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# The COVID-19 Vaccine Anxiety Scale Teen Version: A Mental health screener for COVID-19 Vaccine Related Anxiety among Teenagers

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## Abstract:

**Objective**: The COVID-19 pandemic has had a profound impact on the physical life and psychological health of people worldwide. Not only have adults been affected, but children and adolescents have also suffered. The hope of a return to normal life was raised with the development of vaccines, but misinformation about the effectiveness and safety of the vaccines has created another psychological phenomenon, namely anxiety over the vaccinations themselves. Children are more vulnerable to be affected by such fears and anxiety. To address this problem, a unique scale was developed to measure anxiety among teenagers regarding COVID-19 vaccines, and the scale's psychometrics (validity& reliability) were evaluated.

Methods: Scale items were developed and after reaching 30 total items, item pooling and division of the items into five subscales were performed. These subscales measure Emotional, Cognitive, Physiological, Behavioral

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and Emotion Regulation dimensions. Data was collected from 1296 participants with an age range of 12-18. To check the psychometrics of the scale, Exploratory Factor Analysis, Variance, Rotated Factor Matrix, Construct Reliability and Validity along with Confirmatory Factor Analysis were performed.

Results: For the five dimensions that were developed, the Cronbach alpha reliability coefficients were: Emotional Dimension, 0.797; Cognitive Dimension, 0.857; Physiological Dimension, 0.951; Behavioral Dimension, 0.769; and Emotion Regulation, 0.900.

Conclusions: The developed scale is reliable and valid for measuring vaccination anxiety among teens. Future research should follow up this study with a more expansive population worldwide.

**Keywords:** COVID-19 Vaccine Anxiety Scale, COVID-19 Vaccine Anxiety Scale Teen Version, vaccine, anxiety, reliability, validity, Egypt.

## Background

The first wave of COVID-19 originated in the city of Wuhan, China at the end of 2019 and rapidly affected every region of the world. According to the World Health Organization, as of 27 August 2021, there were 215 million reported cases and the number of deaths had reached 4.7 million **(**WHO, 2021). Many researchers have reported that global contagious disease pandemics made many individuals suffer from fear and anxiety (Chong et al., 2004; Wheaton et al., 2012; Wu et al., 2009; Yip et al., 2010). Among health care workers in Egypt and Saudi Arabia, the disease caused anxiety and stress and even depression and sleep disturbances (Arafa et al., 2021). In some people, pre-existing PTSD, generalized anxiety, health anxiety, stress and death anxiety are predictors of enhanced pandemic anxiety (Wheaton et al., 2012). Nonetheless, some degree of Covid-19anxiety is common in virtually all people due to reasonable fears and uncertainty. Exacerbating the situation, ignorance and misinformation have added to many individuals' uncertainty and anxiety about the illness (Harper et al., 2020; Banerjee, 2020).

As of this writing, vaccines for COVID-19 are the only way to end this pandemic (Lurie et al., 2020). These vaccines are the most effective way to control, prevent, and build immunity in individuals for the disease. The efficacy of these already developed vaccines for society is effectively dependent on the vaccination rates of individuals. Increasing the rate of those who are vaccinated relies on individuals' willingness, which in turn depends on their attitudes toward and acceptance of the vaccines (Wang et al., 2020).With respect to children and adolescents, getting vaccinated is effectively dependent on parents' acceptance of the vaccine (Lazarus et al., 2021).The usefulness of COVID-19 vaccines against the pandemic will be

compromised if a large percentage of people choose not to get vaccinated (Murray &Piot, 2021). The COVID-19 pandemic led to radical changes in students' lifestyles, as education moved entirely to a virtual environment. This shift significantly impacted the educational process, causing numerous challenges for both students and teachers. (Atiyat & Abu Hamour, 2022).

Recent studies have emphasized the importance of psychometric validation in assessing vaccine-related anxiety. Khusaifan and Samak (2024) developed and validated the COVID-19 Vaccine Anxiety Scale (CVAS) for adults, demonstrating its reliability and validity across different dimensions of vaccine-related anxiety. Their findings highlight the necessity of tailored anxiety scales to address concerns specific to various age groups and demographics, which aligns with the objectives of this study in assessing adolescents' vaccine anxiety. Their research concluded that psychometrically validated scales provide accurate assessments that are crucial for designing mental health interventions related to vaccine hesitancy (Khusaifan & Samak, 2024).

One of the important and effective roles of health authorities must be to create awareness among the public regarding vaccine effectiveness and safety to get them to accept the vaccines and get vaccinated to prevent themselves and their children from getting the disease as well as halting the spread of the disease and the concomitant evolution of new variants. Some governments have assessed the acceptance rate among their citizens. As was reported in China, the acceptance rate is 91.3%, in Brazil, it is 85%, in African countries, mostly in South Africa, it is 79%, with the same rate in South Korea as well. About European countries, in France and Italy the acceptance rate is 62%. Russia has a 55% acceptance rate, while in the United States it is 76% (Neumann-Böhme et al., 2020; Detoc et al.,

2020; Pogue et al., 2020; Szilagyi et al., 2020; Daly & Robinson, 2020). There are still countries with low rates of vaccination acceptance, including some Arab countries, Central African nations, and Asian countries, where people are still rejecting vaccines, with many considering vaccination a serious threat to their health or even lives. In some Arab and African nations, vaccination acceptance is less than 30% (Sallam et al., 2020; Nzaji et al., 2020). When studying health care workers in Pakistan, Malik, Malik, and Ishaq, (2021) found that vaccine acceptance increases with increasing age but among reasons cited for vaccine hesitancy, concerns about vaccine effectiveness and side effects were prevalent. Magadmi and Kamel (2021) reported that among Saudi Arabian people, almost 55.3% had hesitancy and fearful thoughts regarding the Covid vaccinations. In the Egyptian population findings of Saied et al. (2020), it was observed that despite 90% of respondents agreeing that there is a need for vaccination, still more than 46% said they will not accept vaccination at this stage as they are fearful, phobic, and anxious regarding the effectiveness of COVID-19 vaccinations. These adult attitudes surely impact the mindsets of teens and adolescents as at this age, they are influenced by elders' decisions. Also, this age group is more vulnerable to developing anxiety symptoms regarding Covid vaccinations (Barth, 2021). Clearly, many individuals, including children, are facing fear and anxieties regarding vaccinations' consequences to their health. This contributed to improving the mental health of infected individuals and enhancing their ability to cope with the challenges they faced. (Ali, 2024, p. 525). According to Ali and Hassan (2023), The COVID-19 pandemic has significantly impacted all aspects of social and economic life, leading to the suspension of economic activities, the closure of educational institutions, and the imposition of lockdowns on populations in many countries.

Anxiety and fears about the disease and the pandemic can be due to a lack of scientific knowledge. And the same holds true for acceptance of COVID-19 vaccinations as well. This anxiety may expose people to false news about the acceptance and significance of COVID-19 vaccines. Anxiety and fear can destabilize one's immunity and make people more vulnerable to the coronavirus (Bajema et al., 2020, Chan et al., 2020). In similar previous situations (e.g., MERS, SARS), as well as for Covid, measurement scales were developed to measure the consequences of persistent illness, as well as vaccination acceptance, fears, and anxieties. (Pérez-Fuentes et al., 2020; Serrano-Mollar, 2012; Yohannes et al., 2013). In the current situation, itis essential to create valid scales to determine individuals' level of anxiety related to COVID-19 and vaccines, and develop strategies to deal with this situation, such as education on the effectiveness of vaccines against such diseases as well as their safety profile. Sufficient awareness of correct information about COVID-19 and vaccines may help keep people secure, but too much attention can also be psychologically disturbing and harmful (Taylor, 2019). The media also plays a vital role in both regards, disseminating truthful and correct scientific information while potentially triggering higher levels of anxiety and phobias (Kumar & Somani, 2020; Lee, 2020b; Hamza et al., 2020; Bodner et al., 2021)

A recent study of 775 adults in the United States found that people who became anxious about the coronavirus and whose performance was affected in various ways became frustrated, even suicidal, and attempted to cope via religious and alcohol/substance abuse (Lee, 2020a). Therefore, Lee (2020a) suggested that it is essential for healthcare experts to understand their patients' psychological state to help people with coronavirus anxiety and COVID-19 vaccination anxiety. This is particularly important for

individuals in their teenage years because teens can develop anxiety quickly and this may affect them their entire life span (Asmundson & Taylor 2020; Lee,2020b).

Thus, anxiety regarding vaccinations is becoming another global issue in addition to the COVID-19 pandemic itself. It is very important to consider its destructive effects on teens and adolescents. Negative information about vaccinations, trials, errors, failures, and fake news, etc., are making individuals, including those in this age group, more anxious regarding vaccines despite our knowing that this is the best way of survival in this pandemic. Because people are anxious about Covid vaccinations, there is a need for a suitable tool to assess individuals' vaccine anxiety so mental health care providers can design appropriate interventions and programs to reduce their fears. It is necessary to design a scale with good validity and reliability for measuring COVID-19 vaccination-related anxiety among all individuals as well as children and adolescents. This study aimed to determine the psychometric properties of the COVID-19 Vaccination Anxiety Scale Teen Version for individuals inthe age range from 12-18 in the Egyptian population.

## Purpose of the Study

Researchers have reported on studies of adults regarding COVID-19 vaccination anxiety and acceptance. However, there is a huge gap in the literature regarding younger people. So, the purpose of this research was to address such issues in the teenage population. To fill this gap and provide a reliable and valid screening scale, this work began by developing the COVID-19 Vaccine Anxiety Scale Teen Version (CVAS Teen Version) and then tested it with a sample of teens with an age range from 12-18 in Egypt.

## Methods

For this study, we used a cross-sectional research design for the collection of self-reported response survey data from Egypt-resident teens. Online consent was obtained from the guardians and caregivers of those teen participants to fulfil the ethical consideration. Parents and caregivers were briefly informed of the study's purpose. The workwas completed in two phases. In the first phase, item pooling was accomplished, resulting in five different dimensions for this scale. In the second phase, from the targeted sample of Egyptian teens with an age range from 12 to 18, data was collected from 1246 (male=786, female=460) participants. The data collection was performed over five months, from the 1st of January 2021 to the 31st of May, 2021.Data collection was conducted by having participants respond to questionnaires via Google Forms.

Item Pooling with Subscale Description

The COVID-19 Vaccination Anxiety Scale Teen Version is a unique scale, so to develop item pooling and division of the items into subdomains, first a systematic review of the literature was conducted. Then, expert opinion was obtained regarding theoretical aspects, literature, analysis, and finalization of scale items. This resulted in the division of items into five subdomains: Emotional Dimension (ED), Cognitive Dimension (CD), Physiological Dimension (PD), Behavioral Dimension (BD), and Emotion Regulation (ER). Responses for each scale item used a Likert scale ranging from 1 to 5 (1=strongly disagree, 2=disagree, 3=neutral, 4=agree and 5=strongly agree).

## Results

The final version of the COVID-19 Vaccination Anxiety Scale Teen Version is shown in the Appendix. Multivariate analyses were performed after specifying the suitable sample size; as per Preacher and MacCallum (2002), it should be not less than 200. In the current study, demographic data was collected via questionnaire. Among 1296 teen participants, 836(65.5%) were male and 460 (34.5%) females, the majority of whom (98.9%) were in the age range of 16-18 (Table1).

**Table 1 Demographical Profile of the Sample, n=1296**

| Variable | Category | *f* | % |
|---|---|---|---|
| **Gender** | Male | 836 | % 35.5 |
| | Female | 460 | % 64.5 |
| **Age** | Years 13-15 | 14 | 1.1% |
| | Years 16-18 | 1232 | 98.9% |

## Validating the Scale

This research sought to validate the scale that was used to measure five key dimensions, that is, Emotional Dimension (ED), Cognitive Dimension (CD), Physiological Dimension (PD), Behavioral Dimension (BD), and Emotion Regulation (ER). The latter, Emotion Regulation, was measured by two sub-dimensions, namely Reappraisal (RE) and Suppression (SUP). Being a study that used the scale for a new population, it was imperative, according to Judd, McClelland, and Ryan (2017), to ascertain whether the measurement items explained the dimensions well and this entailed the use of Exploratory Factor Analysis (EFA). To further validate the dimensions, construct validity was conducted using Confirmatory Factor Analysis (CFA).

## Exploratory Factor Analysis

Before the use of EFA, it was imperative to test the adequacy of the used sample. This was done through the Kaiser-Mayer-Olkin (KMO) measure of sampling adequacy (Loehlin& Beaujean, 2017). The results are presented in Table 2.

**Table 2 KMO and Bartlett's Test**

| | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | 953. |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 21784.977 |
| | df | 435 |
| | .Sig | 000. |

The results show that KMO = 0.953 and this was greater than the minimum expected 0.50 (Thompson, 2018), suggesting that the sample size for the sample data used was more than the minimum necessary size. Further, for Bartlett's test of sphericity, $\chi^2(435) = 62309.337$, $p<0.05$, and, again, this meant that the assumption was not violated. Since the focus of the analysis was to extract factors rather than reduce the items, the Principal Axis Factoring (PAF) method was considered instead of Principal Component Analysis (PCA). Further, the constructs were assumed to be marginally correlated or not correlated at all, hence the orthogonal rotation. The importance of each of the items used in the factor analysis was then determined through the computation of the communalities. These indicated the amount of variance in each variable that is accounted for and, according to Little (2013), the minimum variance expected is 0.40. The results are summarized in Table 3.

None of the communalities was less than 0.40, with the minimum

observed being 0.514 for the item: "I experience chest discomfort when I read or listen to COVID-19 vaccine news." The second lowest item had a communality of 0.520 and this was: "I feel nauseous when I think of getting the COVID-19 vaccine." The variances are presented in Table 4.

**Table 3 Scale Items and Communalities**

| | Initial | Extraction |
|---|---|---|
| I find it difficult to relax when I think about taking the COVID-19 vaccine. | .450 | .603 |
| The thought of getting a vaccination makes me restless. | .481 | .569 |
| Even after information about vaccine trials and success rates, I am not able to control my worry. | .452 | .553 |
| I am afraid that the vaccine could cause possible harm to me and my family. | .495 | .584 |
| I am scared that the COVID-19 vaccine could cause the disease. | .491 | .562 |
| I use to have repetitive negative thoughts about the consequences of COVID | .461 | .530 |
| I am fearful of the side effects of the COVID-19 vaccine. | .466 | .536 |
| I am scared that the COVID-19 vaccine could cause some sort of deformity or dysfunction in my body. | .456 | .525 |
| I experience shortness of breath when I think of taking COVID | .424 | .550 |
| I experience chest discomfort when I read or listen to the COVID-19 vaccine news. | .396 | .514 |
| I feel nauseous when I think of getting the COVID-19 vaccine. | .392 | .520 |

| | | |
|---|---|---|
| I experience loosening of bowels when think of taking the COVID-19 vaccine. | .663 | .695 |
| My heart starts to run faster when I think or read about the COVID-19 vaccine. | .658 | .691 |
| I feel some sensation in my muscles when I think about getting the COVID-19 vaccine. | .664 | .691 |
| I experience pain in my muscles when I think of getting the COVID-19 vaccine. | .680 | .713 |
| I experience hot and cold flushes when I think about getting the COVID-19 vaccine. | .651 | .678 |
| I feel numb when I think of taking the COVID-19 vaccine. | .647 | .676 |
| I frequently check for vaccine validation facts to ensure its effectiveness. | .668 | .697 |
| The thought of taking the COVID 19 vaccine causes difficulty in falling asleep and bad dreams. | .622 | .646 |
| I would prefer to avoid vaccines in case it's not compulsory | .655 | .687 |
| When I want to feel happier, I think about something different | .518 | .575 |
| When I want to feel less bad (e.g., sad, angry, worried) I think about something different. | .538 | .596 |
| When I'm worried about something; I make myself think about it in a way that helps me feel better. | .509 | .566 |
| When I want to feel happier about something, I change the way I'm thinking about it. | .527 | .592 |
| I control my feelings about things by changing the way I think about them. | .530 | .579 |

| | | |
|---|---|---|
| When I want to feel less bad about something I change the way I'm thinking about it. | .537 | .600 |
| I keep my feelings to myself. | .511 | .606 |
| When I am feeling happy, I am careful not to show it. | .498 | .588 |
| I control my feelings by not showing them. | .499 | .594 |
| When I'm feeling bad (e.g., sad, angry, worried), I am careful not to show it. | .474 | .558 |
| *Note.* Extraction Method: Principal Axis Factoring. | | |

**Table 4 Variance Explained by Factors**

| Factor | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | % Of Variance | Cumulative % | Total | % Of Variance | Cumulative % | Total | % Of Variance | Cumulative % |
| 1 | 9.378 | 31.261 | 31.261 | 9.008 | 30.028 | 30.028 | 6.300 | 21.001 | 21.001 |
| 2 | 5.134 | 17.114 | 48.375 | 4.727 | 15.756 | 45.784 | 3.764 | 12.547 | 33.548 |
| 3 | 2.254 | 7.512 | 55.887 | 1.852 | 6.174 | 51.958 | 2.991 | 9.971 | 43.520 |
| 4 | 1.539 | 5.129 | 61.016 | 1.104 | 3.680 | 55.638 | 2.105 | 7.016 | 50.536 |
| 5 | 1.181 | 3.935 | 64.951 | .737 | 2.455 | 58.094 | 1.504 | 5.014 | 55.550 |
| 6 | 1.074 | 3.580 | 68.531 | .644 | 2.147 | 60.240 | 1.407 | 4.690 | 60.240 |
| 7 | .532 | 1.774 | 70.305 | | | | | | |
| 8 | .519 | 1.729 | 72.034 | | | | | | |
| 9 | .500 | 1.666 | 73.699 | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 10 | .493 | 1.642 | 75.342 | | | | | | |
| 11 | .482 | 1.606 | 76.948 | | | | | | |
| 12 | .462 | 1.541 | 78.489 | | | | | | |
| 13 | .458 | 1.528 | 80.018 | | | | | | |
| 14 | .441 | 1.470 | 81.487 | | | | | | |
| 15 | .430 | 1.432 | 82.920 | | | | | | |
| 16 | .424 | 1.412 | 84.332 | | | | | | |
| 17 | .409 | 1.364 | 85.696 | | | | | | |
| 18 | .398 | 1.325 | 87.021 | | | | | | |
| 19 | .393 | 1.309 | 88.330 | | | | | | |
| 20 | .384 | 1.279 | 89.610 | | | | | | |
| 21 | .369 | 1.230 | 90.840 | | | | | | |
| 22 | .363 | 1.210 | 92.050 | | | | | | |
| 23 | .337 | 1.122 | 93.172 | | | | | | |
| 24 | .327 | 1.089 | 94.261 | | | | | | |
| 25 | .312 | 1.040 | 95.301 | | | | | | |
| 26 | .304 | 1.013 | 96.314 | | | | | | |
| 27 | .290 | .966 | 97.279 | | | | | | |
| 28 | .286 | .952 | 98.232 | | | | | | |
| 29 | .274 | .915 | 99.146 | | | | | | |
| 30<br>.256<br>.854<br>100.000 | | | | | | | | | |
| *Note.* Extraction Method: Principal Axis Factoring. | | | | | | | | | |

According to Hoyle (2012) and Hancock and Mueller (2013), the minimum expected eigenvalue is 1.0 and from the results, six factors had eigenvalues that were greater than 1.0. This meant that out of all the items, six factors had been extracted. Factor 1, whose eigenvalue was $\lambda = 9.378$, explained the greatest variance of 21.001%, followed by Factor 2 ($\lambda = 5.134$) which explained 12.547% of the variance. Factor 3 ($\lambda = 2.254$) explained 9.971% of the variance, Factor 4 ($\lambda = 1.539$) explained 7.016% of the variance, while Factor 5 ($\lambda = 1.181$) explained 5.014% of the variance. Finally, Factor 6 ($\lambda = 1.074$), explained 4.690% of the variance. The cumulative variance explained was 60.240% and is greater than the minimum criterion of50%; this confirmed that the extracted factors were valid (Byrne, 2016; Thompson, 2018; Gana and Broc, 2019). Table 5 presents the rotated factor matrix.

The outcomes show that six factors had been extracted. Comparing the items with factor loadings greater than 0.50 (Bandalos & Finney, 2010; Thompson, 2018), it can be seen that for Factor 1, the items measured the *Physiological Dimension*, for Factor 2, they measured *Reappraisal*, for Factor 3, they measured the *Cognitive Dimension,* for the fourth factor, the items measured *Suppression*, for Factor 5, the items measured the *Behavioral Dimension*, and lastly, Factor 6 items measured the *Emotional Dimension*. It should be noted that the EFA result had grouped the dimensions according to the original conceptualized form and this confirms that the scale was good.

## Construct Reliability

According to Howitt and Cramer (2017), the reliability of the research constructs ought to be tested before their use in modelling to evaluate

internal consistency. In this regard, it was necessary to ensure that the reliability of the underlying variables used in the research was tested.

**Table 5 Rotated Factor Matrix**

| Items | Factor | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| | .232 | .041 | .279 | .095 | .104 | **.671** |
| | .291 | .068 | .367 | .025 | .132 | **.572** |
| | .230 | .032 | .310 | .073 | .170 | **.607** |
| | .240 | .038 | **.702** | .026 | .139 | .108 |
| | .233 | .001 | **.675** | .041 | .119 | .188 |
| | .241 | .043 | **.656** | .074 | .123 | .140 |
| | .239 | .051 | **.657** | .058 | .130 | .156 |
| | .221 | .059 | **.664** | .046 | .106 | .135 |
| | .273 | .081 | .209 | .042 | **.639** | .128 |
| | .276 | .119 | .166 | .001 | **.619** | .111 |
| | .233 | .099 | .197 | -.00 | **.639** | .087 |
| | **.797** | .006 | .173 | .059 | .138 | .086 |
| | **.804** | .017 | .164 | .028 | .108 | .071 |
| | **.794** | -.01 | .191 | .032 | .115 | .099 |
| | **.808** | -.00 | .162 | .070 | .133 | .107 |
| | **.770** | .002 | .206 | .015 | .178 | .106 |
| | **.788** | -.01 | .159 | .046 | .120 | .113 |
| | **.791** | .000 | .185 | .032 | .148 | .121 |
| | **.768** | .033 | .174 | .018 | .122 | .100 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **.785** | -.02 | .212 | .059 | .074 | .131 |
| | .000 | **.728** | .004 | .205 | .038 | .032 |
| | -.019 | **.737** | .069 | .212 | .041 | .012 |
| | -.011 | **.733** | .005 | .151 | .079 | .008 |
| | .009 | **.754** | .013 | .150 | .030 | .002 |
| | -.012 | **.719** | .056 | .226 | .058 | .068 |
| | .010 | **.750** | .045 | .173 | .069 | .009 |
| | .061 | .347 | .079 | **.689** | .011 | .030 |
| | .103 | .345 | .055 | **.672** | .008 | .057 |
| | .064 | .327 | .040 | **.690** | .012 | .073 |
| | .020 | .331 | .062 | **.665** | .036 | .025 |
| *Note:* Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization. Rotation converged in 6 iterations. | | | | | | |
| | | | | | | |

To achieve this, Cronbach's alpha was computed and, as per Kilic (2008), the minimum acceptable alpha was 0.70. The results are summarized in Table 6.

From the outcome, none of the constructs had a reliability alpha that was less than the minimum criterion of0.70. The minimum observed alpha was for the construct *Behavioral Dimension* ($\alpha = 0.744$) and thus the results show that the dimensions used met the reliability requirements.

**Table 6 Reliability Testing**

| Construct | N of items | Alpha |
|---|---|---|
| Emotional Dimension | 3 | .797 |
| Cognitive Dimension | 5 | .857 |
| Physiological Dimension | 9 | .951 |
| Behavioral Dimension | 3 | .769 |
| Emotion Regulation | 10 | .900 |
| Reappraisal (RE) | 6 | .893 |
| Suppression (SUP) | 4 | .849 |

## Test-Retest Reliability

To confirm test-retest reliability, we used intraclass correlation coefficients (ICCs) and Kappa coefficients (KCs). ICCs are an ideal index to measure the scale's test-retest reliability with reflecting correlation along with agreement (Portney & Watkins, 2009). To quantify the agreement level, KCs were used on categorical variables for assessing the inter-rated and test-retest reliability for clinical scales (Brenner & Kliebsch, 1996). For all domains of this scale, the average ICC score was 0.901 and average KC was 0.867, which showed considerable test-retest reliability for all five sub-dimensions of the scale (see Table 7).

**Table 7** *Test-retest Reliability*

| | ED | CD | BD | PD | RE | SUP |
|---|---|---|---|---|---|---|
| ICC | 0.891 | 0.911 | 0.861 | 0.902 | 0.931 | 0.911 |
| KC | 0.856 | 0.812 | 0.941 | 0.821 | 0.871 | 0.904 |

*Note:* ICC=intraclass correlation coefficient, KC= Kappa coefficient

## Construct Validity

Having tested the reliability of the constructs, it was also essential to validate whether the constructs were valid. To achieve this, confirmatory factor analysis was also carried out, over and above the exploratory factor analysis, and the measurement model is shown in Figure 1.

The validity of the constructs was tested by measuring both the convergent and discriminant validity. The convergent validity of the constructs was measured using the Average Variance Extracted (AVE), which, according to Hox (2013) and Kline (2016), ought to be at least 0.50. On the other hand, the discriminant validity was tested using the Heterotrait-Monotrait Ratio (HTMT), which, according to Fox et al. (2012), Brown (2015), and Kline (2016), ought to be less than 0.85. The results for both tests are presented in Table 8.

Concerning convergent validity, the minimum AVE was 0.526 for the Reappraisal (RE) construct and because all the AVEs were greater than 0.50, this confirms that the convergent validity assumption was not violated. On the other hand, the highest HTMT score was 0.694, between the Behavioral Dimension (BD) and Suppression (SUP), and because this was less than the maximum tolerable threshold of 0.85, it confirms that the discriminant validity was not violated. Therefore, by and large, the constructs used in the study were reliable and valid.

**Table 8 Convergent and Discriminant Validity**

| | CR | AVE | MSV | MaxR(H) | ED | CD | BD | PD | RE | SUP |
|---|---|---|---|---|---|---|---|---|---|---|
| ED | 0.951 | 0.684 | 0.309 | 0.951 | 0.827 | | | | | |
| CD | 0.893 | 0.581 | 0.422 | 0.893 | 0.031 | 0.762 | | | | |
| BD | 0.857 | 0.545 | 0.482 | 0.857 | ***0.556 | ***0.120 | 0.738 | | | |
| PD | 0.849 | 0.584 | 0.422 | 0.849 | ***0.149 | ***0.649 | ***0.191 | 0.764 | | |
| RE | 0.769 | 0.526 | 0.308 | 0.770 | ***0.555 | ***0.210 | ***0.539 | ***0.149 | 0.725 | |
| SUP | 0.796 | 0.566 | 0.482 | 0.797 | ***0.548 | ***0.134 | ***0.694 | ***0.214 | ***0.523 | 0.752 |

Note. ***p>.001

*AVE, Average Variance Extracted; CR, Composite Reliability; MaxR (H), maximum reliability; MSV, Maximum Shared Squared Variance.*

**Table 9 Confirmatory Factor Analysis (CFA) Model Fit Summary**

## CMIN

| Model | NPAR | CMIN | DF | P | CMIN/DF |
|---|---|---|---|---|---|
| Default model | 75 | 437.851 | 390 | .047 | 1.123 |
| Saturated model | 465 | .000 | 0 | | |
| Independence model | 30 | 21975.277 | 435 | .000 | 50.518 |

## Baseline Comparisons

| Model | NFI Delta1 | RFI rho1 | IFI Delta2 | TLI rho2 | CFI |
|---|---|---|---|---|---|
| Default model | .980 | .978 | .998 | .998 | .998 |
| Saturated model | 1.000 | | 1.000 | | 1.000 |
| Independence model | .000 | .000 | .000 | .000 | .000 |

## Parsimony-Adjusted Measures

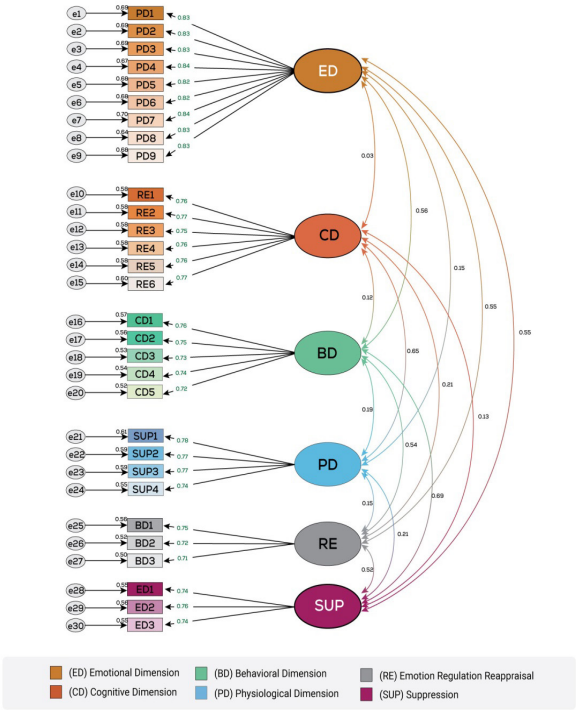
| Model | PRATIO | PNFI | PCFI |
|---|---|---|---|
| Default model | .897 | .879 | .895 |
| Saturated model | .000 | .000 | .000 |
| Independence model | 1.000 | .000 | .000 |

## RMSEA

| Model | RMSEA | LO 90 | HI 90 | PCLOSE |
|---|---|---|---|---|
| Default model | .010 | .001 | .015 | 1.000 |
| Independence model | .199 | .197 | .201 | .000 |

*Table 9 presents the CFA model fit summary, including key goodness-of-fit indices such as CMIN/DF, NFI, RFI, IFI, TLI, CFI, and RMSEA. The results indicate a good model fit, with the default model showing favorable comparative fit indices (CFI = 0.998) a*

**Figure 1 Measurement Model: Confirmatory Factor Analysis**




This structural equation model (SEM) diagram illustrates the relationships between different dimensions of emotional regulation, suppression, and their associated observed indicators. The latent variables include Emotional Dimension (ED), Cognitive Dimension (CD), Behavioral Dimension (BD), Physiological Dimension (PD), Emotion Regulation Reappraisal (RE), and Suppression (SUP). Each latent variable is measured by multiple observed indicators (PD1–PD9, RE1–RE6, CD1–CD5, SUP1–SUP4, BD1–BD3, and ED1–ED3), with standardized factor loadings shown for each. Correlations between latent variables are indicated with curved arrows, highlighting the strength and direction of associations.

## CFA Model Goodness of Fit

According to Wang and Wang (2019), it is crucial to evaluate the goodness Off it of the structural equation model. In this respect, several indices were reviewed. These comprised the $\chi^2$/df which, according to Fox et al. (2012) and Arbuckle (2016), should be less than 3.0. The second layers were the baseline comparisons, and these included the normed fit index (NFI) as well as the comparative fit index (CFI), both of which ought to be greater than 0.90 (Boomsma, Hoyle, & Panter, 2012; Hoyle, 2012; Arbuckle, 2016). Parsimony adjusted measures, which included the parsimonious normed fit index (PNFI) and the parsimonious comparative fit index (PCFI), were also calculated. These were expected to be greater than 0.50 (Gefen, Rigdon, &Straub, 2011; Wang &Wang, 2019). Lastly, the Root Mean Square Error of Approximation (RMSEA) is based on the non-centrality index and should be less than 0.08. The model fit results from the analysis are presented in Table 9.

From the findings, $\chi^2$/df = 1.123, which is <3.0 and thus was less than the maximum acceptable threshold. For the baseline comparisons, NFI = 0.980, which is >0.90, RFI = 0.978>0.90, IFI = 0.998>0.90, TLI = 0.998>0.90 and CFI = 0.998>0.90. Regarding the parsimony adjusted measures, PNFI = 0.879>0.50, while the PCFI was 0.895>0.50. Lastly, the RMSEA statistic was 0.010<0.08 and thus was within the desired threshold. The overall conclusion was that the CFA model and the results therefrom were valid.

## Discussion

Considering the worldwide COVID-19 pandemic and its psychological effects on individuals, this research aimed to investigate the psychometric properties of the teen version of the COVID-19 Vaccination Anxiety

Scale. The results showed that the CVAS Teen Version with a five-dimensional structure has good psychometric properties.

In this study, to evaluate the convergent validity, the CVAS Teen Version's five sub-dimensions – Emotional Dimension, Cognitive Dimension, Physiological Dimension, Behavioral Dimension, and Emotion Regulation, the latter with two sub-dimensions, Reappraisal and Suppression– were used. The lowest AVE statistic was 0.526 (for the Reappraisal construct) and all the AVEs were greater than 0.50, thus validating that the convergent validity assumption was not violated. The outcomes associated with construct validity also showed that the six-factor structure has a good model fit.

For variance explanation, factor analysis was used. As discussed in the Exploratory Factor Analysis section, the cumulative variance explained was 60.24%, which is greater than the minimum criterion of50%. This confirmed that the extracted factors were valid (Byrne, 2016; Thompson, 2018; Gana & Broc, 2019).

The CVAS Teen Version demonstrated excellent internal consistency and the Cronbach's alpha coefficients on all five dimensions conformed to the necessary criteria. These results were consistent with Lee's (2020a) main study, which reported Cronbach's alpha of 0.93 for the Coronavirus Anxiety Scale, and were in line with the results of the COVID-19 vaccination acceptance scale (Esteban et al., 2021) which was 0.83. Also, all items had good content validity, indicating that all questions were related to anxiety about COVID-19 vaccination for the age range of 12-18. Construct reliability was also confirmed on all five subdomains of the CVAS Teen Version as it was found that the Emotional Dimension's $\alpha = 0.797$, the

Cognitive Dimension's α = 0.857, the Physiological Dimension's α = 0.951, the Behavioral Dimension's α = 0.769 and Emotion Regulation's α = 0.900, while for Emotional Regulation's two sub-dimensions, Reappraisal hadα = 0.893 and Suppression had α = 0.849. Also, test-retest reliability using ICC and KC was acceptable. These findings confirmed that the reliability of the research constructs ought to be tested before their use in modelling to evaluate the internal consistency (Howitt & Cramer, 2017). In this regard, none of the constructs had a reliability alpha that was less than the minimum criterion of0.70. The results showed that the dimensions used met the reliability requirements.

The outcomes of this research study are consistent with those of Evren et al. (2020). In their research, the Cronbach's alpha for the Coronavirus Anxiety Scale (CAS) was reported to be 0.80. In addition, CAS showed a positive correlation with the Fear of COVID-19 Scale (Ahorsu et al., 2020) and the Corona Obsession Scale (Lee, 2020b). The diagnostic accuracy of CAS is also comparable to other psychiatric screening tools (Evren et al., 2020).

The results demonstrated that the CVAS Teen Version had significant positive correlation with all five sub-dimensions, which indicates that the scale can detect whether respondents indeed have vaccination anxiety as well as significant emotional, cognitive, physiological, behavioral, and emotional regulation symptoms, which have more deleterious effects on the psychological health of teens. These findings are also in tune with other studies, such as Ahorsu et al. (2020), Harper et al. (2020), and Lee (2020).

Both sub-dimensions of Emotion Regulation had significant positive associations with other dimensions of the CVAS Teen Version. Difficulties

in emotional regulation are important to detect by health care professionals. Gross and Jazaieri (2014) reported that difficulty in regulating emotion is the inability to control emotional responses to the stimuli that produce those emotions and such individuals experience emotional states in maladaptive ways. Silk et al. (2003) stated that emotion regulation problems have been identified in more than half of the first and second axis disorders, which was also shown in the research study of Repetti et al. (2002). According to Ochsner and Gross (2007), many psychiatric disorders are associated with emotional instability and emotional dysregulation. Emotional dysregulation is particularly strongly correlated with depression and anxiety disorders (Phillips et al., 2002; Mennin, 2004).

Higher CVAS Teen Version scores are associated with negative psychological effects and maladaptive strategies, such as difficulty regulating emotion when experiencing coronavirus vaccination anxiety (Mohammadpour et al., 2020). As already discussed, many suffer anxiety about the COVID-19 disease; for example, health care workers have been reported to experience anxiety due to exposure to patients suspected or confirmed to have COVID-19 (Lai et al., 2020). Nonetheless, such individuals may also be afraid and anxious concerning the effectiveness of COVID-19 vaccinations (Lee, 2020a). It can be assumed that people who cannot control their emotions regarding COVID-19 may experience anxiety regarding vaccinations. And those individuals have a strong impact on their younger family members, including teens and adolescents, leading them to decline vaccines or develop more fear and anxiety regarding the consequences of COVID-19 vaccinations.

The divergent validity of the scale was also evaluated. According to the results, the highest HTMT score was 0.694, between the Behavioral

Dimension and Suppression, one of the sub-domains of Emotion Regulation, and because this was less than the maximum tolerable threshold of 0.85, this confirms that the discriminant validity was not violated. Similarly, the CFA model fit met the criteria and did not violate the threshold, which served as validation of this model. These findings indicate that individuals in the age range of 12-18 are less flexible and will have more anxiety regarding Covid vaccination. While in such a situation, the age group of 12-18 is more vulnerable to develop symptoms and psychological issues due to fear and anxiety regarding the vaccinations' effects(Barth, 2021). Studies have shown that individuals with high avoidance experience more emotional responses to stimuli and report severe symptoms of stress and anxiety (Tull et al., 2004; Solan, 2004). These findings are consistent with the outcomes of other research studies that have examined the psychological effects of the COVID-19 pandemic, including Zhang et al. (2020), Liu et al. (2020), and Li et al. (2020).

## Limitations and Suggestions

There are also some limitations to this study. First, in the current research, participants belonged to the general Egyptian teen population and no formal diagnoses regarding mood or mental disorders were considered (e.g., generalized anxiety, stress, etc.). Second, there is no doubt that there is subjectivity involved in anxiety and it not easy to assess objectivity. Third, we used a convenient sampling method, which may affect the generalizability of the results.

It is suggested that in future studies, this tool be tested in individuals known to have hesitancy and fear and anxieties regarding COVID-19 vaccinations in a large sample to determine its sensitivity and specificity. A

further suggestion is that to overcome fake news about the vaccines, which trigger anxieties, it is important to provide reliable and credible sources of information, and public awareness programs should be developed to disseminate the facts regarding the safety of the vaccines.

## Conclusion

The present study confirmed that the CVAS Teen Version, based on five dimensions, has good psychometric properties that can be used to assess anxieties among teens regarding COVID-19 vaccination. Therefore, therapists, health professionals, and researchers can use this screening tool to diagnose COVID-19 vaccination anxiety in individuals aged between 12 and18.

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## Appendix

## Final Version of Covid Vaccination Anxiety Teen Version

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| **1.** I find it difficult to relax when I think about taking the COVID-19 vaccine. | | | | | |
| **2.** The thought of getting a vaccination makes me restless. | | | | | |
| **3.** Even after information about vaccine trials and success rates, I am not able to control my worry. | | | | | |
| **4.** I am afraid that the vaccine could cause possible harm to me and my family. | | | | | |
| **5.** I am scared that the COVID-19 vaccine could cause the disease. | | | | | |
| **6.** I use to have repetitive negative thoughts about the consequences of COVID | | | | | |
| **7.** I am fearful of the side effects of the COVID-19 vaccine. | | | | | |
| **8.** I am scared that the COVID-19 vaccine could cause some sort of deformity or dysfunction in my body. | | | | | |
| **9.** I experience shortness of breath when I think of taking COVID | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **10.** I experience chest discomfort when I read or listen to COVID-19 vaccine news. | | | | | |
| **11.** I feel nauseous when I think of getting the COVID-19 vaccine. | | | | | |
| **12.** I experience loosening of bowels when think of taking the COVID-19 vaccine. | | | | | |
| **13.** My heart starts to run faster when I think or read about the COVID-19 vaccine. | | | | | |
| **14.** I feel some sensation in my muscles when I think about getting the COVID-19 vaccine. | | | | | |
| **15.** I experience pain in my muscles when I think of getting the COVID-19 vaccine. | | | | | |
| **16.** I experience hot and cold flushes when I think about getting the COVID-19 vaccine. | | | | | |
| **17.** I feel numb when I think of taking the COVID-19 vaccine. | | | | | |
| **18.** I frequently check for vaccine validation facts to ensure its effectiveness. | | | | | |
| **19.** The thought of taking the COVID 19 vaccine causes difficulty in falling asleep, broken sleep, and 2 bad dreams. | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| **20.** I would prefer to avoid vaccines in case it's not compulsory | | | | | |
| **21.** When I want to feel happier I think about something different | | | | | |
| **22.** When I want to feel less bad (e.g., sad, angry, worried) I think about something different. | | | | | |
| **23.** When I'm worried about something; I make myself think about it in a way that helps me feel better. | | | | | |
| **24.** When I want to feel happier about something, I change the way I'm thinking about it. | | | | | |
| **25.** I control my feelings about things by changing the way I think about them. | | | | | |
| **26.** When I want to feel less bad (e.g., sad, angry, worried )about something I change the way I'm thinking about it. | | | | | |
| **27.** I keep my feelings to myself. | | | | | |
| **28.** When I am feeling happy, I am careful not to show it. | | | | | |
| **29.** I control my feelings by not showing them. | | | | | |
| **30.** When I'm feeling bad (e.g., sad, angry, worried ), I am careful not to show it. | | | | | |

## List of Abbreviations in the Manuscript:

**COVID-19** - Coronavirus Disease 2019

**CFA** - Confirmatory Factor Analysis

**CMIN** - Minimum Discrepancy (Chi-square fit statistic)

**DF** - Degrees of Freedom

**P** - Probability Value

**CMIN/DF** - Chi-square divided by Degrees of Freedom (Model Fit Index)

**NFI** - Normed Fit Index

**RFI** - Relative Fit Index

**IFI** - Incremental Fit Index

**TLI** - Tucker-Lewis Index

**CFI** - Comparative Fit Index

**PRATIO** - Parsimony Ratio

**PNFI** - Parsimony Normed Fit Index

**PCFI** - Parsimony Comparative Fit Index

**RMSEA** - Root Mean Square Error of Approximation

**LO 90** - Lower Bound of 90% Confidence Interval for RMSEA

**HI 90** - Upper Bound of 90% Confidence Interval for RMSEA

**PCLOSE** - Probability of Close Fit

**EFA** - Exploratory Factor Analysis

**KMO** - Kaiser-Meyer-Olkin Measure of Sampling Adequacy

**ICC** - Intraclass Correlation Coefficient

**KC** - Kappa Coefficient

**AVE** - Average Variance Extracted

**CR** - Composite Reliability

**MSV** - Maximum Shared Variance

**HTMT** - Heterotrait-Monotrait Ratio

**PD** - Physiological Dimension

**CD** - Cognitive Dimension

**ED** - Emotional Dimension

**BD** - Behavioral Dimension

**ER** - Emotion Regulation

**RE** - Reappraisal

**SUP** - Suppression

**WHO** - World Health Organization

**PTSD** - Post-Traumatic Stress Disorder

**SPSS** - Statistical Package for the Social Sciences

# مقياس قلق لقاح كوفيد - 19 للمراهقين: مقياس لتقييم القلق المرتبط بلقاحات كوفيد - 19 بين المراهقين في مصر

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## ملخص البحث:

الهدف: كان لجائحة كوفيد19- تأثيرات هائلة على الحياة الجسدية والصحة النفسية للأشخاص في جميع أنحاء العالم. لم يتأثر البالغون فقط، بل عانى الأطفال والمراهقون أيضًا. وقد أُثير الأمل بالعودة إلى الحياة الطبيعية مع تطوير اللقاحات، لكن انتشار المعلومات المضللة بشأن فعالية وسلامة اللقاحات خلق ظاهرة نفسية جديدة، وهي القلق بشأن اللقاحات نفسها. الأطفال أكثر عرضة للتأثر بمثل هذه المخاوف والقلق. لمعالجة هذه المشكلة، تم تطوير مقياس فريد لقياس القلق بين المراهقين بشأن لقاحات كوفيد19-، وتم تقييم الخصائص السيكومترية للمقياس

المنهجية: تم تطوير عناصر المقياس وبعد الوصول إلى 30 عنصرًا إجمالاً، تم تجميع العناصر وتقسيمها إلى خمسة أبعاد فرعية. تقيس هذه الأبعاد الجوانب: العاطفية، والمعرفية، والفسيولوجية، والسلوكية، وتنظيم الانفعالات. تم جمع البيانات من 1296 مشاركًا تتراوح أعمارهم بين 18-12 عامًا. للتحقق من الخصائص السيكومترية للمقياس، تم إجراء تحليل العوامل الاستكشافية، وتحليل التباين، ومصفوفة العوامل المدورة، والصلاحية الإنشائية والموثوقية، بالإضافة إلى تحليل العوامل التأكيدي

النتائج: بالنسبة للأبعاد الخمسة التي تم تطويرها، كانت معاملات ألفا كرونباخ لموثوقية المقياس كالتالي: البعد العاطفي، 0.797؛ والبعد المعرفي، 0.857؛ والبعد الفسيولوجي، 0.951؛ والبعد السلوكي، 0.769؛ وتنظيم الانفعالات، 0.900.

الخلاصة: المقياس المطور موثوق وصالح لقياس قلق اللقاحات بين المراهقين. يجب أن تتابع الدراسات المستقبلية هذه الدراسة مع عينة أكبر من السكان على مستوى العالم

**الكلمات الدالة:** مقياس قلق لقاح كوفيد19-، نسخة المراهقين لمقياس قلق لقاح كوفيد19-، اللقاح، القلق، الصدق، الصلاحية، مصر

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