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Meta-Analytic Reliability Generalization Study of Perceived Stress Scale in Türkiye Sample

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Abstract

The aim of the study is to examine the meta-analytic reliability generalization of the 14, 10, and 8-item forms of the Perceived Stress Scale, which was developed by Cohen, Kamarck and Mermelstein in 1983 and translated into Turkish by different researchers (Erci, 2006; Yerlikaya & İnanç, 2007; Eskin et al. 2013, etc.) between 2006 and 2013, for the theses produced in Türkiye. For this purpose, how different moderator variables affect the reliability coefficients and publication bias were also examined. A total of 81 Cronbach Alpha coefficients from 78 studies, selected in accordance with the established criteria, were included in the meta-analysis. Reliability generalization was applied in the data analysis. The analyses were conducted using the random effects model with coefficient values converted through the Bonett method. In the study, the effect size value was found to be .82 (95% CI: .80, .83), and it was concluded that the sample type (α= .81) and the study area (α= .81) moderator variables had a statistically significant effect on the reliability estimation in terms of heterogeneity of effect sizes. This revealed that these two moderator variables affected the estimations of the reliability coefficients. In addition, it has been observed that other moderator variables such as age, gender, and the number of items in the scale are not sources of heterogeneity and have no effect on reliability estimation. From this, it was deduced that the scale works well enough to generalize to different contexts with different item numbers. Finally, according to the results of the analysis for the determination of publication bias, it was seen that there was no publication bias in the study.

Keywords: reliability generalization, meta-analysis, perceived stress scale, Cronbach alpha coefficient, Bonett method.

Introduction

One of the important reasons for the rapid progress of science is that it is cumulative. Accumulation of science is valuable with the accuracy of the inferences that are considered scientific knowledge. One of the conditions required for knowledge to be scientific is to obtain that knowledge by measuring it with the help of tools whose standards have been determined. The usefulness of the measurements depends on the robustness of the qualifications of the measurement tool. The most important of these qualities are validity and reliability. Validity evidence and reliability coefficients of the scores obtained from the measurement tools should be examined. One of Cronbach's (1947) definitions for reliability among these concepts is the degree to which the test score reflects the individual's current state in the general and group factors defined by the test. Anastasi (1976) defines reliability as the consistency of scores obtained when re-examined by the same people in different situations with the same test or with different sets of equivalent items or under other varying conditions. In the Standards (American Educational Research Association (AERA) et al., 2014), reliability is defined as the correlation between the scores on two equivalent forms of the test and is used to refer to the consistency of scores across replications of a test procedure.

As stated in Classical Test Theory, reliability is not an inherent property of the test but a value derived from a specific implementation. As with validity, test score reliability should be considered in relation to specific test purposes and contexts. Defining, measuring and reporting reliability should begin with considerations of the intended uses and interpretations of the test. The reliability of test scores varies

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according to the sample structure, diversity and context of implementation (Crocker & Algina, 1986; Haertel, 2006; Streiner et al., 2015). Therefore, many scientific institutions, journals, and researchers have recommended reporting the reliability estimates with the data obtained from the studies and avoiding the misuse of reliability coefficients from previous test applications (Vacha-Haase et al., 2000; Wilkinson, L., & the APA Task Force on Statistical Inference, 1999). Cronbach's Alpha is the most commonly used coefficient in the literature to analyze and interpret internal consistency reliability (Özdemir et al., 2020; Urbina, 2004). Nevertheless, as in all coefficients, Cronbach's Alpha coefficient varies from study to study even if the same scale is used since it is a sample-dependent coefficient. For example, while the Cronbach Alpha value was .60 in one study (Güler, M.Ş., 2019) using the Perceived Stress Scale (PSS), it was found to be .97 in another study (Güler, B., 2019).

Reliability analyses depend on the areas of variability allowed in the test procedure (e.g., tasks, contexts, raters) and the proposed interpretation of test scores (AERA et al., 2014). In contrast to common misconceptions, reliability is a dynamic characteristic of test scores rather than a fixed value for measurement results and can vary according to the properties of the data (Thompson & Vacha-Haase, 2000 as cited in Eser & Doğan, 2023). Therefore, reliability should be calculated again after any measurement and reported in each study. Reliability coefficients may also differ depending on the variety of sample characteristics, and for this reason, sample size, scale implementation conditions, implementation time etc. differences require the generalization of the reliability of the studies conducted. Reliability generalization (RG) was initially developed by Vacha-Haase (1998). RG analyzes the sources and amount of variability of reliability coefficients in different studies (Vacha-Haase, 1998). RG studies are subsequent analyses aimed at establishing of an average estimate of the effect sizes observed across studies, and specifically to search for evidence of reliability. (Borenstein, 2009; Hunter & Schmidt, 2004; Vacha-Hasse, 1998 as cited in Allan, 2021).

RG studies are relatively new, but they provide beneficial information beyond the simple definition of score reliability for an instrument. A properly conducted RG study can provide more accurate estimates of score reliability by synthesizing reliability estimates from a data set of estimates from individual samples (Beretvas et al., 2008).There are various sources and studies in the literature related to RG studies. (e.g., Aguayo et al., 2011; Allan, 2021; Alzahrani, 2016; Hongyan et al., 2015; Nicolas et al., 2021). However, only Eser and Aksu (2021), Özdemir et al. (2020), Şen (2021a) and Şeten (2012) studies are available in the Turkish literature. It is seen that the interest in RG study has been increasing in recent years. Unfortunately, however, as many RG studies reveal, there is still a critical shortage of studies reporting reliability estimates for the samples used. This is problematic for several causes. First, underreporting continues to spread the misconception that reliability is a property of the scale, not the scores derived from it. Second, under-reporting limits the data that can be used in an RG study to provide a precise and accurate pooled estimate of reliability (Beretvas et al., 2008). In RG studies, the moderator variables that affect the reliability coefficient are generally handled as sample size, sample type, year of study, participant characteristics, etc. This study investigated the generalizability of reliability coefficients based on sample size, gender, year of study, number of items in the scale, sample type, field of study, thesis type and average age of the participants, and whether the reliability coefficients are affected by these variables. The reasons for selecting these variables are that perceived stress varies according to gender (Graves et al. 2021), age (Osmanovic-Thornström et al., 2015), sample type and the job (Lee et al., 2012) in the context of the field of study. However, the desire to examine the effect of sample size, thesis type and number of items that affect study quality and reliability in the context of the studies conducted required the inclusion of these variables in the study. In addition, since the number of studies using the perceived stress scale was more than 500, a limitation was necessary. For this reason, theses that are believed to have been prepared more carefully and in which the number of samples is generally higher were considered within the scope of the research. Even the number of theses written on this subject is well above the number of studies used in many RG studies.

Within the scope of the study, it was aimed to examine the reliability generalization of the PSS developed by Cohen et al. (1983) in forms with different number of items. The PSS, developed by Cohen et al. (1983), was chosen because it is the most widely used stress scale. In addition, within the scope of scale development, it was found important that three different samples were formed and analyzed, and

the reliability coefficients obtained from these samples were high, with values of .84, .85, and .86. In addition, the fact that there was no significant difference in the comparison of male and female participants in the samples provides the possibility of applying the scale to all individuals. Stress has become one of the most commonly used concepts in daily life in recent years. Stress has become one of the most commonly used concepts in daily life in recent years. It is often used to mean "anxiety," "worry," and "tension," and is defined as an external load or demand on a mental, biological, social , or psychological system (Lazarus, 1993). Following the definition of stress, theoretical frameworks, such as Lazarus' Stress and Related Relationships Theory, have been developed to provide a comprehensive context for how it is measured. Questions such as what stress is, its sources, its physical and psychological symptoms, when it becomes dangerous, and how to manage it have become important. Although people have similar experiences, stress responses and outcomes may differ (Cohen et al., 1997; Lazarus & Launier, 1978). This suggests that people differ in the way they interpret and react to events. Questions regarding what stress is, its sources, physical and psychological symptoms, when it becomes dangerous, and how to manage it have gained importance. Although people have similar experiences, stress reactions and outcomes may vary (Cohen et al., 1997; Lazarus & Launier, 1978); that is, people differ in the way they interpret and react to situations. Stress has a negative impact on people's ordinary actions in their lives and on their quality of life. Lazarus (1990) discussed four controversial issues related to stress and adopted the view that stress is a subjective rather than objective phenomenon, that it can be measured as relatively minor adversity rather than major catastrophes, that the relationship between stress and adaptive outcomes is not due to confounding, and that any measure of stress should assess the content or sources of stress rather than its degree. He also advocated for a greater emphasis on the psychological content of stress scales and more attention to the broader adaptive context of the individual, the systems theory perspective, and the time periods over which stress is measured. Among the types and definitions of stress, perceived stress represents a global and comprehensive construct of stress and is based on the concept that individuals actively interact with their environment, evaluating potentially threatening or challenging events considering available coping resources (Katsarou et al., 2013). Studies have shown that the increase in the perceived stress levels of individuals negatively affects their quality of work and life (Camci, 2021; Havare, 2019; Ataman Temizel & Dağ, 2014 etc.). Cohen (1994) stated that the Perceived Stress Scale (PSS) is one of the most common psychological instruments used to measure stress perception and that the scale is a measure of the extent to which situations in one's life are considered stressful. The scale items are constructed to measure how unpredictable, uncontrollable and overloaded individuals find their lives. The scale also includes a series of direct questions about current stress levels. Within the scope of the research, Cronbach Alpha coefficient was used as the reliability coefficient. There are areas where the Cronbach Alpha coefficient is incomplete (Agbo, 2010), and it is sometimes misused by researchers. Although these are some of the reasons why more than one reliability coefficient is recommended (Agbo, 2010), Cronbach's Alpha is the most widely used reliability measure (Hussey et al., 2023) and used in almost all studies employing this scale. Yerlikaya and İnanç (2007) adapted the 14-item form of the PSS into Turkish. Some items in the scale (4th, 5th, 6th, 7th, 9th, 10th and 13th) were reverse coded and the internal consistency coefficient of the scale was found to be 0.84. In the adaptation made by Eskin et al. (2013) for the 14-item form of the PSS, the internal consistency coefficient was found to be 0.86. The first of the two factors in the scale was named as "Insufficient Self-Efficacy Perception" and the other as "Stress/Discomfort Perception". It was stated that these two factors explained 46.5% of the total variance. The Turkish adaptation study of the 10-item form of PSS was also carried out by different researchers. In the first Turkish adaptation study conducted by Erci (2006), 4 items were scored as positive and 6 items as negative. The Alpha coefficient of the scale was found to be 0.70 and it was stated that the scale explained 58.1% of the total variance. The internal consistency coefficient of the PSS-10 scale, adapted to Turkish by Çelik Örücü and Demir (2009), was found to be 0.84. In Eskin et al. (2013), it was found that the scale consisted of two factors: "insufficient self-efficacy" and "perception of stress or discomfort". The reliability values of the two factors were determined as .69 and .80. The total reliability of the scale was found to be .82. The 8-item form of the PSS was adapted by Bilge et al. (2009) and prepared in a 5-point Likert type (0 never, 4 very often) and three items were scored in reverse (4th, 5th, 6th). In addition, the Cronbach Alpha coefficient was found to be .81. The reliability coefficients of the PSS scale in different cultures are also quite high. For example, in a study

conducted in Mexico, Ramírez and Hernández (2007) found the Cronbach Alpha coefficient to be .83, and in a study conducted in Greece, Andreou et al. (2011) found the Cronbach Alpha coefficient to be .82. The reason for choosing the PSS in this study is that stress, defined as physical strain that can cause physical and mental diseases by reducing the body's resistance (Birol & Akdemir, 2003), is associated with many concepts in various fields. In addition, in recent years, especially during the pandemic period, the number of studies on the concept of stress has increased in parallel with the increase in people's stress levels and types. The Coronavirus Disease-2019 (COVID -19) pandemic has caused significant stress for humanity (Singh et al. 2021). A study by Qui et al. (2020) showed that stress was high among young people during the pandemic. However, another study by Pedrozo-Pupo et al. (2020) showed that stress was found to be similar across all age groups. The young population struggled with stressors such as the absence of face-to-face academic, physical and social activities, disruption of routine and boredom. Adults struggled with specific issues such as financial burdens, social isolation, the unpredictability of life and increased childcare responsibilities due to school closures (Gallagher et al. 2020). Considering that stress has a significant impact on people's life and health, it is extremely important to reliably measure the level of perceived stress. An examination of both Turkish and international literature showed that the PSS was frequently used to measure perceived stress levels. Since the number of studies conducted in this field is very large, the scope of the research is limited to the theses in which PSS is used in the Turkish sample. 31 of the 164 theses, in which PSS was used in the process until the end of the study, belong to the year 2021 only. Considering that the reliability values of the studies using the PSS in the theses examined in Turkish literature range from .60 to .97, it would be useful to investigate these differences and generalize the reliability findings to the Turkish sample.

Given that there are different perceived stress scales (e.g., for prenatal pregnant women (Razurel et al., 2014), for nursing students (Sheu et al., 2002), for children (Snoeren & Hoefnagels, 2014), it is thought that a good understanding of the psychometric properties of the PSS concept by researchers and an RG of the PSS scale would provide an important basis for researchers to consider the PSS in future studies. Therefore, the aim of the study was to conduct an RG meta-analysis to investigate the variability of PSS score reliability across studies. RG studies can help to understand how reliable the scores produced by the scale are across different samples, number of items, and fields of study, etc., rather than whether the measurement is reliable or not. It is thought by Vacha-Haase et al. (2002) that RG studies can contribute to field experts and individuals who will develop scales. As a result of all these, it is essential that this study be included in the Turkish literature and in the fields of education, health and psychology. For that reason, a meta-analytic RG analysis was conducted for the Turkish sample of the PSS and it was examined how the reliability coefficients were generalized according to the moderator variables of number of items, sample type, field of study, sample age, year of publication, type of thesis, gender and sample size, and whether the reliability coefficients were affected by these variables. For this reason, a meta-analytic RG analysis was conducted for the Turkish sample of the PSS, examining how the reliability coefficients generalized according to the moderator variables of the number of items, sample type, field of study, sample age, publication year, thesis type, gender, and sample size, and whether these variables affected the reliability coefficients. Finally, the question of whether the reliability coefficients were affected by these variables was sought to be answered. The results of this study will inform researchers who plan to conduct studies using this scale about the range of reliability estimates that can be expected for the PSS and ensure that sources of variability are considered.

Methods

In this research, the meta-analysis method was used to synthesize the results of these studies by considering and examining them for a specific purpose (Büyüköztürk et al., 2019). This section includes sampling, coding of study variables, and data analysis. The RG study was conducted according to the PRISMA (Liberati et al., 2009) guidelines. Accordingly, the databases of the theses were searched and the studies suitable for the criteria were determined. Then, identical studies were removed and studies were evaluated for inclusion in the meta-analysis.

Data Collection Process

The selection process for the studies included in the research is presented in Figure 1 (Liberati et al., 2009). Figure 1 illustrates that the first step is to search for relevant studies. As mentioned above, since the number of studies conducted using PSS is very high, it was decided to examine only the theses in which PSS was used and the theses were scanned from https://tez.yok.gov.tr/UlusalTezMerkezi/ where the theses are uploaded in Türkiye. The keywords used were "perceived stress" and "stress they perceive". When it was searched with keywords on the specified site, it was seen that there were a total of 164 studies. First of all, double coding was avoided for the theses reached by using both keywords. In addition, for studies containing two or more reliability coefficients, the coefficients were coded independently. Therefore, a total of 157 studies out of 164 studies were coded. These 157 studies were then reviewed according to the inclusion criteria. The criteria were as follows:

I) Cronbach Alpha reliability coefficients should be reported

II) Sample type, sample size and number of items should be given.

III) The language of the studies should be English or Turkish.

Theses in which Cronbach Alpha reliability coefficient was not given, variables selected as moderator variables within the scope of the research were not reported, and theses published after 2021 were not included in the study. The stages of the meta-analysis process are shown in Figure 1. Within the scope of the research, 78 studies with 81 Cronbach Alpha reliability coefficients that met the inclusion criteria are given in Appendix 1.

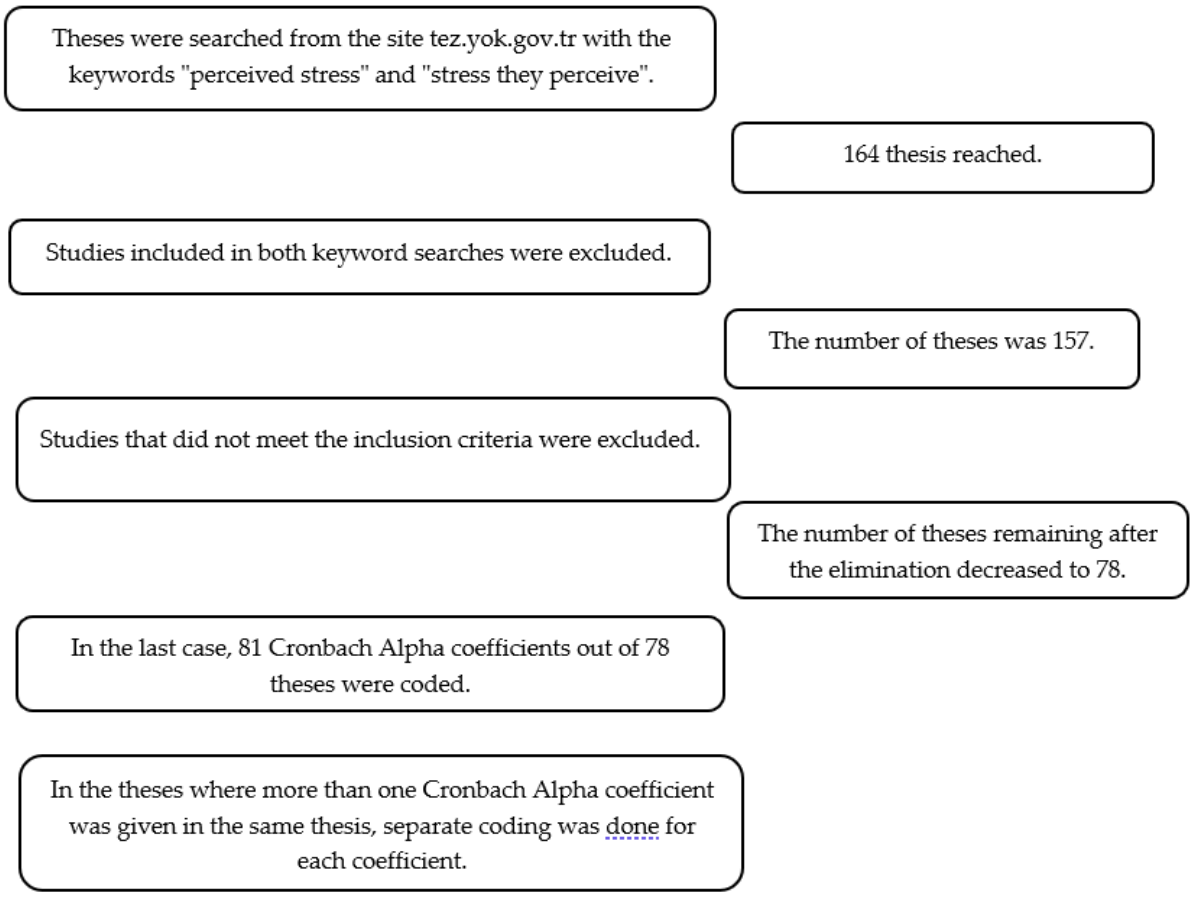

Figure 1. Meta-Analysis stages of studies on perceived stress

The Process of Coding Study Variables

During the evaluation process, data were collected and compared according to the desired criteria in 25 of 78 studies, which is more than 30% of the studies (Şen, 2018). The aim of this process is to examine whether there is agreement between raters. Table 1 and Table 2 display the cross tabulation values and fit statistic values.

Table 1.
Crosstabs between raters

			Rater 2		Total
			0	1	
Rater 1	0	N	14	0	14
		% within Rater 1	100%	0%	100%
		% within Rater 2	93,3%	0%	100%
		% of Total	56%	0%	56%
	1	Count	1	10	11
		% within Rater 1	9,1%	90,9%	100%
		% within Rater 2	6,7%	100%	44%
		% of Total	4%	40%	44%
Total		Count	15	10	25
		% within Rater 1	60%	40%	100%
		%within Rater 2	100%	100%	100%
		% of Total	60%	40%	100%

According to Table 1, rater 1 and rater 2 scored 14 of the 25 studies jointly as "0" and 10 studies jointly as "1". There was disagreement on only one study. The Cohen's Kappa statistic is presented in Table 2.

Table 2.
Cohen's Kappa statistic value

	Value	Asymp. Std. Error	Approx. T	Approx. Sig.
Measure of Agreement Kappa	.92	.08	4.61	.00
N of Valid Cases	25			

Cohen's Kappa Statistic (1960) was used for the percentage of agreement between raters. Accordingly, Cohen's Kappa coefficient was found to be 0.92. This value indicates almost perfect agreement (Landis & Koch, 1977). Following the high agreement values, the variables of interest in all studies were coded. Table 3 displays the descriptive statistics of the studies.

Table 3.
Descriptive statistics of the variables included in the study

Descriptive Variables	Categories	Number of Studies	Number of Cronbach Alpha
Sample Size	<250	39	42
	>250 range <500	29	29
	>500	10	10
Gender	Male/Total	78	81
Number of Items	0-1 range 14	55	56
	10	19	21
	8	4	4
Type of Sample	Student	25	25
	Hospital Staff	18	19
	Individual	26	26
	P-P (Patient or Pregnant)	9	11
Field of Study	Education	14	14
	Health	27	30
	Psychology	26	26
	Business	4	4
	Sport	4	4
	Human Resources	3	3
Publication Year	2005-2010	4	4
	2011-2015	6	6
	2016-2021	68	71
Age of Participants	16-20	10	10
	21-30	27	30
	Over 30	26	26
Type of Thesis	Master	62	63
	Doctoral	12	14
	Medical Specialty	4	4
Total		78	81

Studies were divided into three categories based on sample sizes: small sample (250 or less), medium sample (between 251-500), and large sample (over 500). All of the scales used in the studies belong to Cohen et al. (1983) and forms of the scale consisting of three different numbers of items (14-10-8) were used. The sample of the studies was categorized as students (high school and university), hospital staff

(doctors, nurses, hospital attendants), individuals (teachers, architects, lawyers, parents, patient relatives, etc.), and P-P (patients and pregnant women). A separate category was created because it was thought that the stress experienced by the people in the category called P-P would be different from other individuals, considering their diseases or pregnancy status. This is because pregnancy, which is considered a physiological event, is a source of intense stress for women during the reproductive period (Özkan et al., 2013). Also, Cohen et al. (1983), it was revealed that social tension, depressive disorders, vital events and physical symptoms affect perceived stress. The gender variable was calculated using the overall sample proportion of men. The fields of the studies examined, education, health, psychology, business, sports sciences, and human resources. The publication years of the studies were divided into three categories, with an interval of six years. The reason for separating the years in this way is the wide range of years (17 years) and the fact that the years in which the scale was translated into Turkish were firstly between 2006-2010 and secondly between 2011-2015. The mean ages of the samples in the studies were divided into three categories: 16-20, 21-30 and over 30. The reason for dividing the ages in this way is that the scale is considered as the beginning of high school and early university (16-20), young adulthood (21-30) (Santrock, 2006) and middle age and above (30+) (Boyd & Bee, 2014). Studies were divided into three categories according to the type of thesis: master's, doctoral and medical specialty.

Data Analysis

Considering the argument about the sample-specific nature of reliability, the variation in reliability estimates between studies using the same reliability coefficient can be explained by variation in sample structures or scale forms. Therefore, some sample structures or scale forms may produce higher reliability estimates than others, resulting in differences in reported reliability coefficients between studies. (Vassar & Bradley, 2010). RG is a meta-analytical strategy used to discover variances in reliability coefficients between studies and to identify study variables that may account for such differences. Various techniques have been used for data analysis in RG studies (Vacha-Haase, 1998; Rouse, 2007). In this study, as in many other studies (Aguayo et al., 2011; Allan, 2021; Hongyan et al., 2015; Nicolas et al., 2021; Özdemir et al., 2020; Rouse, 2007, etc.), the Cronbach Alpha coefficients of the studies to be examined were collected. A typical study that measures only a random sample of the universe would include a sampling error in the Alpha coefficient of unknown magnitude and direction (Bonett, 2002). For this reason, instead of using the Alpha coefficient directly in the study, it was converted to other coefficients. The most commonly used of these methods are conversion to Fisher's Z, Hakstian-Whalen and Bonett coefficients. While some of the studies (Beretvas et al., 2002) emphasized the necessity of transforming the Alpha coefficient, it was stated that there was no need to transform the Alpha coefficients in some of the studies (Henson& Thompson, 2002; Thompson& Vacha-Haase, 2000).

For alpha coefficients, Hakstian-Whalen and Bonett transforms are better than Fisher's Z. The Hakstian-Whalen transform normalizes the distribution of the reliability coefficients. However, on a theoretical basis, the Bonett method is a better Alpha coefficient transformation, since the method proposed by Bonett (2002) can normalize the distribution of the Alpha coefficients and fix their variances (Sen, 2021b).

In the study, the Bonett transform was applied to the Alpha coefficients obtained from the studies. In addition, analyzes of the 14-10 and 8-item forms of the PSS were combined. This is because, when the adaptation studies of the scales and their items were examined, the explained variance was found to be similar, and the shorter scale forms were obtained by removing items from the 14-item form. In addition, in studies in which scales with different numbers of items in an analysis were used, it was thought that the number of items in the scales could be moderator variables, and the number of items was included in the moderator analyzes.

The two methods used to obtain the effect size in the meta-analysis are the fixed effects and random effects models. In the fixed-effects model, heterogeneity between studies is low, and variation arises only from the sample participating in the studies. The random effect model, on the other hand, is a model in which the variance between studies is high, and the effect sizes estimated as a result of the meta-analysis are obtained as the average of the differing effect sizes in all studies. In addition, if the model is random at one level and fixed at the other level, this model is called a mixed effects model (Borenstein, 2019). In the random effects model, the variance may also be caused by factors other than the participants in the studies (Sen,2018). Field and Gillett (2010) stated that using the random effects model makes more sense than using the fixed effects model. Since the studies used in the research have different characteristics (sample, field, age, etc.), the random effects model, which assumes that the variance between studies is estimated greater than zero, was used. The heterogeneity of the Alpha coefficient was evaluated by calculating the I2 value as a function of the Q statistic. The Q statistics were applied to test the homogeneity assumption between the alpha values. While the I2 statistic is a possible measure of the amount of heterogeneity according to Higgins and Thompson (2002), Borenstein (2019) stated that the I2 statistic does not tell the researcher how much the effect size varies but provides information about the relationship between two distributions. It can be said that I2 values of approximately 25%, 50% and 75% reflect low, medium and large heterogeneity, respectively (Huedo-Medina et al., 2006).

Before interpreting the obtained effect size conclusions, Bonett-transformed values were converted back to Alpha coefficients. The impact of moderator variables on the variability of the reliability estimates was assessed using analog ANOVA and meta-regression. The moderator variables—sample size (≤250, 251-500, >500), number of items (14, 10, 8), type of sample (students, hospital staff, individuals, P-P), field of study (education, health, psychology, business, sports, human resources), publication year (2005-2010, 2011-2015, 2016-2021), age (16-20, 21-30, >30), and type of thesis (master's, doctoral, medical specialty)—were analyzed using analog ANOVA, while the gender ratio (number of men/sample size) was analyzed using meta-regression. Finally, analyzes were made using fail-safe N method, Orwin's fail-safe N (Orwin, 1983), Begg and Mazumdar's rank correlation test (Begg & Mazumdar, 1994), Duval and Tweedie's Trim and Fill method (Duval & Tweedie, 2000), Egger's regression test (Egger et al., 1997), and funnel plot methods to examine publication bias.

Fail-Safe N aims to provide assurance that the results are not entirely an artifact of publication bias. The fact that the p-value for Fail-Safe N is smaller than the alpha value ($p<0.001$) indicates that the study is a strong study with low reliability (Borenstein, 2019; Eser & Doğan, 2023). Begg and Mazumdar suggested calculating the rank correlation between precision and effect size. A statistically significant correlation indicates that the average effect size is larger in small studies. The Trim and Fill method presumes that area studies are missing due to publication bias. It creates these studies, adds them to the analysis and runs the analysis using the original and assigned studies to obtain an adjusted mean. If the p-value obtained from Egger's regression test is lower than the alpha level ($p<.05$), it indicates the presence of publication bias. (Borenstein, 2019, Şen & Yıldırım, 2020). CMA package program was used for statistical analyses.

Results

The descriptive statistics of the different item numbers in the scales for the 81 Alpha coefficients of the 78 theses examined within research scope are given in Table 4. Values for each scale were calculated separately, and then overall values were obtained for all studies.

Table 4.
Descriptive statistics of the theses examined within the research scope

	Number of Cronbach' α	Mean Cronbach' α	Lower 95% CI	Upper 95% CI	Min	Max
PSS-14	56	.80	.78	.82	.60	.97
PSS-10	21	.83	.81	.84	.76	.88
PSS-8	4	.78	.71	.85	.66	.86
Total	81	81	.79	.82	.60	.97

According to Table 4, PSS-14 was included in 56 studies and had Cronbach alpha values between .60-.97. These values are the lower and upper limits in all studies. PSS-10 was used in 21 studies and values between .76-.88 were obtained. PSS-10 had the highest lower and upper limit values. PSS-8 was used in only 4 studies and had the lowest mean alpha value and the lowest lower limit value. The stem-and-leaf plot of the Alpha coefficients obtained from the studies is as in Figure 2.

```
 Frequency   Stem & Leaf

    2,00 Extremes    (=<,61)
    4,00      6 .  6789
    9,00      7 .  112223344
   19,00      7 .  5555667888888899999
   22,00      8 .  0011112222334444444444
   19,00      8 .  5555666677777777899
    5,00      9 .  00111
    1,00      9 .  7

 Stem Width:      ,10
Each Leaf:       1 case
```

Figure 2. Stem-and-leaf plot of studies

According to the stem-and-leaf plot, the distribution appears to be close to normal (slight negative skew (left-skewed)) and the density is concentrated in the .80-.85 range, with 22 studies. Descriptive statistics of the theses including mean, standard deviation, skewness and kurtosis values are given in Table 5.

Table 5.
Descriptive Statistics of Studies

	N	Mean	SD	Skewness		Kurtosis	
PSS	81	.81	.07	Statistic	Std. Error	Statistic	Std. Error
				-.61	.28	.46	.53

According to Table 5, the mean alpha coefficient of 81 studies is .81 and the standard deviation is .07. An analysis of the skewness and kurtosis values reveals that the distribution of Alpha coefficients is slightly left-skewed (negatively skewed). Table 6 presents the descriptive statistics for the general and moderator variables converted into Bonett coefficients, as well as the values converted back into Alpha coefficients. It also shows the lower and upper limits, and the minimum and maximum values of the Alpha coefficients for the studies analyzed within the scope of the research.

Table 6.
Reliability estimates of PSS across studies for different moderator variables

			%95 Confidence Interval			
Moderator Variables	Mean Effect Size	Bonett	Lower Bound	Upper Bound	Minimum	Maximum
Sample Size						
<250	.83	-1.77	.80	.85	.68	.97
250-500	.81	-1.65	.78	.83	.60	.87
>500	.81	-1.66	.76	.85	.66	.87
Number of Items						
14	.82	-1.69	.79	.84	.60	.97
10	.83	-1.78	.82	.85	.76	.87
8	.79	-1.56	.68	.86	.66	.86
Type of Sample						
Student	.83	-1.76	.80	.85	.67	.91
Hospital Staff	.82	-1.71	.79	.85	.66	.89
Individual	.82	-1.72	.78	.85	.60	.97
P-P	.78	-1.52	.76	.80	.72	.87
Field of Study						
Education	.82	-1.69	.78	.85	.67	.87
Health	.81	-1.67	.79	.84	.66	.91
Psychology	.84	-1.82	.82	.86	.68	.91
Business	.86	-1.94	.63	.95	.71	.97
Sport	.70	-1.21	.65	.75	.60	.74
Human Resources	.79	-1.56	.67	.87	.68	.86
Publication Year						
2005-2010	.83	-1.78	.82	.85	.81	.84
2011-2015	.83	-1.79	.80	.86	.76	.87
2016-2021	.82	-1.70	.80	.83	.60	.97
Age of Participants						
16-20	.81	-1.68	.77	.85	.67	.87
21-30	.82	-1.73	.80	.84	.60	.91
over 30	.81	-1.67	.80	.84	.69	.91
Type of Thesis						
Master	.82	-1.72	.71	.89	.61	.97
Doctoral	.79	-1.58	.74	.84	.60	.84
Medical Specialty	.83	-1.77	.67	.91	.69	.88
Total	.82	-1.71	.80	.83	.60	.97

In Table 6, the statistical values of the moderator variables and the mean effect size coefficient for the total PSS scores are presented in the bottom line. While the mean effect size coefficient of the PSS is .82, the lower bound is .80 and the upper bound is .83 in the 95% confidence interval. In parallel, the scores of the studies ranged between .60 and .97 in reliability. The mean effect size values of the studies divided into three categories according to the sample size are between .81 and .83. The mean effect size values of the item numbers of the scales used in the studies are between .79 and .83. The mean effect size values of types of samples of the studies are between .78 and .83. The mean effect size values of the fields of the studies are between .70 and .84. The mean effect size values of the studies divided into three categories according to the publication years are between .82 and .83. The ages of the participants in the studies were divided into three categories and the mean effect size values of these categories were between .81 and .82. According to the type of studies, the mean effect size values are between .79 and .83.

The heterogeneity of the effect size values of the reliability coefficients within the research scope was analyzed through the Q and I2 statistics and the forest plot. The Q statistic for the effect sizes $Q(80) = 1543.26$, $p < .01$ was found to be statistically significant. The I2 value of the effect sizes was found to

be 94.82. If this value is close to 0, it indicates low heterogeneity, and if it is close to 1, it indicates high heterogeneity. (Şen &Yıldırım, 2020). In addition, the forest plot of the studies examined within the scope of the research is given in Figure 3.

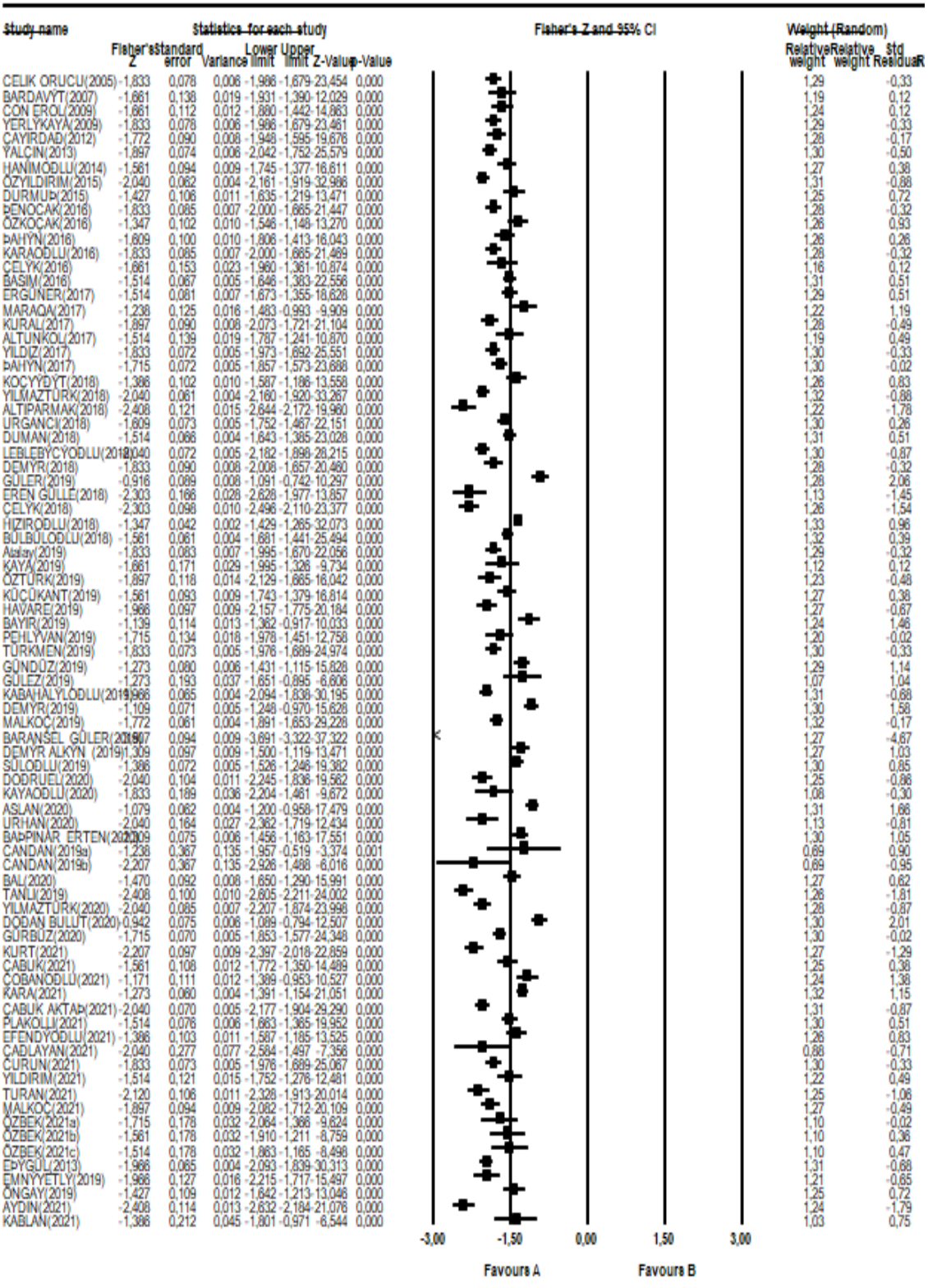

Figure 3. Forest plot of studies

Given that the results of the analysis indicate that there is heterogeneity across studies that is worth examining, the sources of heterogeneity need to be explained. For this reason, Analog ANOVA and meta-regression analyses were performed on moderator variables to determine possible causes of heterogeneity between effect sizes. Analogue ANOVA tests the homogeneity of effect sizes for subcategories of a categorical variable and the differences between categories (Lipsey & Wilson, 2001). When analyzing the results, a significance level of $p < .05$ is used. If $p < .05$, the moderator variable is considered a source of heterogeneity; otherwise, it is not. Table 7 displays the analysis results for the sample size moderator variable.

Table 7.
Analog ANOVA results of the sample size variable

Model	Sample Size	Q	df(Q)	p-value
Fixed Effect	<250	733.86	41	.00
	250-500	437.93	28	.00
	>500	311.69	9	.00
	Total within	1483.47	78	.00
	Total between	59.95	2	.00
	Overall	1543.43	80	.00
Mixed Effect	Total between	1.61	2	.45

When Table 7 is examined, it is observed that the p-value is greater than .05 according to the mixed effects model, indicating that the sample size moderator variable is not a source of heterogeneity. Table 8 displays the results of the Analog ANOVA, where the heterogeneity of the number of items in the scales is examined as a moderator variable.

Table 8.
Analog ANOVA results of the number of items variable

Model Type	Number of Items	Q	df(Q)	p-value
Fixed Effect	14	1284.66	55	.00
	10	111.21	20	.00
	8	50.85	3	.00
	Total within	1446.72	78	.00
	Total between	96.71	2	.00
	Overall	1543.43	80	.00
Mixed Effect	Total between	1.92	2	.38

According to the results in Table 8, it was determined that the p-value was greater than .05 in the mixed effects model and the moderator variable of the item numbers of the scales was not a source of heterogeneity. Table 9 displays the results of Analog ANOVA in which the heterogeneity of types of samples included in the studies was examined as a moderator variable.

Table 9.
Analog ANOVA results of types of samples variable

Model Type	Types of Samples	Q	df(Q)	p-value
Fixed Effect	Individual	809.11	25	.00
	Hospital Staff	250.46	18	.00
	P-P	16.76	10	.08
	Student	441.14	24	.00
	Total within	1517.46	77	.00
	Total between	25.96	3	.00
	Overall	1543.43	80	.00
Mixed Effect	Total between	9.71	3	.02

When Table 9 is examined, it is observed that the p-value is less than .05 according to the mixed effects model and the types of samples moderator variable is one of the sources of heterogeneity. The results of the Analog ANOVA, where the heterogeneity of the fields of the studies was examined as the moderator variable, are presented in Table 10.

Table 10.
Analog ANOVA results of the fields of the studies variable

Model Type	Field of Study	Q	df(Q)	p-value
Fixed Effect	Education	244.69	13	.00
	Human Resources	30.74	2	.00
	Business	379.09	3	.00
	Psychology	265.38	25	.00
	Health	349.18	29	.00
	Sport	19.17	3	.00
	Total within	1288.25	75	.00
	Total between	255.18	5	.00
	Overall	1543.43	80	.00
Mixed Effect	Total between	37.89	5	.00

According to the results in Table 10, the p-value was found to be less than .05 in the mixed effects model, indicating that the study fields moderator variable was a source of heterogeneity. In Table 11, the results of the analysis of the moderator variable of the publication years of the studies are given.

Table 11.
Analog ANOVA results of publication year variable

Model Type	Publication Year	Q	df(Q)	p-value
Fixed Effect	2005-2010	2.79	3	.43
	2011-2015	39.20	5	.00
	2016-2021	1460.22	70	.00
	Total within	1502.21	78	.00
	Total between	41.21	2	.00
	Overall	1543.43	80	.00
Mixed Effect	Total between	1.74	2	.42

According to the results in Table 11, the p-value was found to be greater than .05 in the mixed effects model, indicating that the publication years of the studies were not a source of heterogeneity as a moderator variable. While the gender of the participants in the studies was used as a moderator variable, the results obtained by taking the ratio of male participants to all participants were analyzed by meta-regression analysis. Table 12 displays the results of the meta-regression analysis.

Table 12.
Meta-Regression analysis results for the gender moderator variable based on the mixed effects model

	Coefficient	Std. Error	95% Lower	95% Upper	Z-value	p-value
Intercept	-1.68	.09	-1.85	-1.51	-19.3	.00
Gender(male%)	-0.05	.20	-.43	.34	-.23	.82

When the results in Table 12 are examined, it is observed that the p-value is greater than .05 in the mixed effects model, indicating that the gender of the participants is not a source of heterogeneity as a moderator variable. Table 13 presents the results of Analog ANOVA, in which the heterogeneity of the age of the participants of the studies was examined as a moderator variable.

Table 13.
Analog ANOVA results for the age variable

Model Type	Age of Participants	Q	df(Q)	p-value
Fixed Effect	16-20	147.98	10	.00
	21-30	418.17	29	.00
	Over 30	347.03	25	.00
	Total within	913.18	63	.00
	Total between	.82	2	.66
	Overall	914.01	65	.00
Mixed Effect	Total between	.47	2	.79

When the results in Table 13 are examined, it is seen that the p-value is greater than .05 in the mixed effects model and the moderator variable of the participants' age is not a source of heterogeneity. Table 14 presents the results of Analog ANOVA, in which the heterogeneity of the types of theses is examined as a moderator variable.

Table 14.
Analog ANOVA results of types of theses variable

Model Type	Type of Thesis	Q	df(Q)	p-value
Fixed Effect	Master	1295.14	62	.00
	Doctoral	108.26	13	.00
	Medical Specialty	51.03	3	.00
	Total within	1455.43	78	.00
	Total between	98.80	2	.00
	Overall	1554.23	80	.00
Mixed Effect	Total between	1.91	2	.52

When the results in Table 14 are examined, it is observed that the p-value is greater than 0.05 in the mixed effects model and the moderator variable of the theses is not a source of heterogeneity. Within the scope of the research, the generalization of reliability was conducted using theses from Türkiye with the PSS developed by Cohen et al. (1983). Since the majority of published studies have high or significant effect sizes, conducting a meta-analysis solely on these studies may lead to publication bias. Therefore, publication bias analysis was performed. Funnel plot was examined for publication bias, then Egger's regression test, Duval and Tweedie's Trim and Fill method, Begg and Mazumdar's rank correlation test, Orwin's safe N and fail-safe N methods and p curve analysis were used. In the fail-safe N method, assuming that the main effect of the additional studies is zero, the number of studies needed to render the p-value insignificant is calculated, and this number is referred to as the safe N. If only a few studies are required, there may be concern that the effect is actually zero. (Borenstein et al., 2013). With this method, N number at $p < .01$ level was calculated as 13740. In Orwin's safe N method, the N value is 9114. The funnel plot asymmetry is shown in Figure 4.

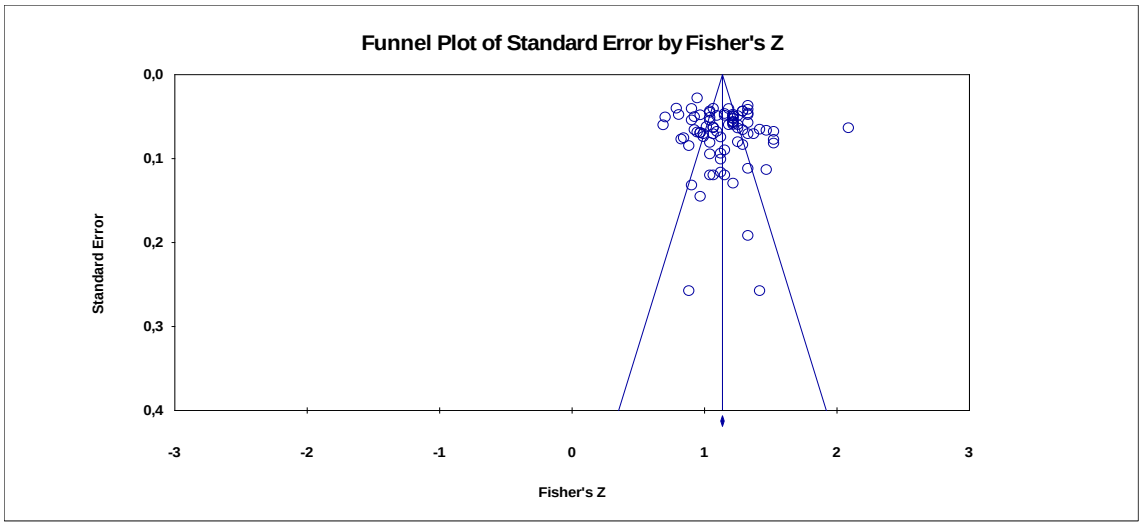

Figure 4. Funnel plot of effect sizes

If there is no publication bias, studies will be distributed symmetrically according to the mean effect size as the sampling error is random (Borenstein et al., 2013). Although the studies appear to be symmetrically distributed on both sides of the effect size, the interpretation is not entirely objective. According to the results of Egger's regression test, the regression cut-off point (intercept) was not significant (cut-off point = 1.230, p = 0.31). This indicates that the regression constant does not deviate significantly from zero. Begg and Mazumdar's rank correlation test also contributed to other results. Accordingly, Kendall's tau value is not significant (Kendall's tau = 0.004, p = 0.96). Finally, the Duval and Tweedie Trim and Fill test found no difference between the observed effect size and the adjusted effect size created to correct for publication bias. As a result of the general symmetrical distribution of the studies performed on both sides of the overall effect size, the difference was found to be zero. According to the results obtained from the analysis of all publication bias, it can be said that there is no evidence of publication bias in the studies. The p-curve represents the distribution of statistically significant p-values ($p < .05$) across a set of studies (Simonsohn et al. 2014). The p-curve visual is given in Figure 5.

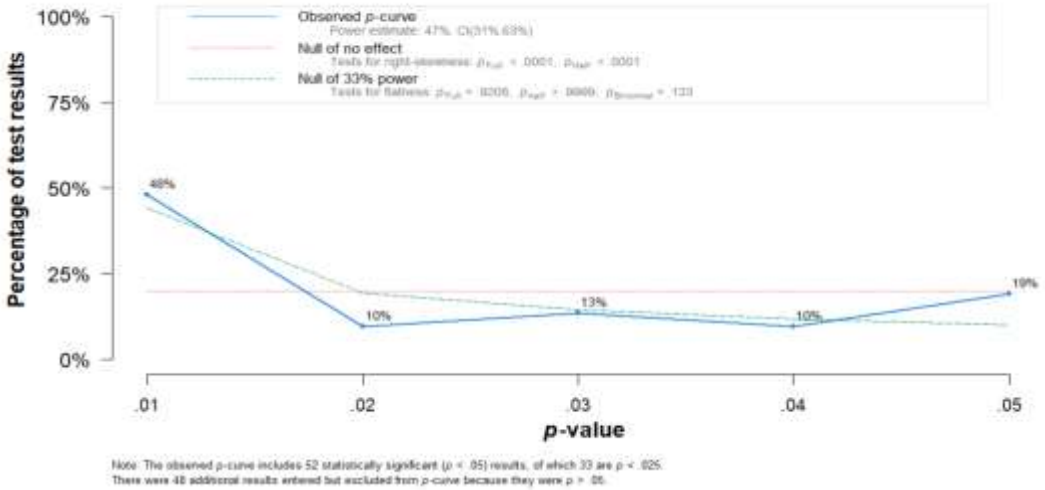

Figure 5. p-curve plot

The p-curve output was interpreted as another analysis to examine publication bias. The p-curve given in Figure 5 contains 52 studies at the $p < 0.05$ significance level, 33 of which have a $p < 0.025$ significance level. Since the p-values of 48 studies was greater than 0.05, these studies were not evaluated. The blue line represents the p-curve with a 48% power estimate. The sharp drop in the p-curve and the concentration of results at lower p-values, together with the statistical tests, indicate that the effects seen in the studies are real and not due to randomness or publication bias. However, the drop in the figure is not sharp and gives an indication that publication bias may be present.

Discussion

In this study, a meta-analytic reliability generalization analysis was conducted. Additionally, it was investigated whether the Cronbach's Alpha coefficient was influenced by sample size, number of items in the scale, sample type, field of study, year of publication, gender, age and type of thesis. The results of this study showed that the average Cronbach's Alpha coefficients obtained from the PSS were at an acceptable level. The fact that these coefficients are generally high can be considered as an indicator of the usability of the scale by both practitioners and researchers. With RG, the average reliability coefficient of the studies can be calculated and the moderator variables that will reveal the variability between the studies can be determined. In this context, RG studies of Maslach Burnout Inventory (MBI) and Beck Depression Inventory-II (BDI), which are similar to PSS, were examined and reliability coefficients and moderator variables that may cause variability in these coefficients were compared. RG studies of Maslach Burnout Inventory were conducted by Alenezi (2023), Wheeler et al. (2011) and Aguayo et al. (2011). In these studies, the mean reliabilities of the sub-dimensions of the scales (Emotional Exhaustion, Depersonalization and low Personal Accomplishment) were found to be .83, .78 and .77 by Alenezi (2023), .87, .71 and .76 by Wheeler et al. (2011) and .88, .71 and .78 by Aguayo et al. (2011) respectively. The reliability coefficients of the original scale are .89, .77 and .74. The RG study of the BDI-II was conducted by Eser and Aksu (2021). In this study, the average reliability coefficient of the studies was found to be .90. The reliability coefficient of the original scale is .92. The average reliability coefficient obtained from three different forms of PSS in this study is 0.81. The reliability coefficient of the original scale is .84. Accordingly, the average reliability coefficients of the PSS and the other two scales are close to the reliability coefficients of the original scales. However, the high reliability coefficients of all three forms of the PSS provide an advantage over the others. It was found that there was heterogeneity in the studies included in the research and as a result of the investigation of the sources of this heterogeneity, it was concluded that two of the eight moderator variables (type of sample and field of study) were the source of heterogeneity.

The structure that PSS tries to measure is stress, and it has been stated in the literature that patients and pregnant women in the P-P category in the type of sample moderator variable experience more stress than other individuals. Therefore, careful consideration is required when selecting samples for studies using the PSS. Özdemir et al. (2020) found the type of sample as a source of heterogeneity in their reliability generalization study for the short and long forms of the Oxford Happiness Scale. The type of sample was found to be a source of heterogeneity in Alzahrani's (2016) thesis in which he conducted a generalization study of reliability to the Brief Symptom Inventory-18 scale. In the reliability generalization studies of Alenezi (2023) and Aguayo et al. (2011) on the Maslach Burnout Inventory (MBI), the sample type was again identified as a source of heterogeneity. Field of study is another variable that may cause heterogeneity when using the PSS. Lower effect size values were obtained than other fields in sports sciences and human resources management in this research. Similarly, Özdemir et al. (2020) and Wheeler et al. (2011) identified field of study as a source of heterogeneity.

In addition, it was concluded that the variables of sample size, gender, age, publication year, type of thesis and number of items in the scale were not sources of heterogeneity in the scope of PSS. Eser and Aksu (2021) found that none of the moderator variables (gender, publication year, type of sample and language) had an explanatory role in the reliability generalization study of Beck Depression Inventory II. In the reliability generalization study by Vassar and Crosby (2008) on the UCLA Loneliness Scale, study type was identified as a source of heterogeneity. Özdemir et al. (2020) found the moderator variable as a source of heterogeneity. In the study of Alzahrani (2016), the gender variable was found

as a source of heterogeneity. In the reliability generalization study of Hongyan et al.'s (2015) 44-item Big Five Inventory, gender, age, sample size and nationality of the participants were found to be sources of heterogeneity. In the study of Aguayo et al. (2011), the country where the study was conducted, the age of the participants, the language, and the type and version of the inventory were found to be sources of heterogeneity. Sample size, age and geographical region were found to be sources of heterogeneity in Allan's (2021) thesis in which she examined the validity and reliability generalization of the Adult Characterological Measurement of Resilience. In addition to the moderator variables examined, the moderator variables varied depending on the scale or inventory examined in different studies. For example, in Esparza-Reig et al. (2021) reliability generalization study of the South Oaks Gambling Screen, the continent where the study was conducted, the data collection method (face to face-others) and clinical conditions moderator variables were found to be sources of heterogeneity. Vassar and Crosby's (2008) study found that the moderator variables of adolescence and social network disconnection are sources of heterogeneity. Vassar and Bradly (2010) found that the moderator variables of language and adolescence are the source of heterogeneity as a result of the reliability generalization they conducted in their research on the Life Orientation Test.

Since the number of items in the scale was not found to be a source of heterogeneity, researchers using the PSS can choose any form (14, 10, or 8 items). A similar conclusion applies to the sample size, gender, and age variables. However, the results in this study were obtained specific to the conditions in the theses examined. Therefore, the results should be considered within the scope of the examined studies, and researchers using the PSS should calculate and interpret reliability based on their own data. In addition, PSS is a scale that is used quite frequently in studies, and for this reason, it is very difficult to address all the studies that include PSS for the RG study. To overcome this situation, only theses were used within the scope of the study. To improve the representativeness of the dataset in an RG study, the scale selected for reliability analysis should have a sufficient number of studies—neither too many nor too few—to allow for generalizations. In addition, in the selection phase, papers can also be included in the scope of the studies to be analyzed. In conclusion, this study of the theses using the PSS demonstrates that the PSS is a reliable scale that can be generalized to different contexts. In the light of these findings, PSS can be used effectively regardless of age range, gender, thesis type, sample size (provided that it is not too small to affect the reliability coefficient) and number of items (8-10-14).

Within the scope of the study, in addition to master's and doctoral dissertations, only medical specialty studies (four) were used within the scope of gray literature sources in the thesis center. The reason for this can be said to be the high number of studies using PSS as mentioned before. In this study eight moderator variables that could be a source of heterogeneity for the theses made using PSS (improved by Cohen et al. (1983)) were examined and the Cronbach Alpha coefficients were transformed with the Bonett method and included in the analysis. In sample selection, it should be realized that the perceived stress levels of patients and pregnant women are higher than other individuals, and research should be conducted by knowing that perceived stress differs in the fields of sports sciences and human resources compared to other fields. Because these variables may change the reliability coefficient of PSS in the studies in which they are included. Unlike PSS, prenatal perceived stress scale can be used for clinical situations such as the effect of prenatal stress perceived by pregnant women on the mother's attachment to the fetus or marital adjustment (Çalışkan Altıntaş, 2024; Yüksel, 2024). However, PSS can be used in studies conducted for individuals with obsessive disorders, bipolar disorders, etc. (Acar, 2024; Toprak, 2023). Nevertheless, in recent years, studies conducted on different samples such as law enforcement officers, refugees and people with post-covid trauma disorders can be examined and the type of sample can be expanded. In studies conducted for patients, the type of disease can be considered as a source of heterogeneity. Because differences in the recovery of diseases may affect perceived stress. In addition, in future studies in this field, variables such as the language in which the scales are applied, ethnicity if different, marital status according to the group to which the scales are applied and research design can be examined by identifying them as different sources of variability. Lastly in future studies, reliability coefficients can be analyzed using different transformation methods, such as the Hakstian-Whalen method.

Declarations

Conflict of Interest: No potential conflict of interest was reported by the authors.

Author Contribution: Ömer DOĞAN: conceptualization, investigation, methodology, data curation, writing - review & editing, visualization. Selahattin GELBAL: conceptualization, supervision, formal analysis, review & editing.

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Consent to Participate: All authors have given their consent to participate in submitting this manuscript to this journal.

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