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Psychometric properties of the 7-item Generalized Anxiety Disorder Scale (GAD-7) in a large representative sample of Finnish adolescents

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ABSTRACT

Symptoms of generalized anxiety disorder (GAD) are common among adolescents and can lead to severe psychosocial impairment, yet there is a lack of a good quality scale to measure symptoms of generalized anxiety in young people. The 7-item Generalized Anxiety Disorder Scale (GAD-7) is a self-report scale used to measure GAD symptoms and has been validated in adult populations, but the measure's psychometric properties regarding adolescents are unknown. The aim of this study was to investigate the reliability, factorial validity, and construct validity of the GAD-7 in adolescents in a nationally representative sample from a general population. Our study was based on Finnish survey data on 111,171 adolescents aged 14–18 years. Our results show that the GAD-7 demonstrates good psychometric properties in adolescents. The internal consistency of the GAD-7 was good (Cronbach's $\alpha = 0.91$) and the instrument's unidimensional factor structure was supported. The associations of GAD-7 sum scores with self-report measures of depression and social anxiety supported construct validity. The psychometric properties of the GAD-7 in this sample of adolescents were similar to those reported among adults. However, studies in which diagnostic interviews are performed are needed to demonstrate the diagnostic efficacy of the measure in this age group.

1. Introduction

The DSM-5 diagnostic criteria for generalized anxiety disorder (GAD) include clearly excessive, uncontrollable, and often irrational anxiety and worry of a duration of at least 6 months (American Psychiatric Association, 2013). Worrying is often related to everyday matters; in adolescents this can refer to, for example, school performance, uncertain situations, or arriving on time to an event (Wagner, 2001). The lifetime prevalence of GAD has been estimated to be around 3.0% for females and 1.5% for males (Merikangas et al., 2010). In the United States, 2.2% of adolescents meet the criteria for GAD, and the prevalence rates show a modest but consistent increase with age in adolescents aged 13–18 years (Costello et al., 2003; Merikangas et al., 2010). Copeland et al. (2014), however, reported a cumulative prevalence of GAD as high as almost 10% by young adulthood. One fourth of all lifetime cases of GAD start by age 20 years (Kessler et al., 2005). Despite the fairly high prevalence and the psychosocial impairment that can come with GAD, recognition of the symptoms is relatively low, and GAD often remains both undetected and undertreated (Kroenke et al., 2007; Lieb et al., 2005).

In children and adolescents, the most common symptoms of GAD are feelings of tension, apprehension, need for reassurance, and irritability (Wagner, 2001). Unrecognized and untreated GAD in adolescence can have long-term consequences and lead to, for example, poor self-perceived health, high general impairment, and low quality of life in adulthood (Wittchen et al., 2000). GAD in adolescents is often comorbid with depression and social phobia (Masi et al., 1999; Moffitt et al., 2007; Ranta et al., 2009).

The 7-item Generalized Anxiety Disorder Scale (GAD-7) is a brief self-report scale designed to identify probable cases of GAD (Spitzer et al., 2006). It was developed as a screening tool for detecting GAD in primary care patients and has become a widely used measure in adults in many different cultures (Delgadillo et al., 2012; Parkerson et al., 2015). In primary care settings, the GAD-7 has been found to be reliable and valid for adults, with a sensitivity of 89% and specificity of 82% at a cut-point of 10 points in clinical populations (Kroenke et al.,

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2007; Spitzer et al., 2006). This self-report measure has shown significant correlations with other anxiety scales (Beck Anxiety Inventory [$r = 0.72$] and the anxiety subscale of the Symptom Checklist-90 [$r = 0.74$]) (Spitzer et al., 2006). It has been shown to correlate with disability measures in primary care, and can be used to explore the level of disability in patients with GAD (Ruiz et al., 2011).

The GAD-7 has been validated for the general adult population in a nationally representative household survey conducted in Germany (Löwe et al., 2008). Based on that data, the GAD-7 seems to be reliable, unidimensional, and valid in measuring general anxiety in the general population (Löwe et al., 2008). In a heterogeneous psychiatric sample, the GAD-7 performed well as a measure of anxiety symptom severity, but demonstrated poor specificity and a possible two-factor, not one-factor, structure (Beard and Björgvinsson, 2014). However, the GAD-7 has mainly shown good sensitivity, specificity, reliability, and factorial, construct, and concurrent validity in many specific subgroups, such as patients with migraine (Seo and Park, 2015), drug and alcohol users (Delgadillo et al., 2012), elderly people (Wild et al., 2014), and pregnant women (Zhong et al., 2015). The Portuguese version of the GAD-7 showed excellent psychometric properties and was found to be valid in a Portuguese sample (Sousa et al., 2015). The Dutch web-based version of the GAD-7 showed good reliability and validity in the general population (Donker et al., 2011). In Finland, the GAD-7 has proven to be a valid and useful tool for detecting GAD among adult high utilizers of health care (Kujanpää et al., 2014).

Also, a systematic review and diagnostic meta-analysis has shown that the GAD-7 has acceptable psychometric properties in adults (Plummer et al., 2016). Whether the measure works as well and is interpreted in a conceptually similar manner by respondents representing different age groups is still unknown. Although the GAD-7 has been validated in adult population samples and primary care patients, its psychometric properties in younger populations need to be examined since different age groups may not interpret the questionnaire in a similar way. Research by Löwe et al. (2008) generated age- and gender-specific normative data for the GAD-7 for different age groups, including those aged 14–24 years, and provided some evidence of the unidimensionality of the scale in that age group. However, to the best of our knowledge, there is no published research on the psychometric properties of the GAD-7 in a general population sample of adolescents only.

In this study we investigate the reliability, factorial validity, and construct validity of the GAD-7 in adolescents (14 − 18 years old) in a large and representative sample from the general population of Finland. The specific aims were as follows:

1 To examine item characteristics, internal consistency, and factor structure of the GAD-7 in a sample of adolescents.
2 To examine construct validity of the GAD-7 for adolescents by investigating associations between GAD-7 scores and self-report measures of depression and social anxiety. To further examine the psychometric properties of the GAD-7 we also present findings on the convergent and discriminant validity of the GAD-7 in subgroups defined by sex and age.

Construct validity can be conceptualized to consist of both convergent and discriminant validity. We use the term convergent validity to refer to the strength of association between the GAD-7 and a measure of social anxiety, given the fear and physiological arousal-related factors shared in common by the different anxiety disorders. Although generalized anxiety and depression also have in common certain underlying factors, they are differentiated by the underlying factors of hyperarousal (in anxiety) versus low positive mood (in depression). Thus, we use the term discriminant validity to refer to the strength of association between the GAD-7 and a measure of depression. For a full discussion of the constructs, see Cummings et al. (2014).

We expected that our analyses of data from our sample of Finnish adolescents would show the internal consistency of the GAD-7 to be good and for the unifactorial model to be supported. In examining sex and age differences in the GAD-7 scores we expected females to have higher scores since anxiety disorders and symptoms are more common among females than males of this age (Lewinsohn et al., 1998; Merikangas et al., 2010). We also expected to find an increase in GAD-7 scores with age in adolescents aged 14–18, with the youngest group having the lowest scores and the oldest group the highest scores.

2. Material and methods

2.1. Subjects and procedure

The School Health Promotion Study (SHPS) of the National Institute for Health and Welfare is a survey conducted among students aged mainly 14–18 years. The data include students from both compulsory basic comprehensive school in grades 8 and 9, and from noncompulsory secondary education. The latter in Finland encompasses academic education, referred to as upper secondary school (USS), and vocational education or vocational school (VS). Among the students in the study, 8th and 9th graders in basic comprehensive school were mostly aged 14–16 years old, and 1st and 2nd year students in secondary education (both USS and VS) were mostly aged 16–18.

The SHPS is conducted every second year, with the purpose being to examine the health, well-being, and behavior of adolescents. Every municipality in Finland is approached and decides if the schools in the area will participate. Students complete the questionnaire independently and anonymously during a school lesson (45 min) under the supervision of a teacher.

The data used in the current study were collected in April and May 2015. Most of the data were collected online but students in some basic comprehensive schools completed paper surveys with the same questions. Altogether 120,100 adolescents participated (58,078 males and 62,022 females). This number covers 64% of all 8th and 9th graders and 43% of all USS students in Finland (National Institute for Health and Welfare, 2016).

Of the SHPS respondents who reported their age, those who were aged 14–18 years were included in the current study (110,392 adolescents). In addition to that, there were 6676 respondents who did not report their age. For them, age was estimated as the mean of the age of all the students in the same grade (8th graders, 9th graders, first year USS students, second year USS students, first year VS students, and second year VS students, respectively 14.86, 15.86, 16.85, 17.87, 17.24, and 18.04). These adolescents were also included in the study. Thus, there were altogether 117,068 adolescents included.

Of the 14- to18-year old study subjects 5897 (5.04%) were excluded from this study because of missing data (at least one missing value for the 7 questions of the GAD-7, the 3 social phobia questions, or the 2 depression questions). In comparison to subjects without missing data, a one-way analysis of variance showed that the excluded cases had similar distributions by sex ($p = .060$) and age ($p = .152$). Our final sample for analysis included 111,171 adolescents aged 14–18 years.

2.2. Measurements

2.2.1. The GAD-7

The seven items of the GAD-7 ask respondents to indicate how often, over the past 2 weeks, they have been bothered by each of the seven core symptoms of GAD that are presented in Table 2 (Spitzer et al., 2006). The answers are rated on a 4-point scale as 0 (not at all), 1 (several days), 2 (more than half the days), and 3 (nearly every day) (Spitzer et al., 2006). Therefore, GAD-7 sum scores range from 0 to 21. A sum score of at least 10 points is the cut-off point most often taken to reflect at least moderate generalized anxiety (Spitzer et al., 2006). A total score of 15 or more on the GAD-7 represents severe anxiety symptoms (Spitzer et al., 2006). In the SHPS a Finnish translation of the

GAD-7 was used. The translation was undertaken by Finnish psychiatry professionals and has been evaluated as valid for screening for general anxiety among Finnish-speaking people, at least in primary health care (Kujanpää et al., 2014).

2.2.2. The Mini-Social Phobia Inventory

The SHPS respondents completed the Mini-Social Phobia Inventory (Mini-SPIN), a measure of social anxiety disorder (Connor et al., 2001). In the Mini-SPIN, respondents are asked how much, during the past week, they have been bothered by three symptoms of social anxiety: (1) "Fear of embarrassment causes me to avoid doing things or speaking to people," (2) "I avoid activities in which I am the center of attention," and (3) "Being embarrassed or looking stupid are among my worst fears" (Connor et al., 2001). The answers are rated on a 5-point scale as 0 (not at all), 1 (a little bit), 2 (somewhat), 3 (very much), or 4 (extremely). The Mini-SPIN has demonstrated good psychometrics for screening for social anxiety disorder in adolescents from the general population (Ranta et al., 2012). The cut-off point was set at 6 points as this score has been found to have the best diagnostic efficiency, meaning it is the optimal cut-off to use both to identify and rule out the presence of social anxiety disorder (Ranta et al., 2012).

2.2.3. Depression

As an indicator of depression, the survey included a two-item depression module with questions (1) “During the past MONTH, have you OFTEN been bothered by feeling down, depressed or hopeless?” and (2) “During the past MONTH, have you OFTEN been bothered by little interest or pleasure in doing things?” These questions detect most cases of depression and have reasonable validity as a case-finding instrument (Arroll et al., 2003; Whooley et al., 1997). A positive response to either of the two questions has in previous research been shown to have a sensitivity of 96% and a specificity of 57% (Whooley et al., 1997). In this study, a “yes” answer to both of the two questions was considered a possible case of depression, and the depression variable was scored as dichotomous.

2.3. Statistical analyses

Mean scores, item-intercorrelations (Spearman's ρ), and corrected item-total correlations (Spearman's ρ between the respective item and the total score without the respective item) were calculated to investigate item characteristics of the GAD-7. For reliability the internal consistency of the GAD-7 was tested using Cronbach's Alpha. The internal consistency was assessed for the total adolescent population sample, and independently for males and for females, for each of the five different age groups, and for four subgroups based on estimates for the presence and absence of both social anxiety and depression.

The factor structure of the GAD-7 was examined using confirmatory factor analysis (CFA). The unidimensionality of the GAD-7, suggested by a number of studies (Dear et al., 2011; Löwe et al., 2008; Mills et al., 2014; Ryan et al., 2013; Sawaya et al., 2016), was assessed with CFA. In the CFA we used diagonally weighted least squares as this method is designed for ordinal data, is less biased, and is more accurate than the maximum likelihood method (Li, 2016). To assess how well the one-factor CFA model fitted the data, five different criteria were used. The root mean square error of approximation and the comparative fit index were used to assess whether the model was adequate (Browne and Cudeck, 1993; Hu and Bentler, 1999). The relative fit of the model was measured by the comparative fit index and the Tucker Lewis index. The fit between the hypothesized model and the observed covariance matrix was assessed based on the goodness of fit index (GFI) and the adjusted goodness of fit index (AGFI).

We examined GAD-7 scale associations with the Mini-SPIN and with the two-item depression module. We also investigated associations of the GAD-7 scores with sex and age. Partial eta squared (ηp^2) was used for measuring effect sizes.

Table 1
Characteristics of the study sample (n = 111,171).

	%	Sex ratio Male/female (%)	Age, *M*	Age, *SD*
Total sample		48.4/51.6	16.49	1.16
Sex				
Male	48.43		16.48	1.16
Female	51.57		16.50	1.16
Age in years				
14	14.46	49.4/50.6	14.68	0.20
15	20.84	49.0/51.0	15.52	0.30
16	25.75	47.9/52.1	16.51	0.28
17	27.72	48.3/51.7	17.45	0.29
18	11.23	47.7/52.3	18.23	0.24
Social anxiety				
No social anxiety (Mini-SPIN < 6)	78.49	51.7/48.3	16.49	1.16
Social anxiety (Mini-SPIN ≥ 6)	21.51	36.6/63.4	16.51	1.15
Depression				
No depression (depression sum < 2)	78.06	52.5/47.5	16.49	1.16
Depression (depression sum = 2)	21.94	33.9/66.1	16.51	1.16

3. Results

3.1. Characteristics of the sample

The characteristics of our sample are summarized in Table 1. Our sample included 37.5% of all the Finnish adolescents aged 14–18 (Official Statistics of Finland, 2016). The mean age of the adolescents in our sample was 16.49 years (*SD* = 1.16 years). Among them, 11.59% (5.90% of males and 19.93% of females) had a GAD-7 total score of at least 10 points, the cut-point most often used to indicate moderate levels of the symptoms of generalized anxiety. In our study sample, 4.57% of all adolescents (2.30% of males and 6.70% of females) had a total score of at least 15, the cut-point for severe levels of anxiety symptoms.

3.2. Item characteristics, internal consistency, and factor structure

Descriptive characteristics for the individual GAD-7 items are summarized in Table 2, and for the whole scale in Table 3. Mean item scores ranged from 0.45 to 0.72. Corrected item-total correlations were ρ = 0.56 or greater, and intercorrelations between the GAD-7 items ranged from ρ = 0.42 to ρ = 0.72. The mean score of the total GAD-7 was 3.94 (*SD* = 4.67). The internal consistency of the GAD-7 was good in the total sample (α = 0.91) and in all the subgroups, with Cronbach's alpha ranging from 0.90 to 0.92 in the age and sex subgroups.

The one-factor structure of the GAD-7 was supported by the CFA. All seven items were specified as indicators of a single factor. Table 2

Table 2
Characteristics of the GAD-7 items in the adolescent sample (n = 111,171).

No.	Item	*M*	*SD*	Corrected Item-total Correlation	CFA[a] factor loading
1	Feeling nervous, anxious, or on edge	0.68	0.84	0.72	0.87
2	Not being able to stop or control worrying	0.45	0.78	0.70	0.94
3	Worrying too much about different things	0.60	0.83	0.71	0.91
4	Trouble relaxing	0.55	0.82	0.68	0.86
5	Being so restless that it is hard to sit still	0.48	0.79	0.56	0.75
6	Becoming easily annoyed or irritable	0.72	0.88	0.68	0.81
7	Feeling afraid as if something awful might happen	0.46	0.82	0.57	0.77

[a] Confirmatory factor analysis.

Table 3
Internal consistency and GAD-7 sum scores by subgroups.

	Cronbach's Alpha	GAD-7 total score *M*	*SD*	Effect size (ηp^2)
Total sample	0.91	3.94	4.67	
Sex				0.082
Male	0.91	2.56	3.89	
Female	0.90	5.23	4.96	
Age in years				0.003
14	0.90	3.35	4.46	
15	0.92	4.04	4.84	
16	0.91	3.97	4.69	
17	0.91	4.01	4.60	
18	0.91	4.25	4.69	
Social anxiety				0.147
No social anxiety (Mini-SPIN < 6)	0.89	3.00	3.83	
Social anxiety (Mini-SPIN ≥ 6)	0.91	7.35	5.74	
Depression				0.295
No depression (depression sum < 2)	0.86	2.59	3.29	
Depression (depression sum = 2)	0.90	8.72	5.61	

shows the loadings of the seven items on the single factor, with loading values ranging from $\gamma = 0.73$ to $\gamma = 0.94$. In the CFA, the unidimensional model fitted the data quite well. The relative fit of the model, measured by the comparative fit index (0.990) and the Tucker Lewis index (0.986), was very good. Absolute fit of the model, measured by the scaled root mean square error of approximation (0.096; 90% CI: 0.095 − 0.097), was less than ideal. However, based on both GFI = 0.999 and AGFI = 0.996, the fit between the hypothesized model and the observed covariance matrix was good.

3.3. Construct validity and subgroup differences

Increasing scores on the GAD-7 scale were strongly associated with both the Mini-SPIN inventory and the evaluation of depression. The intercorrelation (Pearson's) between the GAD-7 sum score and the Mini-SPIN sum score was $r = 0.46$. The intercorrelation (Spearman's) between the GAD-7 sum score and the dichotomous depression variable was $\rho = 0.50$.

Table 3 shows the association between the GAD-7 sum scores and being in one of the examined subgroups. The subgroup with social anxiety and the subgroup with depression had significantly higher scores than did the subgroups without these comorbidities. There were modest differences in the sum scores between age subgroups as well, with the youngest subgroup having the lowest scores and the oldest subgroup the highest scores, with an effect size of $\eta p^2 = 0.003$. However, there did not seem to be a linear correlation between the GAD-7 total score and age, the intercorrelation being $r = 0.044$.

4. Discussion

In this study we found evidence that the GAD-7 is a reliable self-report measure with good psychometric properties in Finnish adolescents. In keeping with earlier findings on adults, the unidimensional structure of the GAD-7 was supported by the results from CFA. We did not find a linear association between the GAD-7 sum score and age, although scores for the youngest age group (i.e., 14-year-olds) were lower than those of the oldest age group. In accordance with our hypotheses, females had significantly higher GAD-7 scores than did males. In addition to that, the associations of the GAD-7 sum score with self-report measures of depression and social anxiety supported the construct validity of the GAD-7. In a German general population study, the intercorrelation between the GAD-7 and the PHQ-2 depression scale in adults was $r = 0.64$ (Löwe et al., 2008). Our finding was fairly similar to that (0.50).

The psychometric properties of the GAD-7 in this population sample of Finnish adolescents were essentially similar to those reported among adults from various countries. The internal consistency of the GAD-7 has usually been reported in terms of Cronbach's alpha, ranging from about 0.80–0.91 for different groups (Delgadillo et al., 2012; Donker et al., 2011; Parkerson et al., 2015; Sousa et al., 2015; Spitzer et al., 2006; Wild et al., 2014; Zhong et al., 2015). In this research, Cronbach's alpha was at least 0.90 for the total sample, for males, for females, and for all age groups. The internal consistency of the GAD-7 was thus supported among adolescents as well.

The anxiety symptoms described in the GAD-7 seemed to be somewhat more prevalent in our sample of adolescents than in adult general populations. Wong et al. (2014) reported a mean GAD-7 sum score of 4.6 ($SD = 4.6$) in a general population sample of Australian adolescents aged between 14 and 16 years ($n = 976$). These scores are similar to those found in our study.

In a German general population sample of those aged 14 years or older, the GAD sum score mean was found to be 2.95 ($SD = 3.41$) (Löwe et al., 2008). The clearest differences between the mean scores of the German adult sample and in our study were for the items "Becoming easily annoyed or irritable" ($M = 0.46$ and $M = 0.72$, respectively) and "Feeling nervous, anxious, or on edge" ($M = 0.50$ and $M = 0.68$, respectively), which were also the most often reported symptoms in our adolescent sample. The high frequency of these symptoms in adolescents may be related to the fact that irritability is common in adolescence (Stringaris, 2011). The distribution of anxiety symptoms and situations that are related to worrying may be different for adolescents compared to an adult population. However, whether these differences in results are due to different measurement error rates in the GAD-7 across age groups rather than to actual differences in the prevalence of specific GAD symptoms remains unknown.

In this study the convergent validity for the GAD-7 (i.e., the strength of association with the Mini-SPIN) was high, but it was slightly lower than for discriminant validity (the strength of association with the depression measure). Although at first glance these findings might appear even to suggest a lack of construct validity for the GAD-7, they do concur with other researchers' findings of a very strong association between symptoms of generalized anxiety and depression among adolescents (Moffitt et al., 2007), and findings that different types of anxiety (i.e., generalized and social anxiety) may share different underlying, common factors with depression (Cummings et al., 2014). As whole, high correlations between the GAD-7 and the depression measure, as well as between the GAD-7 and the Mini-SPIN as found in the present study, are consistent with empirical findings of high comorbidity between generalized anxiety symptoms and both depression and social anxiety (Moffitt et al., 2007; Ranta et al., 2009). Furthermore, these findings can be interpreted to reflect the complex associations between different types of anxiety and depression in youth: on the basis of prior research correlations of GAD symptoms with symptoms of social anxiety need not to be higher than the correlations between GAD symptoms and depression symptoms merely due to the group labels attached to the main categories of symptoms (i.e., anxiety-related symptoms vs. depression-related symptoms; see Cummings et al., 2014).

An essential strength of this study was a uniquely large sample that was population based and included more than a third (37.5%) of all the Finnish adolescents aged 14–18 years. In a Finnish methodological analysis of the present sample, done by the National Institute for Health and Welfare (Halme et al., 2016), the data were evaluated to be of high quality and representative of the Finnish adolescent population. To our knowledge, this is the first study that has examined the psychometrics of the GAD-7 in an exclusively adolescent sample and this study has the highest number of participants in any validation research done on the GAD-7. This kind of national data offers a good opportunity to make a

cross-sectional assessment of the different aspects of self-reported anxiety. However, the generalizability of the study results to other countries and other ethnic groups is unknown. Caution should be warranted especially when generalizing the findings of this study to non-Western populations (Parkerson et al., 2015).

A central limitation of this study was the lack of diagnosis-specific criterion measures (i.e., assessment of GAD and other anxiety/affective disorders) to assess the criterion validity of the GAD-7. Since structured diagnostic interviews were not conducted, validity analyses were limited and based on self-report only. Nevertheless, the results from this study correspond well with results from earlier analyses of primary care patients and adult populations. Therefore, there is some evidence supporting the conclusion that the GAD-7 may be a valid self-report anxiety measure for adolescent subjects. Nonlinear associations between age and generalized anxiety symptoms in mid-adolescence warrant further study.

The GAD-7 has already been found to have acceptable properties for identifying GAD in adults. It is an important step in validating the measure to demonstrate its measurement properties in adolescents as well. Our research shows promising results regarding the psychometrics of the GAD-7 in adolescents, as this instrument seemed to be a reliable and valid measure in terms of our sample. However, more evidence is needed to assess the accuracy of the questionnaire for use in identifying GAD. This would call for a representative sample to be administered structured interviews that enable diagnostic efficiency statistics to be developed for the instrument. Further adolescent studies are required to evaluate the GAD-7 in detail in clinical and nonclinical settings.

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