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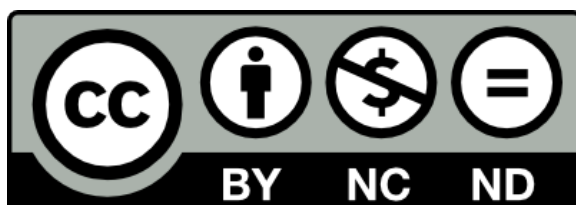
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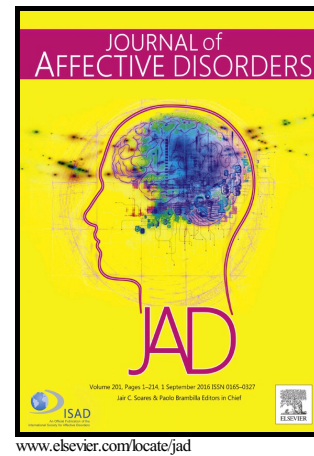


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Andrew J. Lewis, Bosco Rowland, Aiden Tran, Renatti F. Solomon, George C. Patton, Richard F. Catalano, John W. Toumbourou



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Adolescent Depressive Symptoms in India, Australia and USA: Exploratory Structural Equation Modelling of cross-national invariance and predictions by gender and age

Andrew J. Lewis^{1,3}

Bosco Rowland²

Aiden Tran⁷

Renatti F. Solomon^{1,6}

George C. Patton,^{4,5}

Richard F. Catalano⁸

John W. Toumbourou²

Affiliations:

1. School of Psychology and Exercise Science Murdoch University, Perth, WA
2. School of Psychology, Faculty of Health Deakin University, Burwood, Victoria
3. Harry Perkins Medical Research Institute, Fiona Stanley Hospital, Perth WA
4. Murdoch Children's Research Institute, The Royal Children's Hospital Campus Melbourne, Centre for Adolescent Health, Victoria Australia
5. The University of Melbourne, Department of Paediatrics, Faculty of Medicine, Dentistry and Health Sciences, Victoria Australia
6. Department of Psychology, KBP College and Institute for Child and Adolescent Health Research, Mumbai, India.
7. Gatehouse Centre, Royal Children's Hospital 50 Flemington Rd Parkville 3052, Victoria, Australia
8. School of Social Work, University of Washington, USA

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Corresponding Author:

Associate Professor Andrew J. Lewis

School of Psychology and Exercise Science, Murdoch University

90 South Street Murdoch University, Perth. Email: a.lewis@murdoch.edu.au

Abstract

Background: The present study compares depressive symptoms in adolescents from three countries: Mumbai, India; Seattle, United States; and Melbourne, Australia measured using the Short Moods and Feelings Questionnaire (SMFQ). The study cross nationally compares SMFQ depressive symptom responses by age and gender.

Methods: Data from a cross-nationally matched survey were used to compare factorial and measurement characteristics from samples of students from Grade 7 and 9 in Mumbai, India (n=3268) with the equivalent cohorts in the Washington State, USA (n=1907) and Victoria, Australia (n=1900). Exploratory Structural Equation Modelling (ESEM) was used to cross-nationally examine factor structure and measurement invariance.

Results: A number of reports suggesting that SMFQ is uni-dimensional were not supported in findings from any country. A model with two factors was a better fit and suggested a first factor clustering symptoms that were affective and physiologically based symptoms and a second factor of self-critical, cognitive symptoms. The two-factor model showed convincing cross national configural invariance and acceptable measurement invariance. The present findings revealed that adolescents in Mumbai, India, reported substantially higher depressive symptoms in both factors, but particularly for the self-critical dimension, as compared to their peers in Australia and the USA and that males in Mumbai report high levels of depressive symptoms than females in Mumbai.

Limitations: the cross sectional study collected data for adolescents in Melbourne and Seattle in 2002 and the data for adolescents in Mumbai was obtained in 2010-2011

Conclusions: These findings suggest that previous findings in developed nations of higher depressive symptoms amongst females compared to males may have an important cultural component and cannot be generalised as a universal feature of adolescent development.

Keywords: Depression, Adolescence, Cross-national comparisons, Exploratory Structural Equation Modelling (ESEM),

The bulk of our knowledge of the course and predictors of psychopathology is derived from high income countries. Epidemiological studies mostly from high income countries indicate that depressive disorders are highly prevalent and have high rates of lifetime incidence, high chronicity, and considerable functional impairment (1). Depressive disorder and clinically significant symptom levels are well recognised as a major public health issue in both developed and developing countries. The early age of onset depression is closely related to issues of chronicity and lifetime recurrence. The onset of depression during adolescence predisposes to lifetime recurrence of depressive episodes, particularly in women (2). Data from lower and middle income countries offer major opportunities to test the universality of such findings (3).

Thapar et al. conducted one of the most comprehensive reviews to date of the global literature on the epidemiology of depression in adolescence (4). The majority of studies found a prevalence of depression of less than 1% in children and this increases substantially throughout adolescence, with an estimated 1 year prevalence of 4-5% in mid to late adolescence. Thapar et al. noted that one of the most robust findings across many studies, mostly conducted in Western nations, was a significantly higher rate of depression in females (approximately 2:1) and other studies have linked this increase to factors associated with puberty (5, 6).

In most developing countries adolescents are a large proportion of the national population. In India for example, it is estimated that one fifth of India's population – an estimated 230 million people, is between the age of 10 and 19 years (7). As such, adolescent mental health is a central feature of the nation's overall health. Despite this, very few epidemiological studies of depression in adolescents have been undertaken in India (8-10). Nair et al. administered the Beck's Depression Inventory (BDI) via self-reported to 1014 adolescents aged between 10 and 19 in the Kerala state of India (11). 47% of females who had dropped out of school reported a BDI score reflecting a subclinical or higher grade of depression. 22% of female and 13% of male secondary students reported a subclinical or higher grade of depression, while 29% of female college students a borderline or higher grade of depression. Pillai et al. noted that previous research of mental disorders in adolescents in India reported a wide range of prevalence rates from 3% to 36% (7). Community-based studies of Indian adults have found prevalence rates of 61% for depressive symptoms and 16-34% for clinical depression (12). Generally prevalence rates reported in studies are higher for self-reported

symptoms than for diagnostic interviews conducted directly with adolescents and this is consistent with wider studies of depression (13).

Cross- national measurement invariance.

The recent publication of the DSM 5 showed an increased awareness of cross-cultural variation in psychopathology. However, cross-cultural validity of commonly used epidemiological measures is critical for population prevalence estimates, service planning and examination of how risk and protective factors operate across diverse cultures (14). One of the major issues in making valid cross-cultural comparisons is the validity of the measures used.

One crucial factor to ensure accurate and reliable cross national studies of epidemiology is using cross-national data based on a common methodology, including participant selection, measures, and methods of administration. Then testing the invariance of measures can proceed with more confidence that differences found will not be attributable to method differences. In clinical research it is particularly important to establish differences in symptom levels between different groups (e.g., male vs. female; age groups; developed vs. developing nations) (15). Thus, testing whether the underlying factor structure, scale metric and associations are the same for different groups should be routinely considered prior to any conclusion that there are indeed such group differences (16). Testing for invariance is critical prior to making cross-national comparisons of mean levels otherwise differences in levels will not reflect true differences, but, rather, for example, semantic divergence and measurement error. So too the comparison of predictive modeling across cultures requires metric invariance without which comparisons using a common measure do not produce meaningful results (17).

Recently, Exploratory Structural Equation Modelling (ESEM) has emerged as a flexible technique to examine between group invariance. ESEM was developed as an integration of Exploratory Factor analysis (EFA), Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) and has wide applicability to clinical research (15, 18, 19). ESEM allows cross factor loading and rotational strategies to more flexibly examine multidimensionality and to enhance the discriminate validity of derived latent variables (19). ESEM differs from the more traditional CFA which typically assumes independent cluster models (CFA-ICM) in which cross-loadings are constrained to zero and any small cross

factor loadings are assumed to be misspecifications. In contrast, ESEM allows all observed variables to load on all latent factors and cross-loadings are freely estimated. In clinical scales where latent factors are likely to draw heavily on cross factor loadings, ESEM is a good alternative to CFA.

The current study examines a large sample of Indian adolescents living in Mumbai and compares this to data from the same depression measure collected from North American and Australian adolescents. The study draws on the International Youth Development Study (IYDS) which use a standardised research design to cross-nationally assess levels and predictors of multiple adolescent child and adolescent behaviours (20). The measure of depression used is the Short Moods and Feelings Questionnaire (SMFQ), which has been used extensively in high incomes countries. A number of studies have supported a uni-dimensional factor structure for the SMFQ (21-23) and one recent study of Bangladeshi adolescents also suggested the SMFQ was unidimensional.

The aims of the present study are threefold: First to examine the factor structure of the SMFQ using both CFA and the newly develop ESEM technique across the three national groupings. Here we expect that a unidimensional model will show the best fit for the SMFQ in all national groups. The second aim is to conduct the first cross-national comparison of depressive symptomology amongst metropolitan Indian, Australian and North American adolescents. The final aim is to consider the prediction of depressive symptoms by gender and age using a multi-group comparison model and we expect that Indian adolescents will show the internationally common pattern of high levels for females and that depression scores will increase with age in early adolescence.

Method

Participants and Procedure

The data for this analysis was drawn from the International Youth Development Study (IYDS), a tri-national longitudinal study examining the development of youth health behaviour and social adjustment. Data were collected in Mumbai, India (n=3268) and compared with the equivalent cohorts in the Washington State, USA (n=1907) and Victoria, Australia (n=1900). IYDS collected data from representative state samples from Victoria and Washington State obtained using a two-stage cluster sampling design. In the first stage,

within each state and year level, public and private schools containing grades 5, 7 or 9 were randomly selected using a probability proportionate to grade-level size-sampling procedure. A target classroom within each school was randomly selected in the second stage. The IYDS studies in Washington State and Victoria were administered in 2002. Sixty schools with students at each of the three grade levels were randomly selected, and one class was randomly selected at each school. For each grade level in each state, replacement schools were also selected to be contacted if recruitment of sampled schools was unsuccessful. This paper uses only data from the 7th and 9th grade cohorts. Permission to conduct the study in individual classes corresponding to Grades 7 & 9 in these schools was initially requested from school districts for Washington schools, and either the Department of Education and Training or the Catholic Education Office for Victoria schools. Following agreement at these levels consent was sought from school principals, and then finally, from the parents of potential participants.

The IYDS Mumbai Study were undertaken in 2010-2011 with students in school standards (equivalent to US school grades or Australian grades/year) 7 and 9 in the geographical areas of Navi Mumbai and greater Mumbai in Maharashtra. The survey instrument and methodology, were designed to provide a common samples survey, methods of administration, and the grade samples cross-nationally to enable comparison with cohorts from the previous studies conducted in the USA and Australia. However, it should be noted that there are some differences in the historical period at which Indian data was collected. After obtaining Mumbai government school approval, schools identified as appropriate for inclusion in the study were approached directly for permission to conduct the study, and then the parents of potential participants were asked to provide consent. The rate of approvals for study administration was 100% for government schools and 77% for private schools, a higher response rate than obtained in Washington State (42%) or Victoria (65%). Reasons provided for refusing consent by US and Australian schools included anticipated parental objections to survey content, concern about sensitive questions and busy workloads.

In each national study, surveys were administered during a single classroom period of approximately 50 minutes. Solomon et al. noted that the study was successful in its attempt to yield cross-nationally matched samples (24).. Some differences were identified: students

displayed slightly different average ages within the selected grades across the cohorts and the female gender ratio was slightly lower while dishonest responding was higher in Mumbai. These differences were taken into consideration in the subsequent analysis of responses. More detailed information about recruitment, study administration and data management are available in McMorris (20) and Solomon (25).

Based on response to an honesty item (“How honest were you in filling out this survey?”) indicating lack of complete honesty in response, n=191 were removed. In the Mumbai sample, n=15 were removed due to being below 11 year or above 18 years of age. Indian adolescents from Mumbai in Grade 9 displayed a prevalence of dishonest responses of 4.93% while their counterparts in Melbourne and Seattle reported dishonest responding rates of 1.22% and 0.3% respectively. The final sample was 7113 adolescents from Victoria, Australia; Washington State, USA and Mumbai, India.

Depressive symptoms measure

The IYDS study adapted the Communities that Care Youth Survey (CTC) for administration in the three samples. The CTC survey has been used extensively in the U.S., Australia, and Europe and has good psychometric properties (26-28). In the adapted version of the CTC survey depressive symptoms were measured using the Short Mood and Feelings Questionnaire (21). The SMFQ is a self-report scale comprising 13 items derived originally from the 34-item Mood and Feelings Questionnaire (MFQ). Each item takes the form of a simple statement, such as “I cried a lot” or “I thought I could never be as good as the other kids”. Participants were required to respond according to a three-point scale: “True” (scoring two points), “Sometimes True” (one point) or “False” (zero points). For the Australian and Indian components of the study, this instrument was adapted to enhance the cultural appropriateness of the survey with respect to adolescents from each cultural background. It was also translated into the Marathi language for use with the Mumbai cohort (25).

Data Analysis

We conducted the analysis in four steps. First we examined the factor structure of the SMFQ using both CFA and ESEM across the three national groupings and examined model fit

within all national groups. In the second step we examined the cross-national invariance of the best fitting factor model including considering partial invariance, whether allowing some items to be non-invariant would improve model fit to within acceptable indicators as described below. The third stage was to use a multi-group comparison of depressive symptomology amongst Indian, Australian and North American adolescents to compare latent mean scores. The fourth and final stage of analysis was to add gender and age predictors to generate a predictive SEM model, based on the prior ESEM work to examine their influence on depressive symptoms by national group.

IBM SPSS 22.0 was used to analyse descriptive data and to prepare the dataset for analysis in Mplus. CFA and ESEM modelling was conducted in Mplus 7.4. The robust maximum likelihood estimator (MLR) which has been shown to be an improvement on maximum likelihood estimation when data are not normally distributed (29). Adjustment to fit indices based on the MLR estimator are reported in a Scaling Correction Factor statistic (SCF). An oblique geomin rotation was used since there was no clear precedent for targeting specific factor loadings in a multifactorial model and previous publications suggested unidimensionality. As recommended by Marsh et al. (2009) an epsilon value of 0.5 was used. There were no group differences in gender or age for subjects with missing data. Across the 13 single items used for the SMFQ there was a relatively small amount of missing data which ranged from 18-33 cases with missing data for the Australian sample, 9-20 cases missing for the USA sample and 8-26 cases missing for the Indian data. Full information robust maximum likelihood estimation was used to handle missing data (30)

Tests of factorial and measurement invariance.

Multi-national group models for both CFA and ESEM were conducted on best fitting models to examine measurement invariance across national groups. Here we followed the procedure recommended in a series of papers by Marsh and colleagues who provide a detailed discussion of these models (15, 19). Here we focus on establishing the key features of invariance relevant to address the current study aim of comparing means across cultures and ensuring the validity of predictive models testing how age and gender predict depressive symptoms across cultures. A major innovation of recent work in ESEM is to have introduced a 13 step partially nested procedure for the testing of factorial and measurement invariance (15). Configural invariance (Model 1) is established when the pattern of factor loadings is the

same across different countries. Metric invariance refers to when the scale metrics are the same across countries (Model 2). Model 4 tests the invariance of the factor variance-covariance matrix (FVCV). Strong measurement invariance or scalar invariance (Model 5) requires that, in addition to metric invariance, that the item intercepts are also the same across countries. This provides a test of Differential Item Function (DIF) which refers to the violation of incept invariance (30). The establishment of invariance of item intercepts is particularly important in the present study since it indicated that differences based on each of the items show consistency in magnitude and this supports the generalizability of the interpretation of the latent mean differences between the national groups under consideration. Model 5 provides such a test by constraining the intercepts to equality and this allows the latent means to be freely estimated. Model 7 measures strict measurement invariance which adds tests of uniqueness and serves as a test of the generalizability of the measurement error across groups and is required for comparison of manifest test scores. Thus, this model tests national differences in the reliability of depressive symptom ratings. Models 10 to 12 are based on constraint of mean differences between groups to test invariance of latent and manifest means and finally model 13 includes all previous restraints. Table 1S presents and describes the parameters used across all 13 invariance models. Taking Model 5 as our key test, we then undertake multi-group tests to compare means by taking the Australian data as a referent group, and restricting the latent mean to be zero, we used this as a basis of comparison for the latent means in the USA and Indian samples which were freely estimated.

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Insert Table 1S- as a supplementary table.
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Goodness of fit.

The indices used to test the best fit of models were χ^2 , comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA) and its confidence interval at 90%. Hu and Bentler's cut-offs were used as a guide, that is: .95/.90 for CFI and TLI, and .05/.08 for RMSEA for excellent and adequate fit respectively (31). It has been widely noted that rigid adherence to these values can be misleading and interpretation requires consideration of all fit indices together with the sample size, population and research question (32). Chen noted that the comparison of nested models of progressively more contrasted models, as used in Marsh's 13 step invariance testing procedure, should consider

not only overall model fit but also the magnitude of incremental changes between models on CFI, TLI and RMSEA. Again, as a guide, Chen suggested that changes of less than .01 in CFI/TLI and .015 in RMSEA are reasonable indicators of invariance between nested models (33).

Results

Demographic characteristics.

For cohorts in all three cities, the Grade 7 cohort and Grade 9 cohort were examined. The range in age was a minimum of 11 year and a maximum of 18 years. The mean age of students in the respective cohorts was slightly higher in the Seattle, USA (M=14.11, SD = 1.10) compared to the Melbourne, Australia (M=13.90, SD=1.06) and Mumbai (M=13.27, SD=1.27) samples. The percentage of males in each state was similar in Seattle, USA (n=949, 49.6%) compared to the Melbourne, Australia (n=917, 47.9%) while in Mumbai the proportion of males was slightly higher than females (n=1764, 53.9%). 68% of the Mumbai sample reported they were from upper castes and 64% of the Mumbai sample attended English language schools. Notably, rates of smoking for the Mumbai sample were 2% as compared to the 14% for combined USA and Australian sample.

In the total sample, the association of age with depression score total was very small but significant given the large sample size: $r=-.03$, $p=.011$. The majority of students in both Melbourne and Seattle identified as being of Caucasian or White descent, respectively. The item requiring students to identify their racial background was not administered to participants in the IYDS Mumbai Study, but the majority of participants were of Indian descent (24). As an index of transitions and mobility, Students were asked both if they had moved house in the last 5 years and if they had changed schools in the past year. Responses to both issues showed significant differences across national groups. For example, only 23.8% and 18.3% of adolescents did not change schools in Australia and USA, while 57.9% of Indian children did not change schools ($\chi^2 (df 2)= 608.766$, $p<.001$). In part this is due to differences in when normative school changes occur in the different national education systems.

By way of initial description of the data, the performance of the SMFQ across national groups was examined in terms of mean and variance scores, together with

Cronbach's alpha as a measure of internal reliability. Results are presented in Table 1 and shows good reliability and a reasonably consistent pattern of means scores by item.

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Insert Table 1

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Factor structure of the SMFQ.

In the first step of our data analytic approach, a series of CFA and ESEM were conducted to examine the single factor structure of the SMFQ measure separately in each national group. The findings by national group are presented in Table 2, together with a multi-group comparison.

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Insert Table 2

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In contrast to previous findings, indices of model fit for a single factor model did not strongly support the adequacy of a single latent variable model. The comparative fit index (CFI) for single national groups were lower than recommended (31), ranging from 0.92 to .89. The Tucker Lewis Index (TLI) fell below the adequate fit (between .9 and .95) for both the USA (.88) and Indian (.87); the Australian sample was a reasonable fit (.91). For all three groups, the root mean square error of approximation (RMSEA) was acceptable at either 0.06 or 0.07. Given the single factor model for all three groups was poor, there was insufficient justification to undertake a latent mean comparison across national groups or the addition of predictors to the model. Based on these findings and in keeping with Marsh et al (2014), model improvement was explored. There was considerable scope for model fit improvement so the addition of another factor within an ESEM framework was justified. Models with two, three and four factors were run but the 3 and 4 factor model did not reach convergence, and on the grounds of parsimony, we used the 2 factor model.

As noted by Marsh, ESEM is most appropriate when it fits the data better than does a corresponding CFA model (15). This is clearly the case in Table 2 which outlines fit statistics for a two-factor model, for the three groups (models 5-8). For each group, the fit statistics for the two-factor model were in keeping with acceptable values. This indicates that a two factor

model where cross loadings are not fixed provides a much improved model across each national group. Comparison of the fit indices for the multi-group model single factor vs. two factor (ie Model 4 vs Model 8 in Table 1) suggests also that the two factor ESEM displays acceptable model fit with CFI/TFI above 0.9 and RMSEA at .06. Factor Correlations were in the order of $r=.40$ to $r=.50$ across national groups and this showed good discriminant validity for the two factors identified. The multi-group model constraints are equivalent of the Strong measurement invariance model tested below in Table 3 (where the same model for Australia vs India is presented as model 5 in the 13 step invariance procedure).

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INSERT Table 3
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The interpretation of these two factors requires careful consideration. Examination of their respective factor loading weights shows that across all three national groups a core set of depressive symptoms emerges in factor 1. This factor's strongest loadings are on the item "So tired I did nothing" and "Didn't enjoy anything" and "very restless", this also includes typical emotional, affective symptoms such as 'miserable or unhappy' and 'did not enjoy anything'. This first factor will be referred to as an 'affective/somatic' dimension of depression.

Of note is the emergence of a second factor loading strongly on self critical and cognitive features. The highest loadings on this second factor were "Hated myself" followed by "Nobody really loved me" reflecting the cognitive and self-punitive dimension of depression which is well described in the classic papers by Beck and Blatt (34-36). This second factor will be referred to as a "cognitive" dimension of depression. Notably these two factors were positively correlated across all three groups in the order of .45-.49 suggesting a cross-nationally consistent moderate relationship while also indicating that the discrimination between these two factors was consistent cross-nationally.

Cross-National Invariance of SMFQ

The 13 step model for testing invariance within an ESEM or CFA framework, based in Marsh, is presented in Table 3 (15). Here we present the comparison between the Australian and Indian groups only in order to simplify the analysis. We did also examine

the relationship between USA and Indian samples which produced very similar results (results supplied upon request). These findings suggest support for the Configural model which implies that two factors in an ESEM are consistent across country groups, and support for the Weak factorial invariance model which suggest that factor loadings as invariant across national groups. As specific above, Model 5 tested strong factorial/measurement invariance and this model showed marginally acceptable model fit.

As shown in Table 3, model 2 suggested that there was some support for weak factorial invariance for the two factor model. Overall model fit was well within the adequate range (CFI/TLI between .90 and .95 and RMSEA above .08), although CFI and TFI deteriorated to a greater degree than Chen's criteria comparing Model 2 with Model 1 ($\Delta\text{CFI} = -.033$; $\Delta\text{TLI} = -.032$; $\Delta\text{RMSEA} = -.013$). Strong factorial/measurement invariance tested in Model 5 was only marginally within the adequate range, with RMSEA at .065 but with TLI dropping to .89. It is therefore difficult to have confidence that the two factor ESEM shows Strong factorial/measurement invariance.

Examination of partial cross-national invariance.

In order to further improve model fit for strong factorial/measurement invariance such that cross national latent mean comparison could be undertaken with greater confidence, and predictive modelling undertaken, we next moved into examination of partial invariance. This entails examining the contribution of individual factor loadings and intercepts.

Here we made use of modification indexes to remove constraints on d1 (Miserable or unhappy), d2 (Didn't enjoy anything), d5 (Felt I was no good any more), d6 (Cried a lot) and d12 (Never as good as others). This improved model fit considerably as reported in model 5a in Table 3 above. Since full measurement invariance is often not satisfied partial measurement invariance can constitute a good solution (17). Acceptance of the non-invariance of these 5 of a total of 13 items still provides sufficient indicators to allow comparisons of cross-national differences in factor means to be meaningful (37). However, the non-invariance of these items should be noted and considered carefully in the interpretation of cross national mean comparisons and predictive models.

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Insert Figure 1

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Differences in levels of depressive symptoms across national groups

Multi-group comparisons using ESEM allowed valid inferences to be made considering differences in latent means. As presented in Table 4, under the subheading Means, these differences suggested that Indian adolescents showed considerably higher levels of depression. In these analyses mean structures set the intercepts to zero in the first group (Australian) and allow them to be freely estimated in the second and third group. These analyses suggested that the USA group was slightly less self-critical than the Australian group but there was no difference in levels of anhedonic symptoms. However, the Indian group was more anhedonic and very considerably more self-critical than the Australian reference group.

Also presented in Table 4 are standardized latent mean differences comparing the Australian reference group to the US and Indian group for affective-somatic (.03 and .21 respectively) and for the cognitive latent variables (-.10 and .70 respectively). These statistics can be interpreted as a Cohen-type standardized mean difference since Cohen's d is equal to the difference in means divided by the pooled SD , and here the presented standardized latent factor mean is the mean difference divided by the standard deviations of the latent factors. The magnitude of these effect sizes shows that, as compared to the Australian group (and the US sample which was very similar to the Australian) the Indian adolescents showed moderately higher levels of affective-somatic symptoms and, notably, large effect size differences on self-critical/cognitive symptoms.

Predictors of adolescent depression across national groups

Having established the validity of cross-national comparison of partial factorial invariance of the SMFQ across the three national groups using a two-factor ESEM model, we then undertook further analysis examining predictors of these two latent variables. The structural model is presented in Figure 1 and shows pathways for both age and gender as predictors of the latent variables Self-critical/Cognitive (F2) and Affective-somatic (F1) symptoms. The results for slope estimation are presented in Table 4 by national group. Notably, an increase in age shows a small increase in depression in Australian and USA groups for Affective-somatic

symptoms, but not for Self Critical/Cognitive symptoms. However, the opposite pattern is observed in the Indian cohort where increases age significantly predicts increases in the self critical/cognitive symptoms. Notably being female was predictive of self critical/cognitive symptoms in Australian and US samples, whereas the same association was not observed in the Indian Cohort. Instead, and contrary to numerous findings in Western cohorts, being female was associated with lower depression symptoms in the Indian cohort.

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Insert Table 4

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Discussion

Our initial examination of the factor structure of the SMFQ using CFA suggested little support for a unidimensional model, in contrast to a number of findings in mostly developed countries. Use of an ESEM technique across the three national groupings instead suggested that a two-factor model was a considerable improvement, factor loadings were clearly interpretable and this was a more parsimonious model than a 3 or 4 factor model. Continuing with this two-factor model, we then found marginal support for strong metric invariance which would be required for comparison of latent factor mean. So to improve the validity of this cross-national comparison we tested invariance allowing several item to be non-invariant. This partially invariant model was an improvement and showed adequate model fit- sufficient to lend credibility to the mean group comparisons and predictive modelling.

The emergence of a two-factor model for the SMFQ is of considerable interest.

Differences in levels of Symptoms

Following the establishment of the two factor ESEM model, and the establishment of its partially invariant credentials, we proceeded to examine the comparison of cross-national depressive symptomology. Here we found, using Australian adolescents as a comparison point, that North American adolescents were broadly at similar levels with Australian adolescent displaying slightly lower levels of self-critical depressive features. However, adolescents in India reported considerably higher levels of depressive symptoms compared to

adolescents in Australia and USA for both the affective-somatic and self-critical/cognitive factors. The greatest differences were found in the self-critical features suggesting that Indian adolescents in this sample have high levels of self-punitive depressive symptoms.

These high levels of depressive symptoms in India are concerning and require explanation. The effect sizes reported showed that the Indian group showed moderately higher levels of affective-somatic symptoms and large effect size differences on cognitive symptoms whereas the differences between Australian and USA samples were either small or non-significant. This finding shows one of the clear advantages of the technique used in the current study since it highlights that the major area where Indian youth differ is in terms of the self-critical/cognitive group of symptoms. Since the cross-national validity of diagnostic cut points for the SMFQ has not been established, we elected not to present these differences in terms of prevalence estimates. Indeed the two factor structure of the SMFQ would argue against any simple assertion of a single cut point.

These findings come from a wider IYDS survey in which the SMFQ is embedded. The larger IYDS Student Survey was not specifically described as a measure of depression, nor was the study specifically directed at mental disorder. As a result, Indian participants may not have recognised the SMFQ items as mental health items and it is possible that they may have provided responses that were less influenced by social stigma. For example, studies have demonstrated that stigma acts as a widespread cultural barrier to the reporting of symptoms of mental health in developing nations in Asia, including a recent study conducted in Maharashtra, the state where Mumbai is located (38). Self-critical depressive features emerged as a major cross-cultural difference. This may be explained in terms of important demographic features of the Indian sample. The population represents a group undergoing rapid urbanisation and major social changes in terms of employment and education. In other words, the higher levels of general stressors associated with everyday life in developing nations, compared to developed nations may contribute significantly to vulnerability to depression (39) as adolescents experience strong pressure in a competitive educational system. Previous studies have noted that students in the Indian education system faced an increased level of academic pressure from the age of thirteen due to the commencement of annual exams (40). Stressful events are known to impact differently on each gender in terms of their vulnerability to depression (5). In a study conducted in Southern Indian, depressive symptoms, unlike somatic symptoms, were found to be construed as socially disadvantageous

and there emerged clear social and cultural influence on the expression of symptom patterns. Notably this included the degree of stigma associated with different types of psychiatric symptoms (41, 42). Recent work on cultural differences in the expression of psychiatric symptoms also highlights differences such as western cultures generally downplaying the experience of psychological disturbances as compared to collective cultures like India, where people feel freer to speak with one another about their problems and difficulties. Differences in such expression would suggest that Indian students are more likely to endorse items describing that they are experiencing more depression (43).

The mean scores observed in the current study may appear disproportionately higher than prevalence rates previously reported by previous studies of both Indian adolescents (7, 12) as well as North American or Australian adolescents (44, 45). However, it is important to distinguish such studies on the basis that these previous studies reported the prevalence of adolescents meeting the full diagnostic criteria for depressive disorders, such as Major Depressive Disorder or Dysthymia. It should also be noted that such prevalence rates are not inconsistent with the prevalence rates of 61% for depressive symptoms observed in community studies of Indian adults (12).

Predictors of depression

Finally we examined the prediction of depressive symptoms by gender and age using a multi-group comparison model. This produced a very interesting and unique set of findings. In these data Indian adolescents showed a very different pattern of associations with gender and age compared to the Western cohorts, which remained quite similar. The higher levels of depressive symptomology observed in male adolescents in all three city cohorts may reflect the difficulties and additional stressors involved in the transition from primary schooling to high school, combined with the onset of puberty. The findings accord with previous reports of correlations between negative subjective states potentially symptomatic of depression, such as below average activation levels and low affect, and school-based stressors in Indian students in Grade 8 (40). Both stress at school and family as well as family history of mental illness have previously been identified as risk factors for depression in Indian populations (46).

There may also be cultural reasons for the distinction between the more somatic feature identified in the affective-somatic factor, and the cognitive feature. Commenting on developing nations in Asia, Lauber and Rossler (2006) noted that stigmatization is more prevalent in these cultures than in Western cultures (47). Kermode et al. (2009) found that the majority of participants from his study in rural Maharashtra did not conceptualise depression or psychosis as a “real medical issue”(38) . Instead, they attributed causation to social and economic factors, which the authors suggested may be appropriate given the prevalence of poverty as well as gender- and caste-based discrimination in the region.

Gender and age differences

Potential factors that have been identified to account for gender differences in depressive prevalence include biological factors (e.g. differing interaction of sex steroids with stress systems and neurotransmitters), psychosocial variables (e.g. gender-specific expectations, greater cultural barriers for females to accepting physiological changes associated with adolescence), and stress exposure (e.g. greater probability of females being exposed to various stressors which predisposes them to depression) (48). There are also studies showing that female adolescents in western populations are more vulnerable to the quality of their relationship to their parents, than males (5) that early stress exposure may have a long terms impact on child and adolescent depression (49, 50), that there may be differences emerging due to the use of emerging technologies such as social media (51).

Some psychosocial theories of gender variance in depressive symptomology in adolescents suggest that such gender differences can be partially attributed to the greater level of stressors that female adolescents are exposed to, both cultural and other, on a routine basis (52). The findings of the present study may suggest that in developing nations, the gender disparity in adolescent depressive prevalence may not be as pronounced as in developed nations because adolescents of both genders experience a higher level of stressors and other depressive triggers on a regular basis. There are different culturally specific reasons in India which impact differently on male and female adolescents in terms of vulnerability to depression. While academic pressure is a pronounced feature of depression among males, females may experience depression for several other reasons including parental pressure for early marriage and parental and social restriction on socializing (43). Patel has previously reported on factors associated with gender differences in Indian studies with depressed adolescent girls reporting

higher levels of life events in the form of death of a family member, change in residence, failure in examination, end of a relationship and serious illness (7).

The findings on age differences are also intriguing in this study. In the first instance the two factor outcome for the SMFQ enabled a differentiation between self critical/cognitive and affective-somatic symptoms of depression. This enabled a distinction to be made in the prediction by age where Affective-somatic symptoms increased as function of age in the Australian and USA sample, as has been found in many other studies of western adolescents (Shore, et al, in press, whereas the same was not found in Indian adolescents where these symptoms were more stable as age increased (53). Instead it was only in the Indian cohort that age predicted an increase in self critical/cognitive symptoms, suggesting that socio-cultural factors operating in an Indian context induce age related increases in factors influencing depression.

Limitations

There are several limitations to this study. Firstly, the data reported on depressive symptoms rely solely on adolescent self reported symptoms which suffers from a range of well documents reporting biases, an in a cross cultural context, some of these issues may be amplified. In terms of the sampling frame, a number of limitations should be notes. While the data for adolescents in Melbourne and Seattle was obtained in 2002, the data for adolescents in Mumbai was obtained in 2010-2011. Furthermore, while the IYDS study is longitudinal in design, the follow up data for the Mumbai cohort was not available at the time of writing. As such, only a cross-sectional analysis for age could be conducted on the data collected from the Mumbai study and in the comparison cities. In addition, the sampling frame used in the current study compared largely urban dwelling Indian adolescents to Australian and American State representative samples. We cannot therefore infer that the current findings apply to rural or regional areas in our three countries. There is also considerable cross cultural variation in the school education systems such as very large public school classrooms in Mumbai and this may reduce the ability to compare samples.

Cultural variations in the interpretation of survey items possessing different meanings in different languages or cultures are invariably a consideration in any cross-national research (54). While surveys were subject to back translation and pilot testing, differences in language may have resulted in some semantic differences in concepts related to mental health in the survey instruments. It is possible that other such divergences in item interpretation resulting

from the translation of the IYDS study into Marathi or more subtle cultural differences may have affected the findings.

Another important limitation in the clinical application of the current findings is that we cannot infer the cross cultural validity of the clinical cut point of 11+ typically used to identify cases of depression using the SMFQ. As such, despite the clear strengths of such a large cross cultural comparative study, we cannot validly establish cross-cultural prevalence rates given the degree of invariance in the SMFQ. Further validation studies of symptom based measures against diagnostic criteria in an Indian population of adolescents are required based on these current findings.

Conclusions

Despite these limitations, this comparative study provides preliminary evidence with respect to differences in depressive symptoms amongst adolescents of both genders from India, North America and Australia. The findings suggest that the SMFQ performed similarly in the two countries suggesting partial invariance of the 2 factor model across countries. However, the findings suggest that mean levels of adolescent depressive symptomology may be different than in Western nations. Further, age and gender patterns of depression may also be different.

Additional research in these areas would be of value. Finally, the present study hopes to provide a useful template for continued national and cross-national studies of depressive prevalence and aetiology. The standardised methodology employed by the IYDS studies facilitates valid cross-national comparisons of depressive symptomology and aetiology through the use of such uniform methodology and advances in invariance testing and exploratory structural equation modelling. International comparisons across these three countries are supportable but there may be value in looking in more detail at how patterns of items differ across countries.

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Table 1S (Supplementary)
Parameters constrained to be invariant in ESEM invariance testing (based on Marsh (15))

Model	FL	uniq	FVCV	inter	FMn	name of invariance model
1	n	n	n	n	n	Configural
2	y	n	n	n	n	Weak measurement
3	y	y	n	n	n	
4	y	n	y	n	n	
5	y	n	n	y	n	Strong measurement
6	y	y	y	n	n	
7	y	y	n	y	n	Strict measurement
8	y	n	y	y	n	
9	y	y	y	y	n	
10	y	n	n	y	y	Latent mean
11	y	y	n	y	y	Manifest mean
12	y	n	y	y	y	
13	y	y	y	y	y	Complete factorial

Notes: y=constrained, n=not constrained; FL= Factor loading; uniq= uniqueness; FVCV= Factor variance-covariance; inter= intercept; FMn=factor means

Table 1.

SMFQ Item content and descriptive statistics by nation.

Label	Content	Victoria, Australia		Washington, USA		Mumbai, India	
		M	SD	M	SD	M	SD
	<i>In the PAST 30 DAYS...</i>						
d1	Miserable or unhappy	1.07	0.71	0.98	0.73	1.06	0.77
d2	Didn't enjoy anything	0.36	0.57	0.40	0.62	0.74	0.81
d3	So tired I did nothing	0.90	0.75	0.95	0.75	0.89	0.82
d4	Very restless	0.81	0.73	0.83	0.73	0.89	0.81
d5	Felt I was no good any more	0.46	0.69	0.39	0.65	0.76	0.80
d6	Cried a lot	0.34	0.63	0.35	0.63	0.82	0.82
d7	Hard to think or concentrate	0.83	0.68	0.76	0.71	0.97	0.80
d8	Hated myself	0.39	0.66	0.34	0.64	0.68	0.81
d9	I was a bad person	0.31	0.57	0.30	0.58	0.51	0.76
d10	Felt lonely	0.59	0.72	0.68	0.75	0.88	0.81
d11	Thought nobody really loved me	0.39	0.66	0.37	0.65	0.75	0.82
d12	Never as good as others	0.60	0.72	0.51	0.70	0.72	0.80
d13	Did everything wrong	0.35	0.55	0.33	0.60	0.53	0.74
	Total	7.40	5.42	7.21	5.73	10.21	6.43
	Cronbach's alpha	0.87		0.89		0.87	

Table 2.
CFA and ESEM models for one and two factor models for SMFQ by national group and multi-group models.

Model	CFA one factor models	n	χ^2 *	df	SCF	CFI	TLI	RMSEA	90% CI RMSEA	
									lower	upper
1	Aust	1900	550.62	65	1.25	0.922	0.906	0.063	0.058	0.068
2	USA	1907	753.59	65	1.29	0.902	0.882	0.075	0.070	0.079
3	India	3268	1110.02	65	1.25	0.893	0.872	0.070	0.067	0.074
4	3 groups	7075	3622.88	243	1.22	0.853	0.858	0.077	0.075	0.079
	Aust [^]		893.58							
	USA [^]		1014.58							
	India [^]		1714.72							
ESEM- two factor models										
5	Aust	1900	262.60	53	1.23	0.966	0.951	0.046	0.040	0.051
6	USA	1907	312.03	53	1.27	0.962	0.946	0.051	0.045	0.056
7	India	3268	323.176	53	1.26	0.972	0.959	0.039	0.035	0.044
8	3 groups	7075	2325.33	225	1.21	0.909	0.905	0.063	0.061	0.065
	Aust [^]		635.64							
	USA [^]		530.88							
	India [^]		1158.81							

Notes: *= all chi square p values are below $p=.01$

[^]=Chi square contribution to the multi-group model from each national group

Table 3.
13 step invariance testing of Australian vs Indian responses on SMFQ.

Model	χ^2 *	df	SCF	CFI	TLI	RMSEA	90% CIRMSEA		Constrained parameters to be invariant
							lower	upper	
1*	602.77	106	1.29	.971	.957	.041	.038	.044	Configural invariance
2*	1177.87	128	1.23	.938	.925	.054	.051	.057	Factor loadings (FL) Weak factorial invariance
3	1944.07	141	1.24	.894	.883	.067	.065	.070	Uniqueness
4*	1235.07	131	1.26	.935	.923	.055	.052	.057	Factor variance-covariance (FVCV)
5	1792.78	139	1.21	.903	.891	.065	.062	.067	Strong factorial/measurement invariance (Scalar?)
5a*	1208.98	134	1.23	.937	.926	.053	.050	.056	Model 5 but removing items [d1 d2 d5 d6 d12]
6	2079.60	144	1.27	.886	.877	.069	.066	.071	FL+ FVCV+ Uniqueness
7	2650.97	152	1.18	.853	.849	.076	.074	.079	Strict factorial/measurement invariance
8	1796.30	142	1.25	.903	.893	.064	.061	.067	FL+ FVCV+ intercepts
9	2647.64	155	1.25	.853	.852	.075	.073	.078	FL+ FVCV+ intercepts +uniqueness
10	2197.74	141	1.20	.880	.870	.072	.069	.074	FL, FVCV, inter, FMn Latent mean invariance
11	2925.10	154	1.22	.837	.835	.080	.077	.082	Manifest mean invariance
12	2172.42	144	1.25	.881	.871	.070	.068	.073	FL, FVCV, inter, FMn
13	2992.42	157	1.25	.833	.834	.080	.077	.082	Complete factorial invariance

Notes: Models clearly above adequate model fit criteria have been italicised. Model 5a allows items d1 d2 d5 d6 d12 to be non-invariant. * Indicates overall acceptable model fit.

Table 4

Final two factor ESEM model¹ with standardized cross factor loadings, comparison of latent means by country and prediction by age and gender.

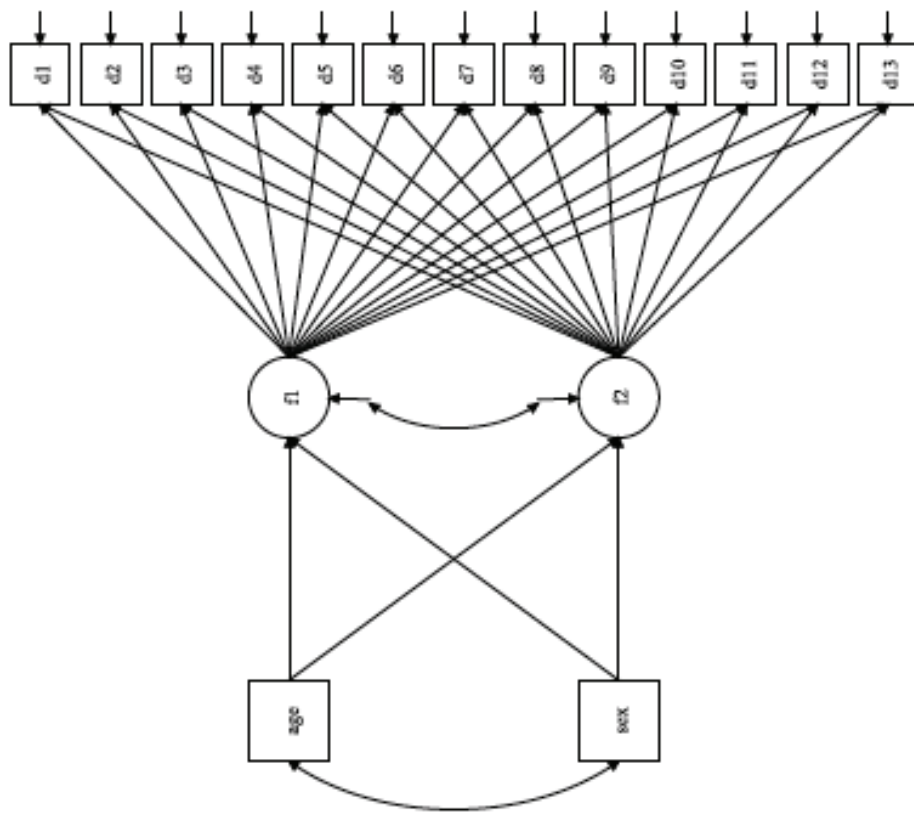
	AUST			USA			INDIA		
	Estimate	S.E.	p	Estimate	S.E.	p	Estimate	S.E.	p
Affective-Somatic (F1) BY									
d1*	0.39	0.02	0.00	0.45	0.02	0.00	0.43	0.02	0.00
d2*	0.49	0.02	0.00	0.54	0.02	0.00	0.46	0.02	0.00
d3	0.64	0.02	0.00	0.73	0.02	0.00	0.74	0.02	0.00
d4	0.57	0.02	0.00	0.65	0.02	0.00	0.67	0.02	0.00
d5*	0.37	0.02	0.00	0.43	0.03	0.00	0.36	0.03	0.00
d6*	0.20	0.02	0.00	0.23	0.03	0.00	0.21	0.02	0.00
d7	0.40	0.02	0.00	0.44	0.02	0.00	0.42	0.02	0.00
d8	0.21	0.02	0.00	0.25	0.02	0.00	0.21	0.02	0.00
d9	0.24	0.02	0.00	0.28	0.02	0.00	0.25	0.02	0.00
d10	0.26	0.02	0.00	0.29	0.02	0.00	0.28	0.02	0.00
d11	0.16	0.02	0.00	0.18	0.02	0.00	0.16	0.02	0.00
d12*	0.18	0.01	0.00	0.21	0.02	0.00	0.21	0.02	0.00
d13	0.26	0.02	0.00	0.30	0.02	0.00	0.27	0.02	0.00
Cognitive (F2) BY									
d1*	0.23	0.02	0.00	0.23	0.02	0.00	0.22	0.02	0.00
d2*	0.14	0.02	0.00	0.13	0.02	0.00	0.11	0.02	0.00
d3	-0.18	0.02	0.00	-0.17	0.02	0.00	-0.17	0.02	0.00
d4	-0.08	0.02	0.00	-0.08	0.02	0.00	-0.08	0.02	0.00
d5*	0.47	0.03	0.00	0.47	0.03	0.00	0.39	0.02	0.00
d6*	0.48	0.03	0.00	0.46	0.02	0.00	0.42	0.02	0.00
d7	0.22	0.02	0.00	0.21	0.02	0.00	0.20	0.02	0.00
d8	0.68	0.02	0.00	0.67	0.02	0.00	0.57	0.02	0.00

d9	I was a bad person	0.49	0.02	0.00	0.49	0.02	0.00	0.45	0.03	0.00
d10	Felt lonely	0.48	0.02	0.00	0.46	0.02	0.00	0.45	0.02	0.00
d11	Nobody really loved me	0.67	0.02	0.00	0.67	0.02	0.00	0.58	0.02	0.00
d12*	Never as good as others	0.53	0.02	0.00	0.53	0.02	0.00	0.53	0.02	0.00
d13	Did everything wrong	0.49	0.02	0.00	0.48	0.02	0.00	0.44	0.03	0.00
<i>Comparison of Latent Means by country#</i>										
<i>F1 Affective-Somatic</i>										
		0.00	0.00		0.03	0.04	0.50	.21	.04	.000
<i>F2 Cognitive</i>										
		0.00	0.00		-.10	0.04	.009	.70	.05	.000
<i>Predictors of latent factors (F1 and F2)</i>										
AGE	→ Affective-Somatic (F1)	0.10	0.03	0.00	0.10	0.03	0.00	0.02	0.02	0.28
SEX (Female)	→ Affective-Somatic (F1)	0.03	0.03	0.40	0.04	0.03	0.20	-0.06	0.02	0.01
AGE	→ Cognitive (F2)	0.03	0.03	0.30	-0.03	0.03	0.24	0.05	0.02	0.03
SEX (Female)	→ Cognitive (F2)	0.29	0.02	0.00	0.24	0.03	0.00	-0.04	0.02	0.05
F2 WITH F1		0.49	0.02	0.00	0.45	0.04	0.00	0.48	0.05	0.00

Note. ^Fit statistics reported above in Table 3, Model 5a and diagram of model presented in Fig 1. Factor loadings over .30 have been bolded in order to assist in the interpretation of the weights for each factor. Significant predictors have been bolded also; * on the item label indicates that this item's constraints have been freed and this item should not be considered invariant across national groups. # latent mean comparisons undertaken using the Australian group as a reference with mean constrained to zero. Significance values on the means for USA and India indicate significance differences as compared to the Australian group. Estimates presented in the USA and Indian columns therefore represent the standardised mean difference from the Australian sample.

Figure 1

Two factor ESEM model with cross loadings and predictors of age and sex (factor loadings and regression weights by national group presented in Table 4 for this model)



Highlights

- A commonly used measure of depressive symptoms, the Short Moods and Feeling Questionnaire (SMFQ) can be used to make valid comparisons between Indian and developed contexts.
- Using a careful measurement, sampling and data analysis framework, we have shown that depressive symptom rates in Indian adolescents are concerning and very high in comparison to an Australian and USA sample.
- The common pattern of adolescent depressive symptoms being higher in females does not apply in this Indian sample. Instead we found males had higher rates.
- The findings raise important questions about the cultural context of adolescent depression and the universality of the supposed mechanisms which place females at greater risk of depressive disorders in adolescence.