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An Examination of Factor Structure of the Hamilton Anxiety Rating Scale in a Non-Clinical Persian Sample

[1]Paul Slater, [2]Brendan Bunting, [1]Felicity Hasson, [3]Ahmed Mohammad Al-Smadi, [3]Omar Salem Gammouh, [4]Ala Ashour and [5]Damian Jordan

[1]Institute of Nursing and Health Research, Ulster University, Coleraine, Northern Ireland
[2]Psychology Research Institute, Ulster University, Coleraine, Northern Ireland
[3]Faculty of Health Science, American University of Madaba, Jordan
[4]Faculty of Nursing, Hashemite University, Zarqa Jordan
[5]Belfast Health and Social Care Trust, Northern Ireland

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Corresponding Author:
Paul Slater
Institute of Nursing and Health Research, Ulster University, Coleraine, Northern Ireland
Email: pf.slater@ulster.ac.uk

Abstract: The Hamilton Anxiety Rating Scale is an internationally used assessment tool for anxiety level however its acceptable factor structure remains fluid. The aim of this paper is to examine the psychometric properties and establish normative anxiety prevalence rates with a Persian randomized sample. A cross sectional survey was distributed to a randomised sample of adults (n = 1260) in the Middle East. A two-factor model was deemed the most statistically and theoretically appropriate measurement model. This represented a split between cognitive and physiological symptoms. Overall, 15.2% of respondents reported at least mild anxiety, with 2.3% experiencing severe anxiety. Lower anxiety scores on the scale were reported among males, the married, younger and higher educated people. The Hamilton Anxiety Scale continues to be a useful tool in the measurement of anxiety. The two factor model separates anxiety into two dimensions, cognitive and physiological aspects and both are highly correlated with each other suggesting a single overarching construct of anxiety. The two-factor model may help provide a better understanding of the effectiveness of different therapeutic techniques. The pooled prevalence of ADs in a non-clinical Persian sample was relatively lower than those of some other countries.

Keywords: Anxiety, Hamilton Anxiety Rating Scale, Normative Data, Psychometrics

Introduction

Anxiety Disorders (ADs) are common psychiatric conditions affecting an estimated 10% of the global population (Alonso *et al*., 2018). ADs include panic disorders with or without agoraphobia, selective mutism, specific phobias, generalized anxiety disorder, social anxiety disorder and separation anxiety disorder DSM-V (APA, 2013).

Prevalence rates across the world range from 24.47% in China (Guo *et al*., 2016), 18% in the United States (Kessler and Wang, 2008), 13.6% in Europe (Alonso and Lepine, 2007) and in 8.1% in Japan (Ishikawa *et al*., 2015). Several studies have reported a higher prevalence for females (Remes *et al*., 2016), lower education levels (Kawakami *et al*., 2012), younger age groups (Lenze and Wetherell, 2011; Baxter *et al*., 2013) and marital status (Kessler *et al*., 2005; Scott *et al*., 2010).

ADs have far reaching social, economic and health burden consequences. For example, a global survey associated ADs with risk to education, income and suffering multiple pains Gureje *et al*., 2008; Levinson *et al*., 2010), with immense health care costs (Bandelow and Michaelis, 2015). Despite the significant problems caused by anxiety, it is well documented that it is poorly diagnosed and inadequately treated (Bystritsky *et al*., 2013).

However adequate treatment of anxiety disorders begins with early detection and diagnoses. The accurate screening for anxiety disorders is the starting point for therapeutic intervention and currently there exists a range of tools available. One widely used DSM based anxiety; questionnaire is the Hamilton Anxiety Rating

Scale (HAM-A sometimes referred to as HADS) (Hamilton, 1959; Thompson, 2015). The 14 items in this measure were originally developed to detect the presence and severity of anxiety and depression in clinical populations. Created prior to modern classification systems such as the DSM-V (APA, 2013) it has formed the benchmark for other devised scales (Beck and Steer, 1991; Beck *et al*., 1998; Donzuso *et al*., 2014). Whilst several papers have reported good reliability and validity (Maier *et al*., 1988; Clark and Donvan, 1994; Mondolo *et al*., 2006; Kummer *et al*., 2010; Leentjens *et al*., 2011) with acceptable Cronbach alpha scores were reported in numerous studies (Bjelland *et al*., 2002; García-Campayo *et al*., 2012; Chouhan *et al*., 2016; Erge *et al*., 2016). However, both Scott *et al*. (2017) and Litster *et al*. (2016) reported little support for the validity and reliability of the HAM-A. The factors structure of the instrument is not standardised, influenced by the medical condition being investigated, ranging from one to a four structure as fitting the data equally well (Bjelland *et al*., 2002; Leentjens *et al*., 2011; Cosco *et al*., 2012; Hung *et al*., 2015; Scott *et al*., 2017).

Nevertheless, since its development HAM-A has been translated into several languages (Fateem, 1998; Kummer *et al*., 2010; García-Campayo *et al*., 2012; Erge *et al*., 2016; Chouhan *et al*., 2016) and utilised in a range of clinical conditions (Capuron *et al*., 2002; Kersting *et al*., 2004; Gençöz *et al*., 2007; Garalejić *et al* 2010; Kummer *et al*., 2010; Chouhan *et al*., 2016; Erge *et al*., 2016; Yang *et al*., 2017).

Whilst ADs are some of the most common psychiatric conditions in the Western world (Simpson *et al*., 2010) few studies have reported the prevalence of anxiety in Arab countries in non-clinical adult populations (Karam *et al*., 2008; Bahammam, 2016) despite exposure to war and conflict existing in the region (Tanios *et al*., 2009) which Baxter *et al*. (2013) reports has a substantial impact of the prevalence of anxiety disorders. In a review paper of anxiety among adults in Saudi Arabia reported prevalence rates ranging from 7-33%, with gender differences detected (Tanios *et al*., 2009). However, the psychometric information regarding the Arabic version of the HAM-A is limited to studies of specific clinical populations (El-Rufaie and Absood 1995; Hassan *et al*., 2015; Terkawi *et al*., 2017). Given the HAM-A continued use in clinical practice and in research, there is a need to identify and, furthermore, test the factor structure of the HAM-A with a normative population to establish what exactly it is measuring. Moreover, as definitions and classifications of anxiety change, new research emerges and new technologies advance the knowledge base of symptomology relating to anxiety, there is a need to ensure that measurement tools such as the scale stay relevant as effective measures in todays' society (Leichsenring, 2006; Leentjens *et al*., 2008). The aim of the current study was to extend this research to explore the psychometric properties of the HAM-A in a non-clinical population in Saudi Arabia.

Methods

Participants

A large scale quantitative, cross sectional survey was conducted with a randomly selected sample of 1,500 individuals living in Amman; the capital city of Jordan as part of a study to look at COPD and psychological comorbidities (Al-Smadi *et al*., 2017) and focused on people over 40 years of age. Participants were recruited and assessed using HAM-A Scale and key demographic details also recorded.

Procedure

The sampling frame consisted of a list of registered residents living in Amman, obtained from Amman Municipality authorities. A sampling frame of 200,000 houses in total. A random sample of 1500 houses that selected using a random number generator and were identified for inclusion on the study. Researcher assistants trained in the collection of psychological data conducted all interviews face-to face. Of the 1500 houses approached, 90 houses approached included individuals who were less than 40 years old and therefore excluded. In total, 150 individuals refused to participate in the study without explanation. A total sample comprised of 1260 participants drawn from Jordan and Iraq representing a response rate of 84%. Based on a potential sampling frame of 20,000 houses and 2 adults per house and with 95% confidence level and 50% anticipated response accuracy, the sample size represents confidence interval of 2.72 (www.surveysystem.com/sscalc.htm).

Measure

The Hamilton Anxiety Rating Scale (HAM-A, Hamilton (1959) is a 14 items scale designed to assess the individuals level of both psychic and somatic anxiety, measured on a 5-point Likert scale ranging from 0 (not present) and 4 (Severe). Total scores range from 0-56. The tool was translated into Arabic by Fateem (1998) and its psychometric properties of the tool have been demonstrated with an Arabic-speaking sample (Gammoh *et al*., 2016) and wider afield (Maier *et al*., 1988; Kummer *et al*., 2010; Leentjens *et al*., 2011). Demographic details collected were also presented (Table 1).

Analytic Plan

Descriptive and measures of dispersion statistics were generated for all items to help inform subsequent analysis. Measures of appropriateness to conduct factor analysis was conducted using The Kaiser-Meyer-Olkin

Measures of Sampling Adequacy and Bartletts test of sphericity. Inter-item correlations were generated to examine for collinearity prior to full analysis. Exploratory factor analysis was conducted using maximum likelihood extraction comparing a 1-4 factor model to identify the most statistically appropriate model. A theoretically derived model based on the results from the exploratory factor analysis was then analysed within a confirmatory framework, using the same data. Once a model had been identified, confirmatory factor analysis was conducted and the model fitted.

The model was re-specified using the modification indices provided in the statistical output until acceptable and a statistically significant relationship identified. All re-specifications of the model were guided by principles of meaningfulness (a clear theoretical rationale); Transitivity (if A is correlated to B and B correlated to C, then A should correlate with C); Generality rule if there is a reason for correlating the errors between one pair of errors, then all pairs for which that reason applies should also be correlated (Kenny, 2011).

Acceptance modification criteria of:

1. The items to first order factors were fitted initially
2. Correlated error variance permitted as all items were measuring the same unidimensional construct
3. Only statistically significant relationship retained to help produce as parsimonious a model as possible
4. Factor loadings above 0.45 to provide a strong emergent factor structure

Acceptable fit statistics were set at Root Mean Square Estimations of Approximation (RMSEA) of 0.05 or below; 90% RMSEA higher bracket below 0.08; and Confirmation Fit Indices (CFI) of 0.95 or higher and SRMR below 0.05 (Byrne, 2011; Wang and Wang, 2012). Cronbach alpha scores were generated for factors in the accepted factor model. The impact of demographic details on the factor model was examined using regression.

Results

There was an even distribution of male and female respondents in the sample. The majority (92.9%) of participants were Jordanians and married (78.0%; Table 1). Most of the participants were aged 40-49 years of age and had a degree.

Measures of Distribution

Mean scores ranged from 0.322 (behaviour at interview) indicating 'not present' to 1.079 'mild' (Tension). Two items (Cardiovascular symptoms and Behaviour on interview) were scored low, with a floor effect and positively skewed accordingly. Seven items had scores that exceeded acceptable boundaries of kurtosis (Fears, Cardiovascular Symptoms, Respiratory Symptoms, Gastrointestinal Symptoms, Genitourinary Symptoms, Autonomic Symptoms, Behaviour at interview). Items with high kurtosis scores were the items that scored low in anxiety levels (Table 2). Correlation matrix of items shows scores ranged from 0.246 and 0.691 and collinearity was not an issue.

Exploratory Factor Analysis

The factor model was tested using exploratory factor analysis and a 1-3 factor model examined. The items were treated as categorical and Maximum Likelihood Robust (MLR) estimator used due to the issue of skewness and kurtosis of the items. The Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC, called the Schwarz criterion), can also be used to compare models, including non-nested models. All three fit statistics provide information on comparative models and lower values indicate a better fit so the model with the lowest AIC, BIC or adjusted BIC is the best fitting model (Kenny, 2015).

Examination of the factor statistics show significant improvements between a 1-factor and 2-factor model and minimal improvement between a 2-factor and 3-factor model (Table 3). Examination of the emergent factor structure of the three models show the 2-factor model to provide the best fit factor model and simplest theoretical model (Table 4).

Table 1: Demographic details of participants

Demographic	Percentage	Demographic	Percentage
Male	49.8% (n = 627)	Less than secondary	8.3% (n = 105)
Female	50.2% (n = 633)	Secondary School	24.6% (n = 310)
Jordanian	92.9% (n =1171)	Degree	54.9% (n = 692)
Other	7.1% (n = 89)	Post Graduate	12.1% (n = 153)
Married	78.0% (n = 983)	40-49 years	45.1% (568)
Divorced	6.0% (n = 76)	50-59 years	30.7% (n = 387)
Widowed	7.7% (n = 97)	60-69 years	15.2% (n = 191)
Single	8.3% (n = 104)	70+ years	9.0% (n = 114)

Table 2: Mean scores (SD), Skewness, Kurtosis and factor loading of items of Hamilton anxiety rating scale

	Mean (SD)	Skewness	Kurtosis
Anxious Mood	1.064	0.732	0.123
Tension	1.096	0.669	-0.223
Fears	0.557	1.719	2.540
Insomnia	0.969	0.840	0.023
Intellectual	0.940	0.985	0.355
Depressed Mood	0.796	1.068	0.605
Somatic (Muscular)	1.079	0.641	-0.306
Somatic (Sensory)	0.573	1.498	1.766
Cardiovascular Symptoms	0.416	2.126	4.328
Respiratory Symptoms	0.581	1.580	2.164
Gastrointestinal Symptoms	0.475	1.799	2.935
Genitourinary Symptoms	0.433	1.929	3.441
Autonomic Symptoms	0.424	1.977	3.953
Behaviour at interview	0.322	2.328	5.797

Table 3: Comparative fit statistics (EFA with categorical data) for 1-3 factor model of HAM-A

	Akaike (AIC)	Bayesian (BIC)	Sample-Size Adjusted BIC
Factor Model	32803.772	33163.437	32941.084
Factor Model	32368.282	32794.742	32531.095
Factor Model	32260.436	32748.553	32446.789

Table 4: Two-factor (Categorical Data) model of HAM-A

ITEMs	Factor 1	Factor 2
Anxious Mood	0.867	0.560
Tension	0.900	0.608
Fears	0.536	0.574
Insomnia	0.634	0.658
Intellectual	0.520	0.624
Depressed Mood	0.639	0.708
Somatic (Muscular)	0.550	0.705
Somatic (Sensory)	0.463	0.704
Cardiovascular Symptoms	0.471	0.713
Respiratory Symptoms	0.472	0.723
Gastrointestinal Symptoms	0.432	0.707
Genitourinary Symptoms	0.439	0.744
Autonomic Symptoms	0.492	0.733
Behaviour at interview	0.423	0.661

Confirmatory Factor Analysis

Fit statistics for the two-factor model show an acceptable model: RMSEA = 0.058, 90% RMSEA = 0.053-0.064, CFI = 0.919, SRMR = 0.040. Suggested modifications include item 2 with Item 1 (Tension with Anxious Moods = 179.376) and cross factor loading cognitive on V7 (Somatic muscular = 48.119). Model 2: RMSEA = 0.041, 90% RMSEA = 0.035-0.047, CFI = 0.960, SRMR = 0.031. There was a correlation between cognitive and physiological measures (Est = 0.800, S.E. = 0.021, Est/S.E. = 37.607). All relationships were statistically significant including modifications introduced in the first model. The factor loadings for all items were acceptable (Fig. 1). Item 7 (Somatic muscular) was a cross factor loading and allowed to influence both factors, however examination of the factor loading suggest it loads more strongly to cognitive symptoms.

Corrected Item to Total correlation

Cronbach's alpha for the total items and the 2 factors were acceptable (Cognitive = 0.84, 7 items; Physiological = 0.81, 7 items; Total scale = 0.89, 14 items). Examination of the alpha if item deleted scores indicate that this score remained static regardless of item deleted. Corrected item-to-total correlations indicating good discrimination (Cognitive = 0.808–0.835; physiological = 0779-0.786; Total scale 0.876-0.884).

Impact of Demographic Details on HAM-A

Fit statistics for the second total sample show an acceptable model: RMSEA = 0.037, 90% RMSEA = 0.033-0.041, CFI = 0.934, SRMR = 0.028. Education

levels had an impact on cognitive anxiety levels were higher levels of education were associated with lower anxiety levels (Degree level education Est = -0.328, S.E. = 0.138, Est/S.E. = -2.369; Postgraduate level education Est = -0.499, S.E. = 0.153, Est/S.E. = -3.265). Being female was associated with higher levels of anxiety Est = -0.224, S.E. = 0.065, Est/S.E. = -3.441).

The impact of demographic details on physiological symptoms on physiological measure (as shown in Fig. 1), a small but significant relationship was noted between marital status and being widowed (Est = 0.358, S.E, = 0.162, Est/S.E. = 2.214) where lower levels of anxiety were noted among married participants. Education levels had an impact on cognitive anxiety levels were higher levels of education were associated with lower anxiety levels (Degree level education Est = -.519, S.E. = 0.138, Est/S.E.= -3.766; Postgraduate level education Est = -0.536, S.E. = 0.145, Est/S.E.= -3.692). Being over 70 years of age increased likelihood of anxiety (Est = 0.493, S.E, = 0.150, Est/S.E. = 3.282). All relationships were at a statistically significant level.

Clinical Definition

Using Hamilton's original categorisation of clinical severity at least 84.8% of the participants did not display symptoms of clinical anxiety; 2.3% of the participants reported severe anxiety. Establishing overall prevalence scores allows for the comparison of prevalence across key demographic details. There was a clear gender difference were females reported higher levels of anxiety across all 3 clinical classifications Chi-square 14.689, df = 3, p = 0.002. The relatively small subsample sizes across the other demographic details limits accurate comparisons at a statistically significant level. Cross tabulation shows that education levels have a significant impact on prevalence rates. The more educated the participant the less likely the presence of a clinical diagnosis or the severity of the anxiety. Interestingly, high levels of anxiety were noted among the oldest age group (70 years+). Similarly, high levels of anxiety were noted among the widowed (Table 5).

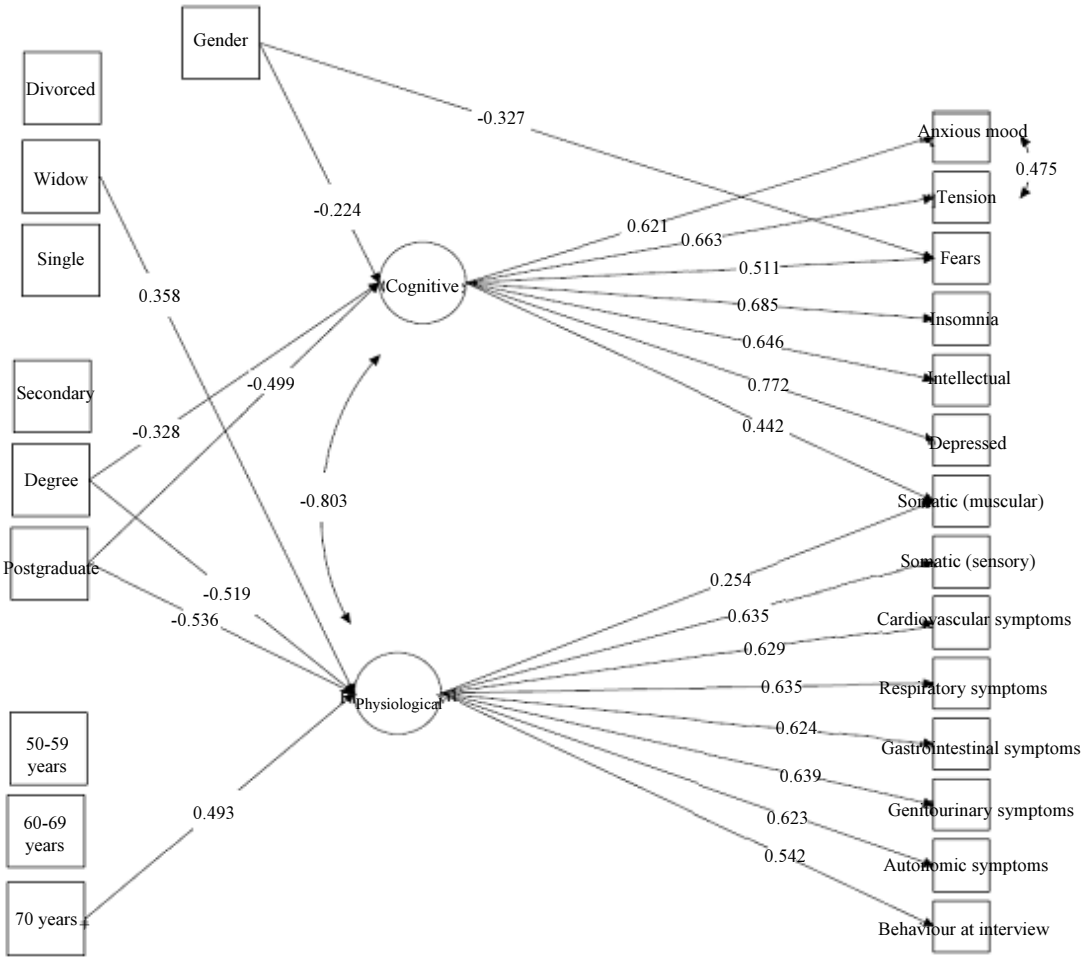

Fig. 1: The measurement model of the HAM-A and statistically significant demographic characteristics

Table 5: Prevalence of clinical definition of anxiety disorders across definitions

	None-Mild	Mild-Moderate	Moderate-Severe	Severe
Female	81.8%	10.8%	3.9%	3.5%
Male	87.8%	7.0%	4.2%	1.0%
Married	86.7%	9.0%	3.4%	1.4%
Divorced	89.3%	4.0%	2.7%	4.0%
Widowed	70.8%	12.4%	11.2%	5.6%
Single	81.1%	8.4%	4.2%	6.3%
Less than secondary	66.7%	18.3%	9.7%	5.4%
Secondary School	79.9%	11.2%	6.5%	2.4%
BS	88.1%	6.7%	2.9%	2.3%
Post Graduate	91.4%	7.9%	0.7%	0.0%
40-49 years	85.9%	9.4%	2.6%	2.1%
50-59 years	88.6%	6.5%	3.0%	1.9%
60-69 years	82.7%	9.5%	6.7%	1.1%
70+years	70.0%	13.6%	10.0%	6.4%
Jordanian	84.5%	9.2%	4.3%	2.1%
Non Jordanian	89.7%	5.1%	0.0%	5.1%
Overall	84.8%	8.9%	4.0%	2.3%

Discussion

The Hamilton Anxiety Rating Scale has been identified as one of the earliest tools to measure the severity of perceived anxiety symptoms (Thompson, 2015) and is one of the most widely used scales in the world (Erge *et al*., 2016). This study presents acceptable psychometric information relating to an Arabic version of an instrument to measure anxiety. The findings support the use of the HAM-A as an internationally renowned tool for measuring anxiety with well-established psychometric properties both here and in previous studies (Beck and Steer, 199l; Mondolo *et al*., 2006; García-Campayo *et al*., 2012). However, the findings challenge Leentjens *et al*. (2011) assertion that a one factor model was a better fit. A two-factor model of anxiety was supported by the study findings and it confirms Hamilton's original 2 factor model of somatic and psychic (Hamilton, 1959). Factor loadings were acceptable and very stringent with such a large sample size and provide surety in the statistical analysis. The Cronbach's alpha scores reported in this study confirm similar scores reported by Leentjens *et al*. (2011) however with a much larger sample size. The sample sizes in the sample provide an acceptable respondent to item ratio of over 90: 1, well above the 10: 1 as recommended by Hair *et al*. (2010).

The separation of anxiety into two separate (cognitive and physiological) but correlated constructs may provide a very useful model for the future examination of the impact of interventions for anxiety such as psychopharmacological treatment. The physiological dimension of anxiety would be affected by medication, yet this may not impact on the cognitive dimension of anxiety. It would also provide a better understanding of the impact of psychological 'talking therapies' in isolation or in combination with psychopharmacological interventions. Measuring how different therapeutic techniques impact on different dimensions of anxiety may help provide a better understanding of the effective treatment, identify relapse predictors or help identify when treatments should be discontinued. The high correlation between constructs suggests that all 14 items of the HAM-A are measuring an overarching single item of anxiety. Cronbach alpha scores confirm the summation of items of the HAM-A to produce an overall classification score and clinical banding.

The overall prevalence of anxiety was substantially lower in this study than reported in other western (Alonso and Lepine, 2007; Kessler and Wang, 2008) and Asian (Ishikawa *et al*., 2015; Guo *et al*., 2016) countries. The rates in this study do reflect Tanios *et al*. (2009) 7-33% range for Persian samples. However, as alluded to by Baxter *et al*. (2013) the figures reported for this region in the Middle East need to be considered in light of the recently experienced high levels of refugee influx and political unrest, which may account for the 'background anxiety' as exemplified by the level of mild anxiety.

Examination of the results support previous research where higher prevalence rates reported by females (Remes *et al*., 2016; Baxter *et al*., 2013), lower education levels (Kawakami *et al*., 2012) and marital status (Kessler *et al*., 2005). Interestingly, the findings here reported higher anxiety among participants aged over 70 years old, contrary to previous research (Lenze and Wetherell, 2011; Baxter *et al*., 2013) which found less anxiety among older people.

Limitations

Whilst the study's findings are based on a large non-clinical sample size, the methods of sample recruitment and data collection may not ensure sample

representativeness. Whilst Hamilton's (1959) original theoretical model indicates two distinct categories of psychic and somatic symptoms and this theoretical demarcation is supported in this study, the model requires confirmation across other countries with larger samples as well as more psychometric testing. Moreover the 2-factor model fits the data but with the introduction of correlated errors across items and cross factor loading. This would indicate the presence of additional factors that are not being measured here. Further research is required to identify these factors.

However further examination of the psychometric properties of the HAM-A instrument, the factor structuring of the instrument and the testing of the model in clinical interventions would provide a better understanding of how therapeutic interventions effect different aspects of anxiety. This may prove useful in examining the progression of effective treatment (or not) of anxiety.

Conclusion

The HAM-A instrument is a valid and reliable instrument for measuring anxiety in an adult population, internationally and across clinical populations. The study also benchmarks the normative levels of anxiety in a Persian non-clinical sample and identifies contributing factors influencing anxiety rates. Interestingly, this study highlights that anxiety levels are higher among older people.

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Author's Contributions

Paul Slater, Felicity Hasson, Brendan Bunting and Damian Jordan: Were responsible for the data analysis, drafting and completion of the manuscript.

Ahmed Mohammad Al-Smadi, Omar Salem Gammouh and Ala Ashour: Were responsible for study design, ethical application and data collection. All authors contributed to the final drafting of the paper.

Ethics

Full ethical approval was gained prior to commencement of the study and the research was conducted in accordance with the Helsinki Declaration as revised 1989. All principles of good clinical practice in research were adhered to throughout the study. Information sheet was distributed and explained to each potential participant. Consent forms were signed by willing participants. Confidentiality and anonymity of participants' responses were ensured and the data was securely stored in line with current university policy.

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