well as the association between gender and PGD were explored. The study identified a significant positive association between gender and PGD levels. However, no significant associations were found for age or the relationship to the deceased, and no significant moderation effect of age was observed. The study's limitations, such as a small sample size, necessitate a degree of caution when interpreting the results. Future research should try to replicate the findings of the current study in larger sample sizes, consider a non-linear relationship between age and PGD, and explore the influence of contextual factors such as health and economic status. Despite its limitations, this study adds to the current literature on violently bereaved individuals by exploring age as a possible moderator, estimating gender as a relevant risk factor for the development of PGD as well as offering suggestions for future research concerning age, gender and the relationship to the deceased.

References

American Psychiatric Association. (2022). *Diagnostic and statistical manual of mental disorders: DSM-5-TR* (5th edition, text revision. ed.). American Psychiatric Association Publishing.

Archer, J. (1999). *The nature of grief: The Evolution and Psychology of Reactions to Loss*. Psychology Press.

Bienvenu, O. J., Samuels, J. F., Costa, P. T., Reti, I. M., Eaton, W. W., & Nestadt, G. (2004). Anxiety and depressive disorders and the five-factor model of personality: A higher- and lower-order personality trait investigation in a community sample. *Depression and Anxiety*, *20*(2), 92–97. https://doi.org/10.1002/da.20026

Boelen, P. A., Olff, M., & Smid, G. E. (2019). Traumatic loss: Mental health consequences and implications for treatment and prevention. *European Journal of Psychotraumatology*, *10*(1). https://doi.org/10.1080/20008198.2019.1591331

Breusch, T. S., & Pagan, A. R. (1979). A simple test for heteroscedasticity and random coefficient variation. *Econometrica*, *47*(5), 1287. https://doi.org/10.2307/1911963

Buur, C., Zachariae, R., Komischke-Konnerup, K., Marello, M., Schierff, L., & O'Connor, M. (2024). Risk factors for prolonged grief symptoms A systematic review and meta-analysis. *Clinical Psychology Review*, *107*, 102375. https://doi.org/10.1016/j.cpr.2023.10237

Cherblanc, J., Zech, E., Cadell, S., Côté, I., Boever, C., Fernańdez-Alcántara, M., Bergeron-Leclerc, C., Maltais, D., Gauthier, G., Verdon, C., Grenier, J., & Simard, C. (2023). Are Mediators of Grief Reactions Better Predictors Than Risk Factors? A Study Testing the Role of Satisfaction With Rituals, Perceived Social Support, and Coping Strategies. *Illness, Crisis & Loss*. https://doi.org/10.1177/10541373231191316

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159. https://doi.org/10.1037/0033-2909.112.1.155

Costa, P. T., Terracciano, A., & McCrae, R. R. (2001). Gender differences in personality traits across cultures: Robust and surprising findings. *Journal of Personality and Social Psychology*, *81*(2), 322–331. https://doi.org/10.1037/0022-3514.81.2.322

Craig, C. D., Sossou, M., Schnak, M., & Essex, H. (2008). Complicated grief and its relationship to mental health and well-being among Bosnian refugees after resettlement in the United States: Implications for practice, policy, and research. *Traumatology*, *14*(4), 103–115. https://doi.org/10.1177/1534765608322129

Creighton, G., Oliffe, J. L., Butterwick, S., & Saewyc, E. (2013). After the death of a friend: Young Men's grief and masculine identities. *Social Science & Medicine*, *84*, 35–43. https://doi.org/10.1016/j.socscimed.2013.02.022

Djelantik, A. A. A. Manik J., Smid, G. E., Mroz, A., Kleber, R. J., & Boelen, P. A. (2020). The prevalence of prolonged grief disorder in bereaved individuals following unnatural losses: Systematic review and meta regression analysis. *Journal of Affective Disorders*, *265*, 146–156. https://doi.org/10.1016/j.jad.2020.01.034

Edmondson, R. (2013). The sociology of ageing. In *Oxford University Press eBooks*. https://doi.org/10.1093/med/9780199644957.003.0003

Eisma, M. C., de Lang, T. A., & Stroebe, M. S. (2021). Restoration-oriented stressors of bereavement. *Anxiety, Stress, & Coping*, *35*(3), 1–15. https://doi.org/10.1080/10615806.2021.1957849

Fiore, J. (2019). A Systematic Review of the Dual Process Model of Coping With Bereavement (1999–2016). *OMEGA - Journal of Death and Dying*, *84*(2), 003022281989313. https://doi.org/10.1177/0030222819893139

Field, A. (2013). *Discovering statistics using IBM SPSS Statistics*. SAGE

Hansson, R. O., & Stroebe, M. S. (2007). Bereavement in late life: Coping, adaptation, and developmental influences. In *American Psychological Association eBooks*. https://doi.org/10.1037/11502-000

Heeke, C., Kampisiou, C., Niemeyer, H., & Knaevelsrud, C. (2017). A systematic review and meta-analysis of correlates of prolonged grief disorder in adults exposed to violent loss. *European Journal of Psychotraumatology*, *8*(sup6). https://doi.org/10.1080/20008198.2019.1583524

Hibberd, R., Elwood, L. S., & Galovski, T. E. (2010). Risk and protective factors for posttraumatic stress disorder, prolonged grief, and depression in survivors of the violent death of a loved one. *Journal of Loss & Trauma*, *15*(5), 426–447. https://doi.org/10.1080/15325024.2010.507660

Jordan, A. H., & Litz, B. T. (2014). Prolonged grief disorder: Diagnostic, assessment, and treatment considerations. *Professional Psychology: Research and Practice*, *45*(3), 180–187. https://doi.org/10.1037/a0036836

Keesee, N. J., Currier, J. M., & Neimeyer, R. A. (2008). Predictors of grief following the death of one's child: the contribution of finding meaning. Journal of Clinical Psychology, 64(10), 1145–1163. https://doi.org/10.1002/jclp.20502

Kersting, A., Brähler, E., Glaesmer, H., & Wagner, B. (2011). Prevalence of complicated grief in a representative population-based sample. Journal of Affective Disorders, 131(1–3), 339–343. https://doi.org/10.1016/j.jad.2010.11.032

Kokou-Kpolou, K., Menick, D. M., Moukouta, C. S., Baugnet, L., & Kpelly, D. E. (2017). A Cross-Cultural approach to complicated grief reactions among Togo–Western African immigrants in Europe. *Journal of Cross-cultural Psychology*, *48*(8), 1247–1262. https://doi.org/10.1177/0022022117721972

Kokou-Kpolou, C. K., Moukouta, C. S., Masson, J., Bernoussi, A., Cénat, J. M., & Bacqué, M. (2020). Correlates of grief-related disorders and mental health outcomes among adult refugees exposed to trauma and bereavement: A systematic review and future research directions. *Journal of Affective Disorders*, *267*, 171–184. https://doi.org/10.1016/j.jad.2020.02.026

Kraemer, H. C., Kazdin, A. E., Offord, D. R., Kessler, R. C., Jensen, P. S., & Kupfer, D. J. (1997). Coming to terms with the terms of risk. *Archives of General Psychiatry*, *54*(4), 337. https://doi.org/10.1001/archpsyc.1997.01830160065009

Kristensen, P., Weisæth, L., & Heir, T. (2012). Bereavement and Mental Health after Sudden and Violent Losses: A Review. *Psychiatry*, *75*(1), 76–97. https://doi.org/10.1521/psyc.2012.75.1.76

Kutner, M. H., & Neter, J. (2004). *Applied Linear Regression models*. Irwin/McGraw-Hill

Lenferink, L. I. M., Smid, G., & Boelen, P. A. (2021). Traumatic Grief Inventory-Self Report Plus (TGI-SR+). *Osf.io*. https://doi.org/10.17605/OSF.IO/RQN5K

Lenferink, L. I. M., van Eersel, J. H. W., & Franzen, M. (2022a). Is it acceptable and feasible to measure prolonged grief disorder symptoms in daily life using experience sampling methodology? *Comprehensive Psychiatry*, *119*, 152351. https://doi.org/10.1016/j.comppsych.2022.152351

Lenferink, L. I. M., Eisma, M. C., Smid, G. E., De Keijser, J., & Boelen, P. A. (2022b). Valid measurement of DSM-5 persistent complex bereavement disorder and DSM-5-TR and ICD-11 prolonged grief disorder: The Traumatic Grief Inventory-Self Report Plus (TGI-SR+). *Comprehensive Psychiatry*, *112*, 152281. https://doi.org/10.1016/j.comppsych.2021.15228

Lundorff, M., Holmgren, H., Zachariae, R., Farver-Vestergaard, I., & O'Connor, M. (2017). Prevalence of prolonged grief disorder in adult bereavement: A systematic review and meta-analysis. *Journal of Affective Disorders*, *212*, 138–149. https://doi.org/10.1016/j.jad.2017.01.030

Lundorff, M., Bonanno, G. A., Johannsen, M., & O'Connor, M. (2020). Are there gender differences in prolonged grief trajectories? *A registry-sampled cohort study. Journal of Psychiatric Research, 129*, 168–175. https://doi.org/10.1016/j.jpsychires.2020.06.030

Nickerson, A., Liddell, B. J., Maccallum, F., Steel, Z., Silove, D., & Bryant, R. A. (2014). Posttraumatic stress disorder and prolonged grief in refugees exposed to trauma and loss. BMC Psychiatry, 14(1). https://doi.org/10.1186/1471-244x-14-106

Olff, M., Langeland, W., Draijer, N., & Gersons, B. P. R. (2007). Gender differences in posttraumatic stress disorder. *Psychological Bulletin*, *133*(2), 183–204. https://doi.org/10.1037/0033-2909.133.2.183

Pohlkamp, L., Kreicbergs, U., Prigerson, H. G., & Sveen, J. (2018). Psychometric properties of the Prolonged Grief Disorder-13 (PG-13) in bereaved Swedish parents. *Psychiatry Research*, *267*, 560–565. https://doi.org/10.1016/j.psychres.2018.06.004

Prigerson, H. G., Horowitz, M. J., Jacobs, S. C., Parkes, C. M., Aslan, M., Goodkin, K., Raphael, B., Marwit, S. J., Wortman, C., Neimeyer, R. A., Bonanno, G., Block, S. D., Kissane, D., Boelen, P., Maercker, A., Litz, B. T., Johnson, J. G., First, M. B., & Maciejewski, P. K. (2009). Prolonged Grief Disorder: Psychometric validation of criteria proposed for DSM-V and ICD-11. *PLoS Medicine*, *6*(8), e1000121. https://doi.org/10.1371/journal.pmed.1000121

Prigerson, H. G., Maciejewski, P. K., Reynolds, C. F., Bierhals, A. J., Newsom, J. T., Fasiczka, A., Frank, E., Doman, J., & Miller, M. (1995). Inventory of complicated grief: A scale to measure maladaptive symptoms of loss. *Psychiatry Research*, *59*(1–2), 65–79. https://doi.org/10.1016/0165-1781(95)02757-2

Richardson, S. J., Lund, D. A., Caserta, M. S., Dudley, W. N., & Obray, S. J. (2003). Sleep patterns in older bereaved spouses. *Omega*, *47*(4), 361–383. https://doi.org/10.2190/0d4f-epmw-3yul-c1jk

Rubin, S. S., & Malkinson, R. (2001). Parental response to child loss across the life cycle: Clinical and research perspectives. In *American Psychological Association eBooks* (pp. 219–240). https://doi.org/10.1037/10436-009

Rynearson, E. K. (Ed.). (2006). *Violent death: Resilience and intervention beyond the crisis.* New York: Routledge.

Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (Complete samples). *Biometrika*, *52*(3/4), 591. https://doi.org/10.2307/2333709

Stroebe, M. S., Folkman, S., Hansson, R. O., & Schut, H. (2006). The prediction of bereavement outcome: Development of an integrative risk factor framework. *Social Science & Medicine*, *63*(9), 2440–2451. https://doi.org/10.1016/j.socscimed.2006.06.012

Stroebe, M., & Schut, H. (2016). Overload: A Missing Link in the Dual Process Model? *OMEGA - Journal of Death and Dying*, *74*(1), 96–109. https://doi.org/10.1177/0030222816666540

Tolin, D. F., & Foa, E. B. (2006). Sex differences in trauma and posttraumatic stress disorder: A quantitative review of 25 years of research. *Psychological Bulletin*, *132*(6), 959–992. https://doi.org/10.1037/0033-2909.132.6.959

van den Berg, S. M. (2021). *Analysing Data using Linear Models*. (5 ed.) University of Twente

Vanderwerker, L. C., & Prigerson, H. G. (2004). SOCIAL SUPPORT AND TECHNOLOGICAL CONNECTEDNESS AS PROTECTIVE FACTORS IN BEREAVEMENT. *Journal of Loss & Trauma*, *9*(1), 45–57. https://doi.org/10.1080/15325020490255304

Appendix A

R code used for statistical analysis

```
###estimating age effect###


##installing packages
install.packages("tidyverse")
install.packages("foreign")
install.packages("broom")
install.packages("stats")
install.packages("stringr")
install.packages("forcats")
install.packages("modelr")
install.packages("haven")
library(haven)
library(tidyverse)
library(foreign)
library(broom)
library(stats)
library(stringr)
library(forcats)
library(modelr)


##setting working directory
setwd("C:/Users/rapha/OneDrive/Dokumente/UT/Assingments/Year 3/Bachelor
Thesis/Statistical analysis")


##getting the datasets
ESM1_T1_T2 <- read_sav("ESM1_T1_T2_Wide.sav")
View(ESM1_T1_T2)


ESM3_T1 <- read_sav("ESM3_T1.sav")
```

```
View(ESM3_T1)

##data cleaning
#excluding na´s in TGI items
ESM3_T1_n1 <- ESM3_T1 %>% filter(!is.na(TGI_1) & !is.na(TGI_2) & !is.na(TGI_3) &
                                 !is.na(TGI_6) & !is.na(TGI_8) &
                                 !is.na(TGI_9) & !is.na(TGI_10) &
                                 !is.na(TGI_11) & !is.na(TGI_18) & !is.na(TGI_19) & !is.na(TGI_21))
view(ESM3_T1_n1)
#excluding suicidal participants --> was already excluded with the NA removal
attr(ESM3_T1_n1$suicidal1.1, 'labels')
#excluding ex psychotic individuals
attr(ESM3_T1_n1$Ex.psychotic, 'labels')
#removing no consent --> everyone gave consent
attr(ESM3_T1_n1$Consent_1, 'labels')
attr(ESM3_T1_n1$Consent_2, 'labels')

##exploring the data set
attr(ESM3_T1_n1$cause, 'labels')
attr(ESM3_T1_n1$kinship, 'labels')
attr(ESM3_T1_n1$Education, 'labels')
attr(ESM3_T1_n1$Gender, 'labels')


##getting the age as a numeric variable
#setting to one format and calculating age
ESM3_T1_n1$DoB <- gsub("/", "-", ESM3_T1_n1$DoB)
view(ESM3_T1_n1)
#calculating age
install.packages("lubridate")
library(lubridate)
```

```
# Converting RecordedDate to Date format and I use only the date

ESM3_T1_n1$RecordedDate <- as.Date(ESM3_T1_n1$RecordedDate, format = "%Y-%m-
%d")

# Calculate ages

ESM3_T1_n1$ageC <- as.numeric(difftime(ESM3_T1_n1$RecordedDate,
ESM3_T1_n1$DoB, units = "days") / 365.25)

view(ESM3_T1_n1)



# age calculated on 06.05.2024 (BY HAND)

ESM3_T1_n1 <- mutate(ESM3_T1_n1, age_6_5_24 =
c(51,55,55,60,39,29,59,61,32,49,51,52,44,42,56,65,

                                    56,50,54,56,36,53,47,48,63,33,58,36,66,47,66,54,56,

                                    64,63,39,44,48,55,35,52,76,54,44,52,69,51))

view(ESM3_T1_n1)



##calculating PGD levels

#10 items in total (without item 13)

ESM3_T1_n2 <- ESM3_T1_n1 %>%

  mutate(PGD_L = rowSums(select(., TGI_1, TGI_3, TGI_6, TGI_9,

                          TGI_10, TGI_11, TGI_18,

                          TGI_19, TGI_21)) +

         ifelse(TGI_8 > TGI_2, TGI_8, TGI_2))

view(ESM3_T1_n2)

#with item 13

ESM3_T1_n3 <- ESM3_T1_n2 %>% mutate(PGD_L_W13 = rowSums(select(., TGI_1,
TGI_3, TGI_6, TGI_9,

                          TGI_10, TGI_11, TGI_13, TGI_18,

                          TGI_19, TGI_21)) +

         ifelse(TGI_8 > TGI_2, TGI_8, TGI_2))

view(ESM3_T1_n3)
```

```
##descriptive statistics
# indentify what the coding is
source_data_hv <- haven::read_sav("ESM3_T1.sav")

#eductation
source_data_hv$Education %>% attr('labels')
# Using table() to count the number of individuals in each education group
education_counts <- table(ESM3_T1_n3$Education)
# Using prop.table() to calculate the proportion of individuals in each education group
education_proportions <- prop.table(education_counts)
# Print the counts and proportions for each education group
education_summary <- data.frame(Education_Level = names(education_counts),
                                Number_of_Participants = as.numeric(education_counts),
                                Proportion_of_Participants = as.numeric(education_proportions))
print(education_summary)

#gender
source_data_hv$Gender %>% attr('labels')

gender_counts <- table(ESM3_T1_n3$Gender)
gender_proportions <- prop.table(gender_counts)
gender_summary <- data.frame(Gender_Level = names(gender_counts),
                                Number_of_ParticipantsG = as.numeric(gender_counts),
                                Proportion_of_ParticipantsG = as.numeric(gender_proportions))
print(gender_summary)

#ex.psych
source_data_hv$Ex.psychotic %>% attr('labels')
```

```
#cause of death
source_data_hv$cause %>% attr('labels')

cause_counts <- table(ESM3_T1_n3$cause)
cause_proportions <- prop.table(cause_counts)
cause_summary <- data.frame(cause_Level = names(cause_counts),
                            Number_of_ParticipantsC = as.numeric(cause_counts),
                            Proportion_of_ParticipantsC = as.numeric(cause_proportions))
print(cause_summary)

#kinship
source_data_hv$kinship %>% attr('labels')

kinship_counts <- table(ESM3_T1_n3$kinship)
kinship_proportions <- prop.table(kinship_counts)
kinship_summary <- data.frame(kinship_Level = names(kinship_counts),
                            Number_of_Participants = as.numeric(kinship_counts),
                            Proportion_of_Participants = as.numeric(kinship_proportions))
print(kinship_summary)

#general
ESM3_T1_n3 %>% summary()
sd(ESM3_T1_n3$ageC)
sd(ESM3_T1_n3$age_6_5_24)
sd(ESM3_T1_n3$PGD_L)
sd(ESM3_T1_n3$PGD_L_W13)
sd(ESM3_T1_n3$age_deceased)

#distribution of age --> plotting a histogram of age
ggplot(ESM3_T1_n3, aes(x = ageC)) +
  geom_histogram(binwidth = 5, fill = "skyblue", color = "black") +
```

```
  labs(x = "AgeC", y = "Frequency", title = "Histogram of Age")
#for rounded age
ggplot(ESM3_T1_n3, aes(x = age_6_5_24)) +
  geom_histogram(binwidth = 5, fill = "skyblue", color = "black") +
  labs(x = "AgeR", y = "Frequency", title = "Histogram of Age")

#distribution of PGD
ggplot(ESM3_T1_n3, aes(x = PGD_L)) +
  geom_histogram(binwidth = 5, fill = "skyblue", color = "black") +
  labs(x = "PGD", y = "Frequency", title = "Histogram of PGD Level")
#for PGD with item 13
ggplot(ESM3_T1_n3, aes(x = PGD_L_W13)) +
  geom_histogram(binwidth = 5, fill = "skyblue", color = "black") +
  labs(x = "PGDwith13", y = "Frequency", title = "Histogram of PGD Level")


## Linear regression analysis
modelA <- ESM3_T1_n3 %>% lm(PGD_L ~ ageC, data = .)
modelA %>% tidy()
confint(modelA)

modelTwith13 <- ESM3_T1_n3 %>% lm(PGD_L_W13 ~ ageC, data = .)
modelTwith13 %>% tidy()
confint(modelTwith13)



##Assumption testing
#linearity: the relationship between the variables can be described by a linear equation
#independence: the residuals are independend of each other
#equal variance: the residuals have qual variance
```

```
#normality: the distribution of the residuals is normal


#linearity
ESM3_T1_n3 %>% ggplot(aes(x = ageC, y = PGD_L)) +
  geom_point() +  # Add data points
  geom_smooth(method = "lm", se = FALSE) +  # Add a smooth line using linear regression
  labs(x = "Age", y = "PGD Level", title = "Relationship between Age and PGD Level")
#-normality-
ESM3_T1_n3 %>% add_residuals(modelA) %>% ggplot(aes(x = resid)) + geom_histogram()
# Shapiro-Wilk test for normality
shapiro.test(modelA$residuals)



#creating plot for residuals against predictor
ESM3_T1_n3 %>% add_residuals(modelA) %>% ggplot(aes(x = ageC, y = resid)) +
geom_point()
#creating plot for residuals against predicted values #
ESM3_T1_n3 %>% add_residuals(modelA) %>% add_predictions(modelA) %>%
ggplot(aes(x = pred, y = resid)) + geom_point()


#- test for equal variance-
# Breusch-Pagan test for homoscedasticity
install.packages("lmtest")
library(lmtest)
bptest(modelA)


#- independence-
#Durbin-Watson test
dwtest(modelA)
```

```
### testing the other independent variables in multiple regression
#dummies for gender
ESM3_T1_n3$Gender <- factor(ESM3_T1_n3$Gender)
DummyWoman <- model.matrix(~ Gender - 1, data = ESM3_T1_n3)
DummyWoman <- DummyWoman[, -1]
ESM3_T1_n3 <- cbind(ESM3_T1_n3, DummyWoman)
View(ESM3_T1_n3)

ESM3_T1_n3$Gender <- factor(ESM3_T1_n3$Gender)
DummyMale <- model.matrix(~ Gender - 1, data = ESM3_T1_n3)
DummyMale <- DummyMale[, -2]
ESM3_T1_n3 <- cbind(ESM3_T1_n3, DummyMale)
View(ESM3_T1_n3)

#dummy for kinship (dummy other --> loosing a child and partner as reference)
ESM3_T1_n3$Dummy_Other <- ifelse(ESM3_T1_n3$kinship %in% c(3, 4, 5, 6, 7, 8), 1, 0)
ESM3_T1_n3$Dummy_Partner_Child <- ifelse(ESM3_T1_n3$kinship %in% c(1,2), 1, 0)
View(ESM3_T1_n3)



##multiple linear regression analysis for Gender and Kinship and age (again)
modelGR_ESM3 <- ESM3_T1_n3 %>% lm(PGD_L ~ ageC + DummyWoman +
Dummy_Partner_Child, data = .)
modelGR_ESM3 %>% tidy()
confint(modelGR_ESM3)



#Displaying the relationships --> linearity
ESM3_T1_n3 %>% ggplot(aes(x = DummyWoman, y = PGD_L)) +
  geom_point() +  # Add data points
```

```
  geom_smooth(method = "lm", se = FALSE) +  # Add a smooth line using linear regression
  labs(x = "Being Female", y = "PGD Level", title = "Relationship between Gender and PGD Level")

ESM3_T1_n3 %>% ggplot(aes(x = Dummy_Partner_Child, y = PGD_L)) +
  geom_point() +  # Add data points
  geom_smooth(method = "lm", se = FALSE) +  # Add a smooth line using linear regression
  labs(x = "Partner or Child", y = "PGD Level", title = "Relationship between Kinship and PGD Level")

ESM3_T1_n3 %>% ggplot(aes(x = ageC, y = PGD_L)) +
  geom_point() +  # Add data points
  geom_smooth(method = "lm", se = FALSE) +  # Add a smooth line using linear regression
  labs(x = "age", y = "PGD Level", title = "Relationship between age and PGD Level")

#-normality-
ESM3_T1_n3 %>% add_residuals(modelGR_ESM3) %>% ggplot(aes(x = resid)) + geom_histogram()
# Shapiro-Wilk test for normality
shapiro.test(modelGR_ESM3$residuals)


#creating plot for residuals against predictor --> # must be done for every predictor variable
ESM3_T1_n3 %>% add_residuals(modelGR_ESM3) %>%
  add_predictions(modelGR_ESM3) %>%
  ggplot(aes(x = DummyWoman, y = resid)) + geom_point() #also to check equal variance
#for Dummy_Partner_Child
ESM3_T1_n3 %>% add_residuals(modelGR_ESM3) %>%
  add_predictions(modelGR_ESM3) %>%
  ggplot(aes(x = Dummy_Partner_Child, y = resid)) + geom_point() #also to check equal variance
#for age
ESM3_T1_n3 %>% add_residuals(modelGR_ESM3) %>%
```

```
  add_predictions(modelGR_ESM3) %>%
  ggplot(aes(x = ageC, y = resid)) + geom_point() #also to check equal variance

#- test for equal variance-
# Breusch-Pagan test for homoscedasticity
install.packages("lmtest")
library(lmtest)



ESM3_T1_n3 %>% add_residuals(modelGR_ESM3) %>%
add_predictions(modelGR_ESM3) %>% ggplot(aes(x = pred, y = resid)) + geom_point()

#- independence-
#Durbin-Watson test
dwtest(modelGR_ESM3)

##how many people are above the cut-off score for PGD (33)?
# Filter the dataset to get only the rows where PGD level is above 33
participants_above_33 <- ESM3_T1_n3 %>%
  filter(PGD_L >= 33)
View(participants_above_33)



###testing realiability of TGI-SR+ in current study
install.packages("psych")
library(psych)

reliability_data <- ESM3_T1_n3 %>% select(TGI_1, TGI_2,TGI_3,
                                          TGI_4,TGI_5,TGI_6,
                                          TGI_7,TGI_8,TGI_9,
```

```
                    TGI_10,TGI_11,TGI_12,
                    TGI_13,TGI_14,TGI_15,
                    TGI_16,TGI_17,TGI_18,
                    TGI_19,TGI_20,TGI_21,
                    TGI_22)
View(reliability_data)
reliability_data_used <- ESM3_T1_n3 %>% select(TGI_1, TGI_2, TGI_3, TGI_6,TGI_8,
                    TGI_9, TGI_10, TGI_11, TGI_18,
                    TGI_19, TGI_21)
View(reliability_data_used)

##calculating Cronbach´s alpha
alpha_result_all <- alpha(reliability_data)
alpha_result_used_Items <- alpha(reliability_data_used)

print(alpha_result_all)
print(alpha_result_used_Items)



###moderation analysis age on the relationship of
###losing a child or partner on PGD levels
##and
###moderation analysis age on the relationship of being female and PGD levels

#multiple regression analysis for age moderation inclusion
modelMA <- ESM3_T1_n3 %>% lm(PGD_L ~ ageC + DummyWoman +
Dummy_Partner_Child + ageC * DummyWoman + ageC * Dummy_Partner_Child, data = .)
modelMA %>% tidy()
confint(modelMA)
```

```
##assumption testing

#Displaying the relationships --> linearity

ESM3_T1_n3 %>% ggplot(aes(x = Dummy_Partner_Child, y = PGD_L)) +

  geom_point() +  # Add data points

  geom_smooth(method = "lm", se = FALSE) +  # Add a smooth line using linear regression

  labs(x = "Partner or Child", y = "PGD Level", title = "Relationship between Kinship and
PGD Level")



ESM3_T1_n3 %>% ggplot(aes(x = DummyWoman, y = PGD_L)) +

  geom_point() +  # Add data points

  geom_smooth(method = "lm", se = FALSE) +  # Add a smooth line using linear regression

  labs(x = "being female", y = "PGD Level", title = "Relationship between gender and PGD
Level")


#-normality-

ESM3_T1_n3 %>% add_residuals(modelMA) %>% ggplot(aes(x = resid)) +
geom_histogram()

# Shapiro-Wilk test for normality

shapiro.test(modelMA$residuals)



#creating plot for residuals against predictor --> # must be done for every predictor variable

#for Dummy_Partner_Child

ESM3_T1_n3 %>% add_residuals(modelMA) %>%

  add_predictions(modelMA) %>%

  ggplot(aes(x = Dummy_Partner_Child, y = resid)) + geom_point() #also to check equal
variance

#for age

ESM3_T1_n3 %>% add_residuals(modelMA) %>%

  add_predictions(modelMA) %>%

  ggplot(aes(x = ageC, y = resid)) + geom_point() #also to check equal variance

#for gender
```

```
ESM3_T1_n3 %>% add_residuals(modelMA) %>%
  add_predictions(modelMA) %>%
  ggplot(aes(x = DummyWoman, y = resid)) + geom_point() #also to check equal variance

#- test for equal variance-
# Breusch-Pagan test for homoscedasticity
bptest(modelMA)

ESM3_T1_n3 %>% add_residuals(modelMA) %>% add_predictions(modelMA) %>%
ggplot(aes(x = pred, y = resid)) + geom_point()

#- independence-
#Durbin-Watson test
dwtest(modelMA)
```