Interests and Preferences of Adolescent Students in Greece for Content, Design and Functionality Features of an Innovative Mental Health Application for Anxiety and Depression Symptoms

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Abstract

The purpose of this study is to investigate the interests and preferences of adolescent students for a mental health application for anxiety and depression, given the lack of previous studies. Combining the data of modern international literature and empirical research on the most common mental health problems in adolescence, anxiety and depression, and on the technological interventions in the field of mental health, the study focuses on applications. The findings presented high rates of anxiety and depression in adolescents, especially among girls, and high rates of correlation for these two mental health problems. In addition, adolescents reported some interest for the use of an application for anxiety and depression, which almost doubled with the presupposition of a mental health professional recommendation for this application. High preference was reported for features related to access, reliability, function/content, security, and personalization of the application. Lower preference was reported for features related to the user's social interaction with others (mental health professionals, peers) and for issues regarding the option of concealing the application on the smartphone. A deeper look into these findings revealed differences in the rates of anxiety and depression in relation to the level of interest and preference of the adolescents for some features of the application. Finally, on the basis of the above findings, the design of a mental health application for adolescents with anxiety and depression symptoms, "CALMA", is recommended.

1. Introduction

Adolescence is a developmental transition period of significant changes, which makes it vulnerable to a variety of mental health problems (Blakemore, 2019).

A wealth of research contributes to the fact that anxiety and depression are the most common mental health problems during adolescence (Kalin, 2021; Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012). Depressive and anxiety disorders were found to rank sixth (6th) on the list of diseases associated with disability-adjusted life years (DALYs) at ages 10 - 24 years, and appear to be associated with incidents of self-harm (Vos et al., 2020). A doubling of anxiety and depression levels in adolescence was noted in the COVID-19 period (Racine et al., 2021).

The average age of onset of anxiety disorders is 11 years, with 75% of all anxiety disorders developing by the age of 21 (Rapee, 2014). On the other hand, the onset of depression is typically located around mid to late adolescence (Petito et al., 2020), with symptoms increasing during adolescence and stabilizing during the transition to adulthood (Galambos, Barker, & Krahn, 2006; Galambos, Leadbeater, & Barker, 2004; Ge, Lorenz, Conger, Elder, & Simons, 1994; Kim, Capaldi, & Stoolmiller, 2003).

In terms of transgender differences, girls are more likely than boys to experience anxiety (Kessler et al., 2012) and depressive disorders (Nolen-Hoeksema & Hilt, 2009), as well as related symptoms (McLaughlin & King, 2015; Rudolph, Flynn, & Abaied, 2008).

Similarly, in studies of adolescents in Greece, high rates of depressive symptoms were also observed, especially among girls (Magklara et al., 2015; Zacharopoulou et al., 2014).

It is worth noting that both anxiety and depressive disorders are often comorbid with each other (McLaughlin & King, 2015), and there are shortcomings not only in the diagnosis (Garcia & O'Neil, 2021; Leaf et al., 1996) but also in the treatment of both disorders, as many adolescents do not seek mental health services (Gulliver, Griffiths, & Christensen, 2010). Therefore, finding ways to engage adolescents with professional mental health services and knowledge about mental health seems of utmost importance (Garrido et al., 2019).

As a consequence of the general widespread daily use of digital technologies (Villanti et al., 2016; Wartella, Rideout, Montague, Beaudoin-Ryan, & Lauricella, 2016) and the Internet by adolescents (Keeley & Little, 2017), one of the recent strategies to overcome this barrier is online mental health services (Sweeney, Donovan, March, & Forbes, 2019), with their effectiveness in a variety of mental health issues highlighted by several studies (Donovan & March, 2014; Ebert et

al., 2015; Reyes-Portillo et al., 2014). Complementarily, "e-health" has been proposed by the World Health Organization (WHO) as a strategy to strengthen health services (Huang et al., 2019).

In this context, there has been a significant increase in the release of mental health apps that successfully assist in the diagnosis, assessment and management of health problems (Free et al., 2013). Their dissemination and use are widespread and appear to have increased following the COVID-19 period (Palmer & Burrows, 2021).

However, Grist, Porter and Stallard (2017), report that applications developed exclusively for children and adolescents are few and far between. From the study review is inferred that there is a gap in the existence of such applications in Greece, too. Also, the majority of mental health apps available raise concerns about their content (Clay, 2020). Focusing on the content of apps for anxiety and depression, there are shortcomings in safety, confidentiality and user referral functions in more appropriate contexts in cases of severe distress, crisis or suicidality (Bry, Chou, Miguel, & Comer, 2018), but also data protection policies for minors (Qu, Saw, Roquet, & Doherty, 2020). Applications for youth anxiety lacked advanced functionalities for real-time assessment of the user's mood and emotional or behavioural state (Myers et al., 2020), but also psychoeducational material (Bry et al., 2018). Furthermore, in applications for depression there is a gap in the use of psychometric tools, such as questionnaires (Qu et al., 2020). Serious deficiencies were also observed in the inclusion of evidence-based content in applications for anxiety and depression (Bry et al., 2018; Qu et al., 2020), which may make mental health professionals even more cautious about recommending their patients to use such apps (Huguet et al., 2016; Kertz et al., 2017), and many apps diminish the role of the health professional when using them (Myers et al., 2020; Qu et al., 2020).

Although the investigation of their effectiveness is at an early stage (Pham, Wiljer, & Cafazzo, 2016), research shows positive effects on mental health issues (Firth & Torous, 2015; Firth et al., 2017a, 2017b; Nicholas, Larsen, Proudfoot, & Christensen, 2015; Shen et al., 2015).

However, studies of populations using mental health apps have noted high dropout/abandonment rates (Alqahtani & Orji, 2020). Central to the effectiveness of mental health apps is the concept of engagement, which is related to the alignment of the app with the interests and preferences of users (O'Brien & Toms, 2008; Rickwood, Webb, Kennedy, & Telford, 2016; Thompson, Peura, & Gayton, 2015). However, here too, there is a research gap (Garrido et al., 2019; Kenny, Dooley, & Fitzgerald, 2016; Ribanszki et al., 2021), much more in Greece.

2. Purpose and Originality of the Research

Based on the above data and gaps in empirical research, the present study was designed to investigate the interests and preferences of adolescents to design an app to support adolescents with symptoms of anxiety and depression.

The novelty of the survey at national and international level is the prior quan-

titative assessment of the interests and preferences of the general and clinical adolescent population for mental health applications, and specifically for anxiety and depression. The aim of this strategy is both to design a mental health application that is more adequately and exclusively targeted at adolescents and to strengthen their commitment to such an application.

Research Hypotheses-Research Questions

In this context, research hypotheses and research questions were formulated. More specifically, it is expected:

- Adolescents report high levels of anxiety (Garcia & O'Neil, 2021) and depression.
- Adolescent girls report higher levels of anxiety (McLaughlin & King, 2015) and depression (Parker & Brotchie, 2010) symptoms than boys.
- Lower anxiety scores (Nelemans et al., 2014) and higher depression scores (Galambos et al., 2006) in late adolescents compared to those in middle adolescence.
- Correlation-covariance values between anxiety and depression in adolescents (McLaughlin & King, 2015).
- Majority smartphone/tablet ownership and app usage among adolescents (Pew Research Center, 2018).
- Low rates of prior use of mental health apps for anxiety and depression by adolescents (Chan, Kow, & Cheng, 2017).
- Low personal interest percentage for using a mental health app to manage anxiety/depression symptoms (Chan et al., 2017).
- Higher interest percentage for using a mental health app to manage anxiety/depression symptoms if recommended by a mental health professional (therapist or psychiatrist) than not involving a professional (Lipschitz et al., 2019).
- High preference for features related to security, personalisation, content and functionality, access and reliability of the application.
- Low preference for including a questionnaire on depression or anxiety.

In the absence of research findings, another originality of the present study is the investigation of the levels of interest in using a mental health app, as well as preferences for each feature of the app, among adolescents in the sample who were a clinical population, noting high levels of anxiety and/or depression in the present study. Specifically, the following research questions were formulated:

- Are there differences in adolescents' anxiety and depression levels in terms of their level of interest in using a mental health app?
- Are there differences in adolescents' anxiety and depression levels in terms of the level of preference for each app feature?

3. Methodology

3.1. Sample

The sample of the study consisted of 117 adolescent boys and girls aged 14 - 18

years old from regions of Greece. Specifically, the sample came from the wider areas of Athens, Patras, Nafpaktos and Chalkida, so as to represent urban and semi-urban adolescent popularities. Most of the adolescents were of Greek nationality and the majority of them were attending a vocational high school (EPAL). Participants also came from Gymnasiums, General Lyceums, while some of them declared to be University students.

3.2. Data Collection Tools

An impromptu Demographic Questionnaire was utilized to collect data to capture the demographics of the sample, the State-Trait Anxiety Inventory-Trait subscale (STAI-T) from Spielberg's State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). to assess anxiety levels, Kovacs' Children's Depression Inventory (CDI) (Kovacs, 1992, 2008) to assess depression levels in the sample, and an impromptu "Questionnaire of Interests and Preferences for Mental Health Applications" to assess homonymous interests and preferences.

The "Mental Health Application Interests and Preferences Questionnaire" consisted of statements about mental health application characteristics rated on a Likert-type scale. These characteristics were derived from the review of empirical qualitative research in this field and were designed according to the specifications dictated by the relevant literature for structuring a new instrument (Lagoumintzis, Vlachopoulos, & Koutsogiannis, 2015; Paraskevopoulos, 1999). More specifically, the questionnaire's statements about adolescents' preferences and needs for mental health applications were grouped into the following categories: Safety, Personalization, Functionality/Content, Access and Confidentiality.

3.3. Procedure

Initially, the survey questionnaire was designed and administered in both paper and electronic form, through the Google Forms platform, in order to reach a larger percentage of the sample. The information and instructions given to the participants were exactly the same, while a written assurance of data confidentiality was given.

The questionnaires were distributed either through direct contact with adolescents or school units, or mailed, or several participants "introduced" other peers to the survey. The only criterion that was set for the selection of the schools was the pupils' age group so as to be compatible with the survey target group (14-18 years old). Of the 13 schools had been approached, 8 admitted the invitation to take part in the survey.

From this process, 125 questionnaires, 112 in paper and 13 electronic, were collected. Of these, eight (8) questionnaires were excluded from the survey due to incomplete completion (5) or due to doubts about the reliability of the answers (3). At this point it is worth mentioning that in the electronic questionnaires it was specified by default that the completion of the questions was com-

pulsory in order to avoid loss of data. This resulted in the final sample of 117 adolescents.

Data were processed and analyzed with the statistical program IBM SPSS Statistics 27.

4. Results

The results of the analyses are presented below in relation to the research hypotheses and the research questions posed.

It is worth mentioning the fact that the items in the State-Trait Anxiety Inventory-Trait subscale (STAI-T) had a normal distribution, while in the Children's Depression Inventory (CDI) they had a non-normal distribution, so the corresponding statistical criteria were selected for the analyses of each scale.

4.1. Demographic Characteristics of the Sample

Table 1 provides a detailed presentation of the demographic characteristics of the survey sample.

The majority of the adolescents who took part in the survey was males (53.8%), of middle adolescence (69.2%) and specifically of the age of 15 (29.9%). The most of the participants were students of vocational high schools (64.1%). The vast majority of the adolescents of the study were Greek.

Table 1. Respondents' demographic data.

N = 117		Frequency (f)	Valid Percent (%)	Cumulative Percent
Gender	Male	63	53.8	53.8
	Female	54	46.2	100.0
	Non binary	0	0	100.0
Age	14 years old	20	17.1	17.1
	15 years old	35	29.9	47.0
	16 years old	26	22.2	69.2
	Middle adolescence (14 - 16 years old)	81	69.2	
	17 years old	24	20.5	89.7
	18 years old	12	10.3	100.0
	Late adolescence (14 - 16 years old)	36	30.8	
Educational level	Secondary school	30	25.6	25.6
	High school	10	8.5	34.2
	Vocational high school	75	64.1	98.3
	University	2	1.7	100.0
Ethnicity	Greek	109	93.2	93.2
	Foreign	8	6.8	100.0

4.2. Anxiety and Depression Levels in the Total Sample

As shown in **Figure 1**, the majority of adolescents in the total sample (44.4%) reported high anxiety, 25.6% reported moderate anxiety, while 29.9% reported no/low levels of anxiety, Also, the vast majority of the sample of adolescents in the survey (88.9%) reported severe depressive symptomatology, with only 11.1% reporting mild depressive symptomatology. Of particular significance is the finding that none of the survey participants reported an absence of depressive symptomatology.

4.3. Comparison of Adolescent Anxiety and Depression Scores by Gender and Age

To investigate possible differences in levels of anxiety and depression by gender (boys-girls) and age group (middle adolescence-late adolescence), the statistical T-test criterion was applied to compare means for independent samples (boys-girls and middle adolescence-late adolescence respectively) in the case of the State-Trait Anxiety Inventory-Trait subscale (STAI-T) due to normal distribution. In the case of Children's Depression Inventory (CDI), the non-parametric test of two independent samples (boys-girls and middle adolescence-late adolescence respectively) Mann-Whitney Test was applied due to non-normal distribution.
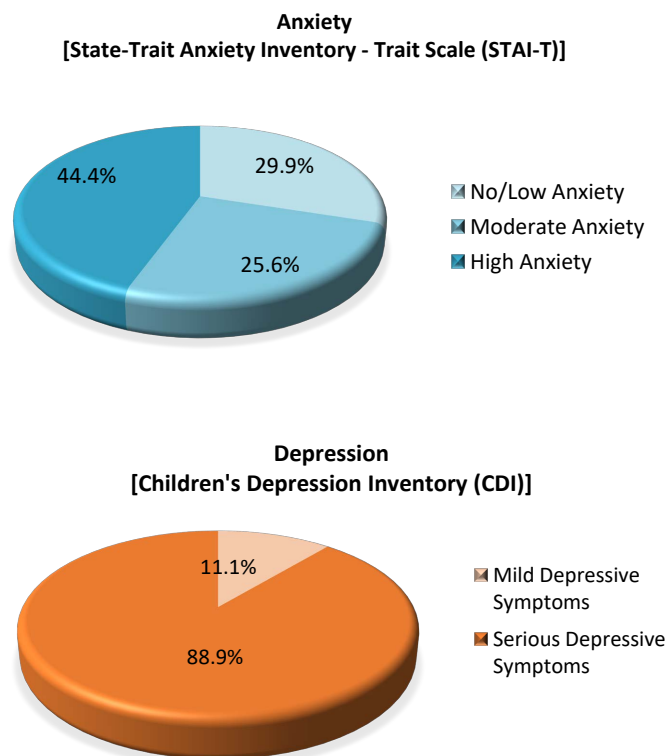
Anxiety
[State-Trait Anxiety Inventory - Trait Scale (STAI-T)]

Depression
[Children's Depression Inventory (CDI)]

Figure 1. Distribution of percentages of anxiety and depression levels in the whole sample.

The analysis revealed statistically significant differences in levels of anxiety and depression between boys and girls.

Specifically, girls have a higher mean ($\overline{x}$ = 46.26, SD = 10.29) than boys ($\overline{x}$ = 41.65, SD = 9.20) in anxiety levels (p = .012). In terms of scores on the Children's Depression Inventory (CDI), higher median scores were observed in girls [M = 30.00 (22.75 - 35.25)] than in boys [M = 25.00 (21.00 - 31.00)] (p = .016) on the Total Depression Score. Statistically significant gender differences were also reflected in the Negative Self-Esteem subscale, with girls again scoring higher [M = 5.00 (3.00 - 6.00)] compared to boys [M = 3.00 (2.00 - 5.00)] (p = .009).

Regarding the comparisons of anxiety and depression levels by age group of the adolescents in the sample, no statistically significant differences were found in either of the two scales, STAI-T and CDI, nor in subscales of the CDI.

4.4. Anxiety-Depression Correlation in the Total Sample

To investigate the correlation between the specific variables the non-parametric Spearman's rho criterion was used as an index of relevance.

From analyses, strong positive associations were found between the State-Trait Anxiety Inventory-Trait subscale (STAI-T) and the Children's Depression Inventory (CDI) and its subscales. More specifically, a positive correlation is observed between the State-Trait Anxiety Inventory-Trait subscale (STAI-T) and the Total Depression Score (r_s = .741, p < .001), and with the subscales of the Children's Depression Inventory, in particular with "Negative Self-Esteem" (r_s = .694, p < .001), "Negative Mood" (r_s = .491, p < .001), "Anhedonia" (r_s = .489, p < .001) and with "Interpersonal Problems" (r_s = .741, p = .003), thus confirming the original research hypothesis.

4.5. Smartphone/Tablet Ownership and Use of Apps and Mental Health Apps

As expected, the majority of the teenagers in the sample (98.3%) have a smartphone/tablet, and a same percentage had used an app (social media, weather, music or movie platforms, games, information, etc.) (98.3%). Also, the majority of the teenagers in the survey (81.2%) have not used an app to manage anxiety or depression.

However, a significant proportion (18.8%) said they had previously used such a mental health app to help manage anxiety/depression.

4.6. Interest in Using Mental Health Apps for Anxiety/Depression in the Total Sample of Adolescents

Of particular interest is the comparative Figure 2, which shows that the percentage of high adolescents' interest to use an app to help them manage their anxiety/depression symptoms, if the app was recommended by a mental health professional (therapist or psychiatrist) (34.2%) was almost twice as the one of the adolescents' personal interest in using a mental health app for anxiety/depression (17.9%).
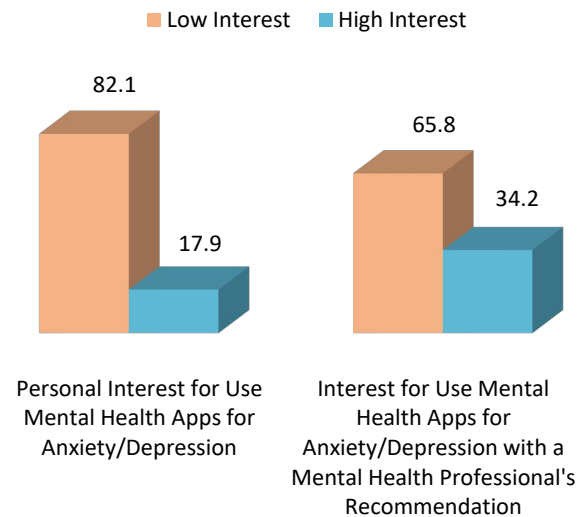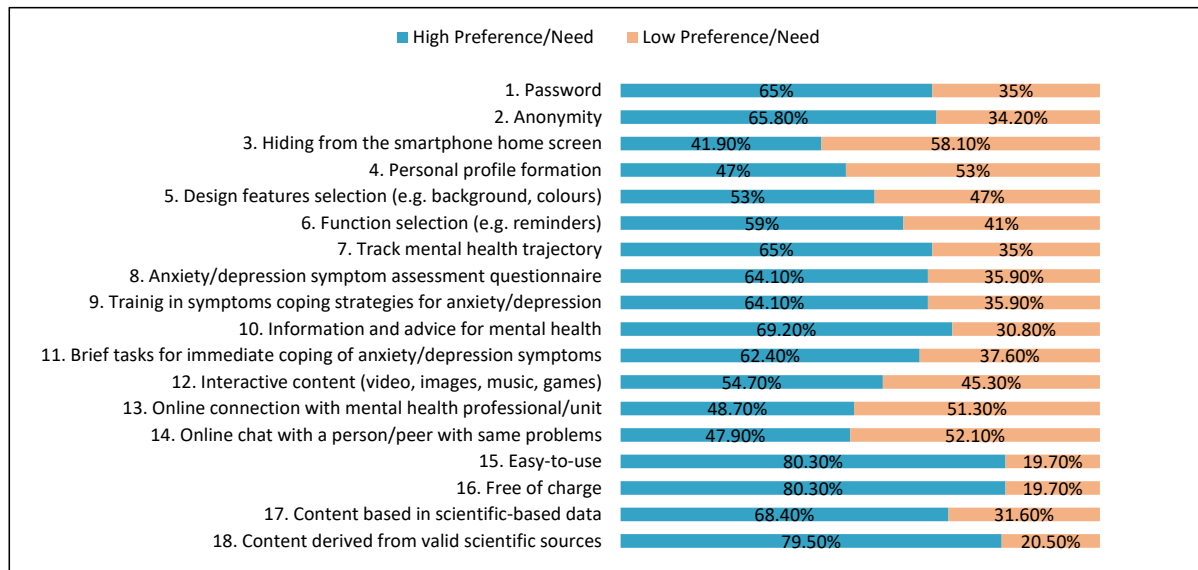
Figure 2. Comparison of percentages of high and low levels of personal interest for use mental health apps for anxiety/depression and of interest for use mental health apps for anxiety/depression with a mental health professional's recommendation in the whole sample.

4.7. High and Low Preferences/Needs for Mental Health Application Features for the Total Sample of Adolescents

As shown in Figure 3, adolescents appeared to indicate a high preference/need for the majority of the app features asked in the survey. Higher percentages of preference appeared to be indicated for parameters related to access and confidentiality, while high percentages were also indicated for features related to the other broad categories (security, functionality/content, personalization). Less high, but at a significant rate, were features such as the ability to hide the app from the mobile phone, the ability to connect to a mental health professional/service and to enable the user to communicate online with another person with the same problems as him/her.

4.8. Interests and Preferences of Adolescents for a Mental Health Application for Anxiety and Depression with High Anxiety and Depression Scores

To compare the anxiety and depression levels in each category "Low Interest"/ "Low Preference", "High Interest"/"High Preference" for the individual interest and preference statements, the statistical criterion T-test for independent samples ("Low Interest"/"Low Preference", "High Interest"/"High Preference") for in the case of the State-Trait Anxiety Inventory-Trait subscale (STAI-T), due to normal distribution, and in the case of the Children's Depression Inventory (CDI), due to non-normal distribution, the nonparametric test of two independent samples ("Low Interest"/"Low Preference", "High Interest"/"High Preference") Mann-Whitney Test was applied.

Items categorization: Security (1, 2, 3), Personalization (4, 5, 6, 7), Function/Content (8, 9, 10, 11, 12, 13, 14), Access (15, 16), Reliability (17, 18).

Figure 3. Comparison of percentages of high and low preferences/needs for mental health app features.

4.8.1. Interests for a Mental Health App for Anxiety and Depression of Adolescents with High Anxiety and Depression Scores

Adolescents who expressed high interest in using an app to help them manage anxiety or depression showed higher anxiety scores ($\overline{x}$ = 49.19, SD = 9.18) compared to those who reported low interest ($\overline{x}$ = 42.59, SD = 9.75) (p = .005), and higher depression scores [M = 31.00 (25.50 - 38.00)] compared to those who reported low levels of interest [M = 25.00 (21.00 - 31.50)] (p = .022).

Similarly, adolescents who reported high interest showed higher anxiety scores ($\overline{x}$ = 48.97, SD = 8.75) for using an app to manage anxiety or depression symptoms if it was recommended by a mental health professional (therapist or psychiatrist), compared to those who reported low interest in this statement ($\overline{x}$ = 41.08, SD = 9.49), a difference that is highly statistically significant (p = .005). In addition, adolescents with high interest also showed higher depression scores [M = 30.50 (24.50 - 37.00)] compared to those who reported low interest [M = 25.00 (21.00 - 31.50)], a difference that is statistically significant (p = .003).

4.8.2. Preferences of Adolescents with High Anxiety and Depression Scores towards a Mental Health Application for Anxiety and Depression

Analysing the relevant data, statistically significant differences were observed in the levels of anxiety and depression of adolescents who reported a high preference for some characteristics compared to adolescents with a low preference.

More specifically, on security-related parameters, adolescents who reported a high preference for password inclusion had higher anxiety scores ($\overline{x}$ = 45.29, SD = 10.29) than those who reported a low preference ($\overline{x}$ = 40.97, SD = 8.70), a statistically significant difference (p = .025). Regarding the possibility of hiding the mobile app, adolescents with high preference also reported higher levels of

anxiety ($\overline{x}$ = 45.98, SD = 10.46) and depression [M = 27.00 (24.00 - 36.50)], compared to those who reported low preference who reported lower scores on anxiety ($\overline{x}$ = 42.19, SD = 9.31) (p = .042) and depression [M = 25.00 (20.25 - 31.75)], (p = .019) respectively.

The ability to select functions (e.g., reminders) in a mental health app was preferred highly by adolescents who had higher anxiety ($\overline{x}$ = 45.36, SD = 10.60), and depression scores [M = 27.00 (23.00 - 35.00)], compared to corresponding scores of adolescents who referred lower preference in this feature ($\overline{x}$ = 41.50, SD = 8.50), [M = 25.00 (20.00 - 30.00)], (p = .031).

Regarding features related to the function/content of the app, it was observed that adolescents who indicated a high preference for the inclusion of an anxiety/depression symptom assessment questionnaire had higher levels of anxiety ($\overline{x}$ = 45.70, SD = 9.53) and depression [M = 28.00 (24.00 - 35.00)] with adolescents with low preference scoring lower for anxiety ($\overline{x}$ = 40.33, SD = 9.85) (p = .005) and depression [M = 23.00 (20.00 - 29.25)] (p = .002), respectively. A high preference for brief exercises to directly address anxiety/depression symptoms was also reported by adolescents in the study who had higher anxiety levels ($\overline{x}$ = 45.59, SD = 9.99), compared to the corresponding anxiety levels of adolescents who reported low preference ($\overline{x}$ = 40.77, SD = 9.22) (p = .011). Interactive content was also highly preferred by adolescents with higher anxiety scores ($\overline{x}$ = 45.50, SD = 9.77), compared to those who reported a low preference ($\overline{x}$ = 41.79, SD = 9.84) (p = .039). High preference for the ability to communicate online with another person with the same problems was manifested by adolescents who also reported higher levels of anxiety ($\overline{x}$ = 45.68, SD = 9.58) and depression [M = 27.00 (23.00 - 35.75)], noting a statistically significant difference from those who reported low preference with the corresponding scores ranging for anxiety ($\overline{x}$ = 42.03, SD = 10.03) (p = .047) and depression [M = 25.00 (20.00 - 31.00)], (p = .036).

High preference regarding access features such as the free availability of the app was reported by adolescents who expressed higher levels of anxiety ($\overline{x}$ = 44.55, SD = 10.40) than those who reported low preference ($\overline{x}$ = 40.60, SD = 7.13), a statistically significant difference (p = .037).

Finally, in terms of application reliability, content reliance on research data was reported in high preference by adolescents with anxiety scores ($\overline{x}$ = 45.41, SD = 9.94), compared to those who reported low preference ($\overline{x}$ = 40.24, SD = 9.11) (p = .008).

5. Discussion

The findings are then analysed in relation to the parameters set in the research hypotheses and research questions.

5.1. Analysis of Findings about Anxiety and Depression in Adolescence

Initially, the findings of the study confirm the majority of international literature

and research, which highlights that anxiety and depression are the most common mental health problems during adolescence (Kalin, 2021; Kessler et al., 2012; UNICEF, 2018). The high rates of depressive symptoms presented in the present study may be a result of response bias. A strongly possible interpretation may also be that adolescents with higher rates of depressive symptoms showed more interest in participating in a study to create a mental health app to support adolescents with symptoms of anxiety and depression, as has been supported by international research (Lipschitz et al., 2019).

The transgender differences identified with higher anxiety and depression scores in girls are consistent with previous research (McLaughlin & King, 2015; Nolen-Hoeksema & Hilt, 2009; Parker & Brotchie, 2010), and even in Greece (Magklara et al., 2015; Zacharopoulou et al, 2014). The age range of the adolescent students in the study (middle and late adolescence) should be taken into account in this finding, as international literature points out that from middle to late adolescence, transgender differences emerge, with girls showing an upward trend in terms of an anxiety disorder symptom (Ohannessian, Milan, & Vannucci, 2017), while being nearly twice as likely to be diagnosed with major depressive disorder and reporting nearly twice as many depressive symptoms as boys (Hankin & Abramson, 2001; Hyde, Mezulis, & Abramson, 2008; Nolen-Hoeksema & Hilt, 2009; Rudolph et al., 2008). Girls' higher scores on "Negative Self-Esteem" levels are possibly related to their more negative attitudes about body appearance and their difficulty in managing the physical changes of adolescence. For women, body image is inextricably linked to self-esteem, and dissatisfaction with body image is a risk factor for depression (Stice, Hayward, Cameron, Killen, & Taylor, 2000). At the same time, boys' lower depression scores may be explained by the fact that depression in boys, and in men more generally, may be ignored, as many find it difficult to talk about their feelings or fear a reduction in their masculinity (Branney & White, 2008).

The fact that no statistically significant differences in anxiety and depression levels were found between the age group of adolescent students seems to be explained by findings from other studies. In particular, Rapee (2012) points out that the average age of onset of anxiety disorders in adolescence occurs at different points in development, and stresses that the precise timing of the onset of these disorders is particularly difficult. At the same time, other studies converge on the conclusion that some anxiety disorders tend to decline and others tend to increase from mid to late adolescence (Hale III, Raaijmakers, Muris, Van Hoof, & Meeus, 2009; Nelemans et al., 2014). The instrument utilized in the present study assessed anxiety symptoms collectively rather than specific anxiety disorders. Regarding the absence of statistically significant age differences in depression scores, it should be mentioned that according to Bulhões, Ramos, Severo, Dias and Barros (2021), depressive symptoms show different trajectories during adolescence, which may lead to different consequences. Also, there are not a few studies that report zero development or even improvement of depressive symp-

toms from mid to late adolescence (Galambos et al., 2006; Measelle, Stice, & Hogansen, 2006).

The high positive correlation values between anxiety and depression levels of the adolescent students in the sample support the high rates of comorbidity between these two mental health problems that have been identified by many researchers (McLaughlin & King, 2015).

5.2. Analysis of Findings about Smartphone/Tablet Ownership and App Use in Adolescence

The possession of smartphones/tablets and the use of apps by the majority of the adolescent students in the survey is confirmed by the evidence of numerous studies that note that the use of digital technologies (e.g., Internet use, smart phones, mobile phone apps and social media platforms) is now an integral part of everyday life for adolescents as well (Villanti et al., 2016; Wartella et al., 2016).

In contrast, the survey findings note that the majority of adolescents have not used an anxiety or depression app in the past, agreeing with other researchers who report a lack of adolescent awareness of such apps (Chan et al., 2017), low rates of installation and use by adolescents (Wartella et al., 2016), poor evidence of effectiveness, and privacy concerns about these apps (Lipschitz et al., 2019).

5.3. Analysis of Findings about Adolescents' Interest in a Mental Health Application for Anxiety/Depression

As originally predicted, the majority of adolescents in the sample showed low interest in using a mental health app to manage anxiety/depression symptoms.

Many adolescents seem to view health management via smartphone as an issue of minor importance compared to other interests. Chan and colleagues (2017) reported that adolescents preferred to use their smartphone to play games, surf the internet or social media rather than to monitor their health. Even in online app shopping (app stores), their preferences revolved around entertainment apps. Negative beliefs about these apps also appeared to play an important role, and many adolescents were concerned about social stigmatisation by their peers if they used such an app (Chan et al., 2017).

In fact, this high interest was expressed by adolescents who reported high levels of anxiety and depression. The finding confirms similar survey data from Lipschitz and colleagues (2019) in a clinical population of adults with anxiety and depression, where 73.1% reported some level of interest in using a mental health app, a figure that reached 77.3% when the question only asked of those who owned a smart device.

It is also crucial to mention the potential impact of the high ownership of smartphones/tablets on the high levels of interest in a mental health application that noted.

It also confirmed the initial hypothesis that adolescents' interest in a mental health app for anxiety and depression would be higher if it was recommended by a mental health professional (therapist or psychiatrist), with percentage almost

twice as high as personal interest in such an app. This high interest, in fact, was reported by adolescents with high anxiety/depression scores. These findings are consistent with data from the research of Lipschitz and colleagues (2019), and other research has also highlighted the important role of the mental health professional in the adoption of other clinical technologies for mental health issues (Nazi, 2013).

Of particular importance seems to be the identity of the health professional who approves and recommends an app of survey participants' use of such an app was higher when the specialist came from the mental health field than from the primary care field. Research also shows that "trusted sources" have a strong influence on an individual's decision to use an intervention, but it rarely happens, raising the imperative for health care providers to be involved in discussions about mobile phone apps (Schueller, Neary, O'Loughlin, & Adkins, 2018).

5.4. Analysis of Findings about Adolescents' Preferences for a Mental Health App for Anxiety/Depression

5.4.1. Safety

Having a password was reported to be highly preferred by the adolescent students in the survey, consistent with the findings of other studies (Kenny et al., 2016). In fact, these adolescents appeared from the findings of the present study to report higher anxiety scores than those who reported low interest in this function. Indeed, the issue of security appears to be a key parameter for the design and use of an app (Proudfoot et al., 2010), which becomes even more critical when considering that in a survey by Bry et al. (2018) only 5% of apps for teenage anxiety had security-related features (e.g., passwords, references to data security).

Important for adolescents is also ensuring that the user has the ability to control privacy issues, such as keeping personal information anonymous (Kenny et al., 2016), as was also shown in the findings where anonymity of the app was high on the preferences of adolescents.

Also, given the fear of stigmatization (Ribanszki et al., 2021), many adolescents suggest the possibility of hiding the mobile app (Kenny et al., 2016), a feature that was also rated relatively highly by the adolescents in this study, who even reported higher anxiety and depression scores than those who reported a low preference for this item.

5.4.2. Personalisation

The sample of teenage students seemed to be divided in terms of their level of preference for the possibility of creating a personal profile. Indeed other studies place this element as important to the attractiveness of the app for teenagers (Kenny et al., 2016), while others mention the privacy issues raised (Alqahtani & Orji, 2020; Kenny et al., 2016).

As an attractiveness feature, the possibility to choose the design features of the application, such as colours and backgrounds (Garrido et al., 2019; Ribanszki et

al., 2021) was also appreciated by many studies, an element that was highly preferred by the teenage students in the study.

Also, the ability to set reminders was set at a high preference by the adolescent students in the study, as originally hypothesized, consistent with findings from other studies. These adolescents also appeared to report high levels of anxiety and depression. Indeed, the role of reminders in a mental health app seems to be particularly important, as they remind the user to participate in mental health-related activities (Huang et al., 2019), perform a specific exercise or take their medication (Marshall, Dunstan, & Bartik, 2020).

The ability to track mental health trajectories was also placed high in the preferences of the sample, a finding that other studies agree with, placing this feature of particular importance for measuring various parameters such as mood and sleep (Alqahtani & Orji, 2020), but also particularly helpful for identifying recurrent mood patterns (Garrido et al, 2019); through the collection of data from the mental health app, if it is found that the user is experiencing significant arousal, Bakker et al. suggest the relaxation breathing technique, which has been shown to be particularly helpful (Manzoni, Pagnini, Castelnuovo, & Molinari, 2008).

5.4.3. Operation/Content

High on adolescents' preferences was the inclusion of psycho-educational content features such as strategies for coping with anxiety/depression symptoms and information and advice about mental health, features that have been positively evaluated as particularly helpful for mental health issues by other researches (Alqahtani & Orji, 2020; Bakker, Kazantzis, Rickwood, & Rickard, 2016).

A high preference was also expressed for the inclusion of interactive content in the app, and this was reported by adolescents with higher anxiety and depression scores. Indeed, the use of images, music, videos and games make the app more engaging and increase user engagement (Alqahtani & Orji, 2020; Kenny et al., 2016; Ribanszki et al., 2021). Music has even been shown to reduce anxiety, among other things (Knight & Rickard, 2001), and activities that include listening to music seem to help regulate emotion (Bakker et al., 2016). Game-based applications have been shown to be particularly helpful in managing anxiety and depression (Knox et al., 2011). It is worth noting, however, that it is rare for apps for adolescent anxiety management to allow users to tailor their content to their own preferences or those that included interactive content that reacted to user-input information (Bry et al., 2018).

Brief exercises for immediate management of anxiety/depression symptoms, which was rated high in the preferences of adolescents, especially those with higher anxiety scores, is a parameter that has been positively evaluated by other studies (Ribanszki et al., 2021). Indeed, among the most widely used intervention methods in mental health applications are techniques of cognitive-behavioral therapy (Bakker et al., 2016; Titov et al., 2011). More specifically, increasing physical activity can reduce symptoms of depression (Cooney et al., 2013) and

anxiety (Anderson & Shivakumar, 2013) and promote psychological well-being (Alexandratos, Barnett, & Thomas, 2012), evidence that has already been exploited by many mobile phone apps (Fanning, Mullen, & McAuley, 2012). At the same time, the notion of immediacy and urgency is also one of the themes often mentioned as a preference by mental health app users, mainly requesting an immediate connection with a specialist in urgent situations (Alqahtani & Orji, 2020).

The not so high preference of the adolescents in the survey for the possibility of connecting with a mental health professional/structure, although adolescents in other studies rated it highly (Garrido et al., 2019; Kenny et al., 2016), possibly related to adolescents' general inertia in seeking help for mental health issues (Rickwood, Deane, & Wilson, 2007), as well as some adolescents' view that accessing help over the phone cannot replace face-to-face contact (Garrido et al., 2019).

Similarly, a less low preference was reported for the possibility of online communication with another person with the same problems, although other studies put it high in the preferences of adolescents (Campbell & Robards, 2013), possibly the preference levels are interpreted taking into account the reservation of some adolescents that the advice given by such peer groups is inaccurate (Garrido et al., 2019). However, high preference for this feature was reported by adolescents with higher anxiety and depression scores, a finding that is in line with other research that reports that although few, there are nevertheless applications where through dedicated forums users have the opportunity to share their experiences and support each other (Alqahtani, Al Khalifah, Oyebode, & Orji, 2019). At the same time, adolescents in this way reinforce a sense of belonging and connection (Campbell & Robards, 2013).

There was also a high preference for adolescents with high anxiety/depression scores to include an anxiety/depression symptom assessment questionnaire, but research contradicts this finding. Specifically, they report that the predetermined options for characterizing situations were "too restrictive" or "quite imprecise" for some adolescents (Kenny et al., 2016), as was the case with the predetermined options on automatic thoughts, which contributed to increased anxiety (Tucker & Goodings, 2015). However, other research has praised mental health apps for their ability to increase users' emotional awareness (Morris et al., 2010; Kauer et al., 2012), which is a key parameter of cognitive-behavioural therapy (Clark, 2013), and by extension a prerequisite for effective user engagement (Ribanszki et al., 2021).

5.4.4. Access

Attributes related to access to the app were rated higher than any other attribute studied in this survey. Ease of use has been rated highly in other studies (Alqahtani & Orji, 2020; Kenny et al., 2016; Ribanszki et al., 2021). The free availability of the app has also been put forward as a very key element for the selection and use of such apps by adolescents (Alqahtani & Orji, 2020; Kenny et al., 2016;

Werner-Seidler et al., 2017), and in the present study, adolescents who reported a high preference for this feature also showed higher anxiety scores, which suggests that it is particularly necessary for them, as parental involvement in paying for the app may have been associated with increased anxiety for adolescents.

5.4.5. Reliability

High preference by the adolescent students in the present study, especially those with higher anxiety scores, was also set for reliability characteristics. Given the paucity of available evidence-based mental health apps (Torous & Roberts, 2017) and by extension the lack of trust in them by users and health professionals (Torous et al., 2018), basing the content of the app on research data is a key component of such an app. At the same time, this feature can motivate users with mental health problems to engage mental health apps plays the scientific identity of the app designer (Alqahtani & Orji, 2020), highlighting the importance of designing the app by mental health experts (Garrido et al., 2019).

6. Limitations

The way the survey sample was collected, as well as its size and demographic characteristics, constitute reservations as to the generalisability of the results. Also, the categorization of ages into middle and late adolescence was derived from Barrett's (1996) proposal, while other researchers recommend different categorizations (Salmela-Aro, 2011). Still, levels of anxiety and depression were assessed only from the perspective of adolescents through self-report questionnaires. There was also a vast majority of adolescents who reported high rates of depression symptoms, a finding that may raise concerns about possible response bias. Therefore, the topic was approached unidimensionally and possibly some adolescents presented a socially acceptable picture, even if their anonymity was respected. Finally, the Self-Reported Questionnaire of Interests and Preferences for Mental Health Applications was designed to quantitatively explore these variables in adolescents by setting predefined characteristics to be assessed, thus depriving them of the opportunity to self-report other characteristics or provide additional information about them.

7. Suggestions for Future Research

For future research, it is suggested to investigate the levels of anxiety and depression systemically, including information from the adolescents' context (parents, teachers, peers). It is also considered necessary to develop mental health applications exclusively for children and adolescents, while investigating their effectiveness (Grist et al., 2017). In addition, it would be important to explore the reasons for discontinuing/abandoning the use of such an app (Alqahtani & Orji, 2020), while also studying ways of designing them that would increase engagement with them (Lattie et al., 2019). A gap is also identified in the development of quantitative tools to assess adolescents' interests and preferences for mental health apps.

8. Implementation of the Research Findings

The findings of the present study can be used not only to obtain data on adolescents' preferences and interests in mental health apps, but also to design such an app for adolescents with anxiety and depression problems.

"CALMA": An Innovative Application to Support Adolescents with Anxiety and Depression Symptoms

- Design of the application by experienced scientific staff (mental health professionals, IT, marketing, graphic design).
- Application Features
  - Password Password
  - Privacy assurance text message
  - Hide app from smartphone home screen
  - Create a personal profile
  - Selection of design features and functions
  - Mental health tracking (graphs)
  - Short psychometric tool for assessing anxiety/depression
  - Multimedia (videos, images, music, games)
  - Comprehensive training material on symptom management strategies
  - Providing mental health advice/information
  - Brief exercises for immediate symptom management
  - Connection to a mental health professional/structure
  - Forum for peer-to-peer communication
  - Free of charge
  - Simple instructions for use
  - Scientific documentation of the content
- Outreach, information and awareness raising for mental health professionals to promote implementation.

9. Conclusion

The findings of the study showed that adolescents have high levels of anxiety and depression. Transgender differences in anxiety and depression levels were also highlighted, with girls showing higher levels than boys. No differences in anxiety and depression scores were found for the adolescent age group. Furthermore, high correlation values of anxiety and depression were identified.

Still, the vast majority of adolescent students reported having a smartphone/tablet and having used various apps, with low rates noted for prior use of anxiety/depression apps.

Most adolescents reported low interest in using a mental health app for anxiety. However, this figure almost doubled when the requirement of a recommendation of this app by a mental health professional was made.

In addition, teenagers reported (relatively) high preference for almost all the characteristics they were asked to rate. Particularly high preference was expressed

for suggestions related to access, confidentiality, security and the function/content of the application. Lower preference was expressed for issues related to the possibility of hiding the application from the mobile phone, and for features related to the social interaction of the user with third parties.

Finally, differences were also observed in anxiety and depression scores in terms of adolescents' level of interest and preference for the various features of the app, thus focusing on the preferences and needs of adolescents with more strongly reported anxiety and depression problems.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Alexandratos, K., Barnett, F., & Thomas, Y. (2012). The Impact of Exercise on the Mental Health and Quality of Life of People with Severe Mental Illness: A Critical Review. *British Journal of Occupational Therapy, 75,* 48-60. https://doi.org/10.4276/030802212X13286281650956

Alqahtani, F., Al Khalifah, G., Oyebode, O., & Orji, R. (2019). Apps for Mental Health: An Evaluation of Behavior Change Strategies and Recommendations for Future Development. *Frontiers in Artificial Intelligence, 2,* 30. https://doi.org/10.3389/frai.2019.00030

Alqahtani, F., & Orji, R. (2020). Insights from User Reviews to Improve Mental Health Apps. *Health Informatics Journal, 26,* 2042-2066. https://doi.org/10.1177/1460458219896492

Anderson, E., & Shivakumar, G. (2013). Effects of Exercise and Physical Activity on Anxiety. *Frontiers in Psychiatry, 4,* Article 27. https://doi.org/10.3389/fpsyt.2013.00027

Bakker, D., Kazantzis, N., Rickwood, D., & Rickard, N. (2016). Mental Health Smart-

phone Apps: Review and Evidence-Based Recommendations for Future Developments. *JMIR Mental Health, 3,* e4984. https://doi.org/10.2196/mental.4984

Barrett, D. E. (1996). The Three Stages of Adolescence. *The High School Journal, 79,* 333-339.

Blakemore, S. J. (2019). Adolescence and Mental Health. *The Lancet, 393,* 2030-2031. https://doi.org/10.1016/S0140-6736(19)31013-X

Branney, P., & White, A. (2008). Big Boys Don't Cry: Depression and Men. *Advances in Psychiatric Treatment, 14,* 256-262. https://doi.org/10.1192/apt.bp.106.003467

Bry, L. J., Chou, T., Miguel, E., & Comer, J. S. (2018). Consumer Smartphone Apps Marketed for Child and Adolescent Anxiety: A Systematic Review and Content Analysis. *Behavior Therapy, 49,* 249-261. https://doi.org/10.1016/j.beth.2017.07.008

Bulhões, C., Ramos, E., Severo, M., Dias, S., & Barros, H. (2021). Trajectories of Depressive Symptoms through Adolescence and Young Adulthood: Social and Health Outcomes. *European Child & Adolescent Psychiatry, 30,* 65-74. https://doi.org/10.1007/s00787-020-01493-9

Campbell, A. J., & Robards, F. (2013). *Using Technologies Safely and Effectively to Promote Young People's Wellbeing.* Young and Well Cooperative Research Centre.

Chan, A., Kow, R., & Cheng, J. K. (2017). Adolescents' Perceptions on Smartphone Applications (Apps) for Health Management. *Journal of Mobile Technology in Medicine, 6,* 47-55. https://doi.org/10.7309/jmtm.6.2.6

Clark, D. A. (2013). Cognitive Restructuring. In *The Wiley Handbook of Cognitive Behavioral Therapy* (pp. 1-22). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118528563.wbcbt02

Clay, R. (2020). *Using Apps with Your Patients.* https://www.apa.org/monitor/2020/04/career-using-apps

Cooney, G. M., Dwan, K., Greig, C. A., Lawlor, D. A., Rimer, J., Waugh, F. R. et al. (2013). Exercise for Depression. *Cochrane Database of Systematic Reviews*, No. 9, CD004366. https://doi.org/10.1002/14651858.CD004366.pub6

Donovan, C. L., & March, S. (2014). Computer-Based Treatment Programs for Youth Anxiety: A Systematic Review. *Psychopathology Review, 1,* 130-156. https://doi.org/10.5127/pr.033613

Ebert, D. D., Zarski, A. C., Christensen, H., Stikkelbroek, Y., Cuijpers, P., Berking, M., & Riper, H. (2015). Internet and Computer-Based Cognitive Behavioral Therapy for Anxiety and Depression in Youth: A Meta-Analysis of Randomized Controlled Outcome Trials. *PLOS ONE, 10,* e0119895. https://doi.org/10.1371/journal.pone.0119895

Fanning, J., Mullen, S. P., & McAuley, E. (2012). Increasing Physical Activity with Mobile Devices: A Meta-Analysis. *Journal of Medical Internet Research, 14,* e2171. https://doi.org/10.2196/jmir.2171

Firth, J., & Torous, J. (2015). Smartphone Apps for Schizophrenia: A Systematic Review. *JMIR mHealth and uHealth, 3,* e4930. https://doi.org/10.2196/mhealth.4930

Firth, J., Torous, J., Nicholas, J., Carney, R., Pratap, A., Rosenbaum, S., & Sarris, J. (2017a). The Efficacy of Smartphone-Based Mental Health Interventions for Depressive Symptoms: A Meta-Analysis of Randomized Controlled Trials. *World Psychiatry, 16,* 287-298. https://doi.org/10.1002/wps.20472

Firth, J., Torous, J., Nicholas, J., Carney, R., Rosenbaum, S., & Sarris, J. (2017b). Can Smartphone Mental Health Interventions Reduce Symptoms of Anxiety? A Meta-Analysis of Randomized Controlled Trials. *Journal of Affective Disorders, 218,* 15-22. https://doi.org/10.1016/j.jad.2017.04.046

Free, C., Phillips, G., Galli, L., Watson, L., Felix, L., Edwards, P. et al. (2013). The Effectiveness of Mobile-Health Technology-Based Health Behaviour Change or Disease Management Interventions for Health Care Consumers: A Systematic Review. *PLOS Medicine, 10,* e1001362. https://doi.org/10.1371/journal.pmed.1001362

Galambos, N. L., Barker, E. T., & Krahn, H. J. (2006). Depression, Self-Esteem, and Anger in Emerging Adulthood: Seven-Year Trajectories. *Developmental Psychology, 42,* 350-365. https://doi.org/10.1037/0012-1649.42.2.350

Galambos, N. L., Leadbeater, B. J., & Barker, E. T. (2004). Gender Differences in and Risk Factors for Depression in Adolescence: A 4-Year Longitudinal Study. *International Journal of Behavioral Development, 28,* 16-25.
https://doi.org/10.1080/01650250344000235

Garcia, I., & O'Neil, J. (2021). Anxiety in Adolescents. *The Journal for Nurse Practitioners, 17,* 49-53. https://doi.org/10.1016/j.nurpra.2020.08.021

Garrido, S., Cheers, D., Boydell, K., Nguyen, Q. V., Schubert, E., Dunne, L., & Meade, T. (2019). Young People's Response to Six Smartphone Apps for Anxiety and Depression: Focus Group Study. *JMIR Mental Health, 6,* e14385. https://doi.org/10.2196/14385

Ge, X., Lorenz, F. O., Conger, R. D., Elder, G. H., & Simons, R. L. (1994). Trajectories of Stressful Life Events and Depressive Symptoms during Adolescence. *Developmental Psychology, 30,* 467-483. https://doi.org/10.1037/0012-1649.30.4.467

Grist, R., Porter, J., & Stallard, P. (2017). Mental Health Mobile Apps for Preadolescents and Adolescents: A Systematic Review. *Journal of Medical Internet Research, 19,* e7332. https://doi.org/10.2196/jmir.7332

Gulliver, A., Griffiths, K. M., & Christensen, H. (2010). Perceived Barriers and Facilitators to Mental Health Help-Seeking in Young People: A Systematic Review. *BMC Psychiatry, 10,* Article No. 113. https://doi.org/10.1186/1471-244X-10-113

Hale III, W. W., Raaijmakers, Q. A., Muris, P., Van Hoof, A., & Meeus, W. H. (2009). One Factor or Two Parallel Processes? Comorbidity and Development of Adolescent Anxiety and Depressive Disorder Symptoms. *Journal of Child Psychology and Psychiatry, 50,* 1218-1226. https://doi.org/10.1111/j.1469-7610.2009.02115.x

Hankin, B. L., & Abramson, L. Y. (2001). Development of Gender Differences in Depression: An Elaborated Cognitive Vulnerability-Transactional Stress Theory. *Psychological Bulletin, 127,* 773-796. https://doi.org/10.1037/0033-2909.127.6.773

Huang, K. Y., Lee, D., Nakigudde, J., Cheng, S., Gouley, K. K., Mann, D. et al. (2019). Use of Technology to Promote Child Behavioral Health in the Context of Pediatric Care: A Scoping Review and Applications to Low- and Middle-Income Countries. *Frontiers in Psychiatry, 10,* Article 806. https://doi.org/10.3389/fpsyt.2019.00806

Huguet, A., Rao, S., McGrath, P. J., Wozney, L., Wheaton, M., Conrod, J., & Rozario, S. (2016). A Systematic Review of Cognitive Behavioral Therapy and Behavioral Activation Apps for Depression. *PLOS ONE, 11,* e0154248.
https://doi.org/10.1371/journal.pone.0154248

Hyde, J. S., Mezulis, A. H., & Abramson, L. Y. (2008). The ABCs of Depression: Integrating Affective, Biological, and Cognitive Models to Explain the Emergence of the Gender Difference in Depression. *Psychological Review, 115,* 291-313.
https://doi.org/10.1037/0033-295X.115.2.291

Kalin, N. H. (2021). Anxiety, Depression, and Suicide in Youth. *American Journal of Psychiatry, 178,* 275-279. https://doi.org/10.1176/appi.ajp.2020.21020186

Kauer, S. D., Reid, S. C., Crooke, A. H. D., Khor, A., Hearps, S. J. C., Jorm, A. F. et al. (2012). Self-Monitoring Using Mobile Phones in the Early Stages of Adolescent Depression: Randomized Controlled Trial. *Journal of Medical Internet Research, 14,*

e1858. https://doi.org/10.2196/jmir.1858

Keeley, B., & Little, C. (2017). *The State of the World's Children 2017: Children in a Digital World*. UNICEF.

Kenny, R., Dooley, B., & Fitzgerald, A. (2016). Developing Mental Health Mobile Apps: Exploring Adolescents' Perspectives. *Health Informatics Journal, 22,* 265-275. https://doi.org/10.1177/1460458214555041

Kertz, S. J., MacLaren Kelly, J., Stevens, K. T., Schrock, M., & Danitz, S. B. (2017). A Review of Free iPhone Applications Designed to Target Anxiety and Worry. *Journal of Technology in Behavioral Science, 2,* 61-70. https://doi.org/10.1007/s41347-016-0006-y

Kessler, R. C., Petukhova, M., Sampson, N. A., Zaslavsky, A. M., & Wittchen, H. U. (2012). Twelve-Month and Lifetime Prevalence and Lifetime Morbid Risk of Anxiety and Mood Disorders in the United States. *International Journal of Methods in Psychiatric Research, 21,* 169-184. https://doi.org/10.1002/mpr.1359

Kim, H. K., Capaldi, D. M., & Stoolmiller, M. (2003). Depressive Symptoms across Adolescence and Young Adulthood in Men: Predictions from Parental and Contextual Risk Factors. *Development and Psychopathology, 15,* 469-495. https://doi.org/10.1017/S0954579403000257

Knight, W. E., & Rickard, N. S. (2001). Relaxing Music Prevents Stress-Induced Increases in Subjective Anxiety, Systolic Blood Pressure, and Heart Rate in Healthy Males and Females. *Journal of Music Therapy, 38,* 254-272. https://doi.org/10.1093/jmt/38.4.254

Knox, M., Lentini, J., Cummings, T. S., McGrady, A., Whearty, K., & Sancrant, L. (2011). Game-Based Biofeedback for Paediatric Anxiety and Depression. *Mental Health in Family Medicine, 8,* 195-203.

Kovacs, M. (1992). *Children's Depression Inventory: Manual* (pp. p-Q8). Multi-Health Systems.

Kovacs, M. (2008). *Children's Depression Inventory (CDI)*. Technical Manual Update, Multi-Health Systems.

Lagoumintzis, G., Vlachopoulos, G., & Koutsogiannis, K. (2015). *Research Methodology in Health Sciences*. SEAB.

Lattie, E. G., Adkins, E. C., Winquist, N., Stiles-Shields, C., Wafford, Q. E., & Graham, A. K. (2019). Digital Mental Health Interventions for Depression, Anxiety, and Enhancement of Psychological Well-Being among College Students: Systematic Review. *Journal of Medical Internet Research, 21,* e12869. https://doi.org/10.2196/12869

Leaf, P. J., Alegria, M., Cohen, P., Goodman, S. H., Horwitz, S. M., Hoven, C. W. et al. (1996). Mental Health Service Use in the Community and Schools: Results from the Four-Community MECA Study. *Journal of the American Academy of Child & Adolescent Psychiatry, 35,* 889-897. https://doi.org/10.1097/00004583-199607000-00014

Lipschitz, J., Miller, C. J., Hogan, T. P., Burdick, K. E., Lippin-Foster, R., Simon, S. R., & Burgess, J. (2019). Adoption of Mobile Apps for Depression and Anxiety: Cross-Sectional Survey Study on Patient Interest and Barriers to Engagement. *JMIR Mental Health, 6,* e11334. https://doi.org/10.2196/11334

Magklara, K., Bellos, S., Niakas, D., Stylianidis, S., Kolaitis, G., Mavreas, V., & Skapinakis, P. (2015). Depression in Late Adolescence: A Cross-Sectional Study in Senior High Schools in Greece. *BMC Psychiatry, 15,* Article No. 199. https://doi.org/10.1186/s12888-015-0584-9

Manzoni, G. M., Pagnini, F., Castelnuovo, G., & Molinari, E. (2008). Relaxation Training for Anxiety: A Ten-Years Systematic Review with Meta-Analysis. *BMC Psychiatry, 8,* Article No. 41. https://doi.org/10.1186/1471-244X-8-41

Marshall, J. M., Dunstan, D. A., & Bartik, W. (2020). Clinical or Gimmickal: The Use and Effectiveness of Mobile Mental Health Apps for Treating Anxiety and Depression. *Australian & New Zealand Journal of Psychiatry, 54,* 20-28. https://doi.org/10.1177/0004867419876700

McLaughlin, K. A., & King, K. (2015). Developmental Trajectories of Anxiety and Depression in Early Adolescence. *Journal of Abnormal Child Psychology, 43,* 311-323. https://doi.org/10.1007/s10802-014-9898-1

Measelle, J. R., Stice, E., & Hogansen, J. M. (2006). Developmental Trajectories of Co-Occurring Depressive, Eating, Antisocial, and Substance Abuse Problems in Female Adolescents. *Journal of Abnormal Psychology, 115,* 524-538. https://doi.org/10.1037/0021-843X.115.3.524

Morris, M. E., Kathawala, Q., Leen, T. K., Gorenstein, E. E., Guilak, F., DeLeeuw, W., & Labhard, M. (2010). Mobile Therapy: Case Study Evaluations of a Cell Phone Application for Emotional Self-Awareness. *Journal of Medical Internet Research, 12,* e10. https://doi.org/10.2196/jmir.1371

Myers, A., Chesebrough, L., Hu, R., Turchioe, M. R., Pathak, J., & Creber, R. M. (2020). Evaluating Commercially Available Mobile Apps for Depression Self-Management. In *AMIA Annual Symposium Proceedings* (Vol. 2020, p. 906). American Medical Informatics Association.

Nazi, K. M. (2013). The Personal Health Record Paradox: Health Care Professionals' Perspectives and the Information Ecology of Personal Health Record Systems in Organizational and Clinical Settings. *Journal of Medical Internet Research, 15,* e2443. https://doi.org/10.2196/jmir.2443

Nelemans, S. A., Hale, W. W., Branje, S. J., Raaijmakers, Q. A., Frijns, T., van Lier, P. A., & Meeus, W. H. (2014). Heterogeneity in Development of Adolescent Anxiety Disorder Symptoms in an 8-Year Longitudinal Community Study. *Development and Psychopathology, 26,* 181-202. https://doi.org/10.1017/S0954579413000503

Nicholas, J., Larsen, M. E., Proudfoot, J., & Christensen, H. (2015). Mobile Apps for Bipolar Disorder: A Systematic Review of Features and Content Quality. *Journal of Medical Internet Research, 17,* e4581. https://doi.org/10.2196/jmir.4581

Nolen-Hoeksema, S., & Hilt, L. M. (2009). Gender Differences in Depression. In I. H. Gotlib, & C. L. Hammen (Eds.), *Handbook of Depression* (pp. 386-404). The Guilford Press.

O'Brien, H. L., & Toms, E. G. (2008). What Is User Engagement? A Conceptual Framework for Defining User Engagement with Technology. *Journal of the American Society for Information Science and Technology, 59,* 938-955. https://doi.org/10.1002/asi.20801

Ohannessian, C. M., Milan, S., & Vannucci, A. (2017). Gender Differences in Anxiety Trajectories from Middle to Late Adolescence. *Journal of Youth and Adolescence, 46,* 826-839. https://doi.org/10.1007/s10964-016-0619-7

Palmer, K. M., & Burrows, V. (2021). Ethical and Safety Concerns Regarding the Use of Mental Health-Related Apps in Counseling: Considerations for Counselors. *Journal of Technology in Behavioral Science, 6,* 137-150. https://doi.org/10.1007/s41347-020-00160-9

Paraskevopoulos, I. (1999). *Interpersonal and Interpersonal Adjustment Questionnaire*. Ellinika Grammata.

Parker, G., & Brotchie, H. (2010). Gender Differences in Depression. *International Review of Psychiatry, 22,* 429-436. https://doi.org/10.3109/09540261.2010.492391

Petito, A., Pop, T. L., Namazova-Baranova, L., Mestrovic, J., Nigri, L., Vural, M. et al.

(2020). The Burden of Depression in Adolescents and the Importance of Early Recognition. *The Journal of Pediatrics, 218,* 265-267.
https://doi.org/10.1016/j.jpeds.2019.12.003

Pew Research Center (2018). *Mobile Fact Sheet.*

Pham, Q., Wiljer, D., & Cafazzo, J. A. (2016). Beyond the Randomized Controlled Trial: A Review of Alternatives in mHealth Clinical Trial Methods. *JMIR mHealth and uHealth, 4,* e5720. https://doi.org/10.2196/mhealth.5720

Proudfoot, J. G., Parker, G. B., Pavlovic, D. H., Manicavasagar, V., Adler, E., & Whitton, A. E. (2010). Community Attitudes to the Appropriation of Mobile Phones for Monitoring and Managing Depression, Anxiety, and Stress. *Journal of Medical Internet Research, 12,* e1475. https://doi.org/10.2196/jmir.1475

Qu, C., Sas, C., Roquet, C. D., & Doherty, G. (2020). Functionality of Top-Rated Mobile Apps for Depression: Systematic Search and Evaluation. *JMIR Mental Health, 7,* e15321. https://doi.org/10.2196/15321

Racine, N., McArthur, B. A., Cooke, J. E., Eirich, R., Zhu, J., & Madigan, S. (2021). Global Prevalence of Depressive and Anxiety Symptoms in Children and Adolescents during COVID-19: A Meta-Analysis. *JAMA Pediatrics, 175,* 1142-1150.
https://doi.org/10.1001/jamapediatrics.2021.2482

Rapee, R. (2012). Anxiety Disorders in Children and Adolescents: Nature, Development, Treatment and Prevention. In J. M. Rey (Ed.), *IACAPAP Textbook of Child and Adolescent Mental Health* (pp. 1-19). International Association for Child and Adolescent Psychiatry and Allied Professions.

Rapee, R. M. (2014). Preschool Environment and Temperament as Predictors of Social and Nonsocial Anxiety Disorders in Middle Adolescence. *Journal of the American Academy of Child & Adolescent Psychiatry, 53,* 320-328.
https://doi.org/10.1016/j.jaac.2013.11.014

Reyes-Portillo, J. A., Mufson, L., Greenhill, L. L., Gould, M. S., Fisher, P. W., Tarlow, N., & Rynn, M. A. (2014). Web-Based Interventions for Youth Internalizing Problems: A Systematic Review. *Journal of the American Academy of Child & Adolescent Psychiatry, 53,* 1254-1270. https://doi.org/10.1016/j.jaac.2014.09.005

Ribanszki, R., Fonseca, J. A. S., Barnby, J. M., Jano, K., Osmani, F., Almasi, S., & Tsakanikos, E. (2021). Preferences for Digital Smartphone Mental Health Apps among Adolescents: Qualitative Interview Study. *JMIR Formative Research, 5,* e14004.
https://doi.org/10.2196/14004

Rickwood, D. J., Deane, F. P., & Wilson, C. J. (2007). When and How Do Young People Seek Professional Help for Mental Health Problems? *Medical Journal of Australia, 187,* S35-S39. https://doi.org/10.5694/j.1326-5377.2007.tb01334.x

Rickwood, D., Webb, M., Kennedy, V., & Telford, N. (2016). Who Are the Young People Choosing Web-Based Mental Health Support? Findings from the Implementation of Australia's National Web-Based Youth Mental Health Service, Eheadspace. *JMIR Mental Health, 3,* e5988. https://doi.org/10.2196/mental.5988

Rudolph, K. D., Flynn, M., & Abaied, J. L. (2008). A Developmental Perspective on Interpersonal Theories of Youth Depression. In J. R. Z. Abela, & B. L. Hankin (Eds.), *Handbook of Depression in Children and Adolescents* (pp. 79-102). The Guilford Press.

Salmela-Aro, K. (2011). Stages of Adolescence. In *Encyclopedia of Adolescence* (pp. 360-368). Academic Press. https://doi.org/10.1016/B978-0-12-373951-3.00043-0

Schueller, S. M., Neary, M., O'Loughlin, K., & Adkins, E. C. (2018). Discovery of and Interest in Health Apps among Those with Mental Health Needs: Survey and Focus Group Study. *Journal of Medical Internet Research, 20,* e10141.

https://doi.org/10.2196/10141

Shen, N., Levitan, M. J., Johnson, A., Bender, J. L., Hamilton-Page, M., Jadad, A. A. R., & Wiljer, D. (2015). Finding a Depression App: A Review and Content Analysis of the Depression App Marketplace. *JMIR mHealth and uHealth, 3,* e3713. https://doi.org/10.2196/mhealth.3713

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory (form Y Self-Evaluation Questionnaire) Consulting*. Psychologists Press.

Stice, E., Hayward, C., Cameron, R. P., Killen, J. D., & Taylor, C. B. (2000). Body-Image and Eating Disturbances Predict Onset of Depression among Female Adolescents: A Longitudinal Study. *Journal of Abnormal Psychology, 109,* 438-444. https://doi.org/10.1037/0021-843X.109.3.438

Sweeney, G. M., Donovan, C. L., March, S., & Forbes, Y. (2019). Logging into Therapy: Adolescent Perceptions of Online Therapies for Mental Health Problems. *Internet Interventions, 15,* 93-99. https://doi.org/10.1016/j.invent.2016.12.001

Thompson, R. B., Peura, C., & Gayton, W. F. (2015). Gender Differences in the Person-Activity Fit for Positive Psychology Interventions. *The Journal of Positive Psychology, 10,* 179-183. https://doi.org/10.1080/17439760.2014.927908

Titov, N., Dear, B. F., Schwencke, G., Andrews, G., Johnston, L., Craske, M. G., & McEvoy, P. (2011). Transdiagnostic Internet Treatment for Anxiety and Depression: A Randomised Controlled Trial. *Behaviour Research and Therapy, 49,* 441-452. https://doi.org/10.1016/j.brat.2011.03.007

Torous, J., & Roberts, L. W. (2017). Needed Innovation in Digital Health and Smartphone Applications for Mental Health: Transparency and Trust. *JAMA Psychiatry, 74,* 437-438. https://doi.org/10.1001/jamapsychiatry.2017.0262

Torous, J., Firth, J., Huckvale, K., Larsen, M. E., Cosco, T. D., Carney, R. et al. (2018). The Emerging Imperative for a Consensus Approach toward the Rating and Clinical Recommendation of Mental Health Apps. *The Journal of Nervous and Mental Disease, 206,* 662-666. https://doi.org/10.1097/NMD.0000000000000864

Tucker, I., & Goodings, L. (2015). Managing Stress through the Stress Free App: Practices of Self-Care in Digitally Mediated Spaces. *Digital Health, 1.* https://doi.org/10.1177/2055207615580741

UNICEF (2018). *Ensuring Mental Health and Well-Being in an Adolescent's Formative Years Can Foster a Better Transition from Childhood to Adulthood.*

Villanti, A. C., Johnson, A. L., Ilakkuvan, V., Jacobs, M. A., Graham, A. L., & Rath, J. M. (2016). Adults' Media Use and Attitudes Report. *Journal of Medical Internet Research, 182,* 6.

Vos, T., Lim, S. S., Abbafati, C., Abbas, K. M., Abbasi, M., Abbasifard, M. et al. (2020). Global Burden of 369 Diseases and Injuries in 204 Countries and Territories, 1990-2019: A Systematic Analysis for the Global Burden of Disease Study 2019. *The Lancet, 396,* 1204-1222. https://doi.org/10.1016/S0140-6736(20)30925-9

Wartella, E., Rideout, V., Montague, H., Beaudoin-Ryan, L., & Lauricella, A. (2016). Teens, Health and Technology: A National Survey. *Media and Communication, 4,* 13-23. https://doi.org/10.17645/mac.v4i3.515

Werner-Seidler, A., O'Dea, B., Shand, F., Johnston, L., Frayne, A., Fogarty, A. S., & Christensen, H. (2017). A Smartphone App for Adolescents with Sleep Disturbance: Development of the Sleep Ninja. *JMIR Mental Health, 4,* e7614. https://doi.org/10.2196/mental.7614

Zacharopoulou, V., Tsironi, M., Zyga, S., Gialama, F., Zacharopoulou, G., Grammatiko-poulos, I. et al. (2014). Depressive Symptoms among Adolescent Students in Greek High Schools. *Health Psychology Research, 2,* 92-95. https://doi.org/10.4081/hpr.2014.1962