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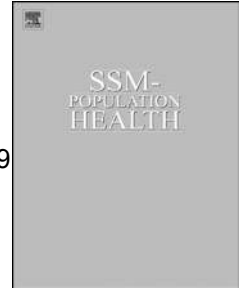O.L.K. Campbell, David Bann, Praveetha Patalay

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The gender gap in adolescent mental health: a cross-national investigation of 566,827 adolescents across 73 countries

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1   **The gender gap in adolescent mental health: a cross-national**

2   **investigation of 566,829 adolescents across 73 countries**

3

4   **Abstract**

5   Mental ill-health is a leading cause of disease burden worldwide. While women suffer from greater

6   levels of mental health disorders, it remains unclear whether this gender gap differs systematically

7   across regions and/or countries, or across the different dimensions of mental health. We analysed

8   2018 data from 566,827 adolescents across 73 countries for 4 mental health outcomes: psychological

9   distress, life satisfaction, eudaemonia, and hedonia. We examine average gender differences and

10   distributions for each of these outcomes as well as country-level associations between each outcome

11   and purported determinants at the country level: wealth (GDP per capita), inequality (Gini index), and

12   societal indicators of gender inequality (GII, GGGI, and GSNI). We report four main results: 1) The

13   gender gap in mental health in adolescence is largely ubiquitous cross-culturally, with girls having

14   worse average mental health; 2) There is considerable cross-national heterogeneity in the size of the

15   gender gap, with the direction reversed in a minority of countries; 3) Higher GDP per capita is

16   associated with worse average mental health and a larger gender gap across all mental health

17   outcomes; and 4) more gender equal countries have larger gender gaps across all mental health

18   outcomes. Taken together, our findings suggest that while the gender gap appears largely ubiquitous,

19   its size differs considerably by region, country, and dimension of mental health. Findings point to the

20   hitherto unrealised complex nature of gender disparities in mental health and possible incongruence

21   between expectations and reality in high gender equal countries.

22

23

24

25

1 **Introduction**

2 Mental ill-health is a leading cause of disease burden globally (Rehm & Shield, 2019; Walker et al.,

3 2015), and in most individuals is first experienced in childhood (Kessler et al., 2005), leading to a

4 growing policy interest in improving adolescent mental health (Das et al., 2016). During childhood and

5 adolescence girls tend to report substantially worse internalising mental health than boys and this

6 gender gap increases with age during adolescence (Bolognini et al., 1996; Bradshaw et al., 2013;

7 Cavallo et al., 2006; Kaye-Tzadok et al., 2017; Ostberg et al., 2006; Torsheim et al., 2006; West &

8 Sweeting, 2003). This may contribute to the disproportionately higher prevalence of common mental

9 health disorders in adult women worldwide (Albert, 2015). It is important to document and understand

10 cross-national differences in mental health with a focus on the gender gap: doing so may help identify

11 countries with successful cultures and/or policies which could be implemented more broadly to reduce

12 the gender mental health gap.

13

14 Adolescence is a formative time of changing identity (Blakemore & Mills, 2014) and is commonly

15 when emotional disorders and the gender gap in mental health emerges (Wade et al., 2002; WHO,

16 2020). It is a period of rapid change and exposure to new risk factors including physical changes,

17 peer pressure, educational stress, and sexual exploration (Viner et al., 2015; WHO, 2020). It is also a

18 time when gender becomes a more salient socialising factor and individuals develop concepts of what

19 it means to be a man or a woman (Greene & Patton, 2020).

20

21 Despite evidence documenting a gender difference in adolescent mental health, it remains poorly

22 understood. First, existing evidence is largely from a small number of high-income Western countries

23 (Bradshaw & Rees, 2017; Cavallo et al., 2006; Elgar et al., 2015; Klocke et al., 2014; Looze et al.,

24 2018; Ottova et al., 2012; Torsheim et al., 2006) and caution must be taken when generalizing their

25 findings to non-Western, middle and low-income countries (Henrich et al., 2010). Second, studies

26 typically use only one measure of mental health; yet it is a multidimensional concept (Steptoe, 2019).

27 As defined by the WHO (WHO, 2018), mental health is not simply the absence of mental illness but

28 also a state of wellbeing and lies along a continuum from ill-health to positive mental health or

29 wellbeing. It is constituted of several weakly correlated dimensions (Huppert & Whittington, 2003)

30 including psychological distress, life satisfaction, hedonia (positive affect) and eudaemonia (the

1   experience of purpose and meaning in life) (Steptoe, 2019). Third, most studies examine average

2   differences (or binary outcomes) in mental health between countries and genders, and do not

3   explicitly examine its distribution. Understanding which part of the population distribution drives

4   average differences may be useful to aid understanding of the nature of the gender gap and potential

5   policy targets (Bann et al., 2019) – for instance, average gender differences may be due to a

6   particularly high frequency of females at the severe end of the spectrum or due to differences across

7   the entire distribution.

8

9   Cross-national comparisons can also identify factors at the country-level which are associated with

10 mental health. Particularly, economic factors and gender equality may play a role. Poverty is

11 considered an established risk factor for worse mental health (Elgar et al., 2015; Carol Graham &

12 Chattopadhyay, 2013; Lund et al., 2010; WHO International Consortium in Psychiatric Epidemiology,

13 2000). However, income inequality is inconsistently associated with mental health, with some studies

14 finding a correlation between higher income inequality and worse mental health (Oishi et al., 2011;

15 Pickett & Wilkinson, 2010), whilst others find that higher income inequality correlates with better

16 mental health (Rözer & Kraaykamp, 2013). A meta-analysis concludes that the relationship between

17 income inequality is weak and dependent on a countries development (Ngamaba et al., 2018). It is

18 unknown how wealth or income inequality are associated with the gender gap in mental health, and

19 whether this differs by dimension of mental health — life satisfaction questions for example typically

20 correlate more strongly with economic factors than affect-related questions (Carol Graham et al.,

21 2010).

22

23 Existing research on the association between gender equality and mental health largely yields

24 inconsistent findings with studies demonstrating no association (Bradshaw & Rees, 2017), stronger

25 positive associations with both male mental health (Carol Graham & Chattopadhyay, 2013) and

26 female mental health (Salinas-Jiménez et al., 2016), and both smaller (Salinas-Jiménez et al., 2016;

27 Torsheim et al., 2006) and larger mental health gender gaps (Costa et al., 2001; Carol Graham &

28 Chattopadhyay, 2013; Zuckerman et al., 2016, 2017). Tesch-Romer et al. (Tesch-Römer et al., 2008)

29 find that the association between gender equality and the adult mental health gender gap varies with

30 the cultural attitudes of gender equality. Where over 50% agree with the statement 'men have more of

1 a right to work than a woman', the mental health gender gap is larger with greater gender equality, but

2 where less than 50% agree, the gap is smaller in countries with greater gender equality. Zuckerman

3 et al. (Zuckerman et al., 2017) suggest that – in a sample of largely adults across 126 countries - a

4 quadratic relationship exists between improving societal conditions (including gender equality) and the

5 gender gap in subjective wellbeing. They argue that as conditions improve women's wellbeing trends

6 downwards relative to men, but as they continue to improve, they trend upwards. Few studies, to our

7 knowledge, have 1) explicitly examined the relationship between gender equality and the mental

8 health gap in adolescents, 2) investigated the adolescent gender gap in a broad sample of countries

9 including low- and middle-income countries and, 3) focused on multiple indicators of mental health.

10

11 Using a large cross-national dataset from 73 countries and economies and spanning a range of

12 income groups, we aimed to 1) describe the gender gap across different measures of mental health

13 (life satisfaction, psychological distress, hedonia, eudaemonia) in terms of both average and

14 distributional differences, and 2) investigate the correlations of macro-level economic and gender

15 equality indicators with wellbeing in boys and girls to better understand the gender mental health gap

16 in adolescents. Consistent with previous literature we hypothesise that girls will have worse average

17 mental health than boys across all outcomes. However, given the inconsistency of relationships

18 between mental health and country level indicators we ask two further research questions: 1) what is

19 the relationship between the economic indicators - GDP and income inequality - and mental health in

20 each gender and the gender gap? 2) What is the relationship between gender equality and mental

21 health in each gender and the gender gap?

22

23 **Methods**

24 **Participants**

25 We used data from the 2018 Programme for International Student Assessment (PISA) (OECD, 2018).

26 PISA is a multi-country cross-sectional study that surveys students at age 15 on their educational

27 attainment and characteristics of their life (OECD, 2020). PISA operates a two-stage sample design

28 where schools are sampled with probability proportional to the size of their enrolment of 15-year olds,

29 and students are sampled randomly with equal probability. Students are then weighted to yield a

30 sample that is representative of the population of the country. A response rate of 80% of selected

1   students in each school is required. Sample sizes range from 3,363 for Malta and 35,943 for Spain.

2   Further detail on the sampling method can be found in the technical report (OECD, 2020).

3

4   In total 73 countries and participating economies were included, containing 566,829 students (49.8%

5   girls and 50.2% boys), representing around 28 million students. Countries excluded were Singapore;

6   Norway; New Zealand; and Israel as they did not collect the mental health measures. Subsamples

7   that were not nationally representative were dropped, such as China. In order to investigate regional

8   patterns, countries were grouped by region according to the World Health Organisation's groupings

9   (Table S1, see for example: https://www.who.int/choice/demography/euro_region/en/). The countries

10   sampled cover a number of regions: North and South America; Europe; Eastern Mediterranean;

11   South East Asia; and the Western Pacific Region. Unfortunately, PISA does not collect data on

12   mental health from any African countries apart from Morocco, so we were unable to include this

13   region in our analysis. Morocco is grouped under Eastern Mediterranean according to WHO regional

14   groupings.

15

16   **Measures**
17   *Outcome variables*

18   Life satisfaction, psychological distress, hedonia and eudaemonia (Huppert, 2014) were all measured

19   in PISA 2018. Life satisfaction was measured by the question: "on a scale of 0-10, overall, how

20   satisfied are you with your life as a whole these days?", with 0 meaning not at all satisfied and 10

21   meaning completely satisfied. Psychological distress was assessed with responses to how often

22   adolescents felt sad, miserable, scared, and afraid on a scale of never, rarely, sometimes, and

23   always. Answers were scored 1-4 and summed to give an overall score ranging from 4-16. Hedonia

24   was assessed with responses (never to always) to how often adolescents felt happy, lively, proud,

25   joyful, and cheerful. Answers were summed to give an overall score ranging from 5-20. Eudaemonic

26   wellbeing was measured by asking students how much they agreed on a scale of strongly disagree,

27   disagree, agree, and strongly agree to the following statements: "my life has clear meaning or

28   purpose"; "I have discovered a satisfactory meaning in life"; and "I have a clear sense of what gives

29   meaning to my life". The answers were scored and summed to give an overall score ranging from 3-

30   12. In order to be able to compare scales each outcome was z-score standardised to have a mean of

1   0 and a variance of 1. Findings did not differ when examined in the original scales (data available

2   upon request). Invariance testing showed that measures were invariant by gender, region and gender

3   x region (Table S2). Original items can be found in the student questionnaire (OECD, 2018).

4

5   All questions were translated into the languages of participating countries by two independent

6   linguists and then reconciled by a third to ensure consistent meaning in all countries. Further

7   information can be found in the PISA technical report (OECD, 2020).

8

9   *Gender*

10   Gender was measured by students responding to the question "are you female or male?" coded 1 for

11   girl and 0 for boy.

12

13   *National Level Characteristics*

14   Measures of gross domestic product (GDP) per capita and income inequality (Gini) were taken from

15   the World Bank dataset. GDP per capita is the total economic output of a country divided by its

16   population and is an estimate of prosperity. The Gini index is a measure of how unequal the income

17   distribution is and ranges from 0, representing perfect equality, to 100 representing perfect inequality.

18

19   Three measures of gender equality were used in this study: the Gender Inequality Index (GII) and the

20   newly created Gender Social Norms Index (GSNI) derived from the World Values Survey, both

21   produced by the UNDP; and the Global Gender Gap Index (GGGI), produced by the World Economic

22   Forum. Whilst all three use the same themes of education, health, political and economic participation

23   they use different indicators to make these up (Table S3 for a summary of indicators). The main

24   difference between the GII and the GGGI is that the GII is calculated in order to measure the loss in

25   human development from gender inequality (see

26   http://hdr.undp.org/sites/default/files/hdr2019_technical_notes.pdf). In contrast, the GGGI aims to

27   separate gender equality from the country's level of development by rewarding or penalizing countries

28   based on the size of the gender gap in a particular resource regardless of the overall level of said

29   resource (World Economic Forum, 2018). The GSNI is different from the other two as it tries to

30   capture social norms through the proportion of people that agree or disagree with a particular

1   statement, for example, "men make better political leaders than women do". This allows us to test

2   whether cultural attitudes towards gender equality are particularly important in terms of mental health

3   outcomes.

4

5   **Analysis**

6   We calculate country-level average differences for each standardised measure of mental health by

7   calculating the weighted male and female mean for each country and then subtracting female average

8   from male. Weighted means were calculated using the R package intsvy (Caro & Biecek, 2017)

9   designed to use the PISA provided weights and to take into account the two-stage sample design.

10   Meta-analyses using the I^2 statistic were performed to test heterogeneity in the gender differences

11   between regions. The I^2 statistic quantifies the percentage of total variation across nations due to

12   heterogeneity rather than chance (Higgins et al., 2003). To examine the distributions of mental health

13   outcomes across the sample, weighted frequency histograms were plotted for each country for each

14   outcome (Fig. S2-5).

15

16   To explore the association of country-level factors on mental health outcomes, we estimated

17   Pearson's correlations (r) and plotted the relationships between the average score for each gender by

18   country against the 5 country-level indicators: GDP per capita, Gini, GII, GSNI, GGGI. We use multi-

19   level linear regression in order to estimate the between country variation in different mental health

20   outcomes and to formally statistically investigate the associations between each of our four mental

21   health outcomes, gender and country-level factors – GDP per capita, Gini and GGGI. We use a single

22   indicator of gender equality to avoid multicollinearity with other equality measures (Table S4).

23   Random intercepts for countries and random slopes for gender are modelled. Using weight scaling

24   method A proposed by Asparouhov (Asparouhov, 2006) and Carle (Carle, 2009) we adjust the final

25   student weights by the number of individuals in each cluster divided by the sum of the sampling

26   weights in each cluster (see (Carle, 2009), Appendix B), in order to estimate multi-level models.

27

28   As additional and sensitivity analyses, we plot quadratic country-level associations to test for non-

29   linear associations. Secondly, to check that models are robust to the inclusion of different measures

30   of gender equality we ran the models using the GSNI instead of the GGGI. Thirdly, we investigated if

7

1   ecological findings were robust to adjustment for individual level controls - socioeconomic

2   background, age and immigration status. Socioeconomic status was controlled for using the PISA

3   derived economic social and cultural status (ESCS) index that is a composite measure of parental

4   education, highest parental occupation and home possessions. Fourthly, to test if findings are robust

5   to the removal of country outliers, we calculate cook's distance of countries for single-level models,

6   with countries as data points and GGGI, GDP per capita, and Gini as independent variables, and the

7   outcome variable as the average gender gap in each mental health outcome. The 3 countries with the

8   highest cook's distance are removed from the final models as a robustness check.

9   **Results**

10 *Do girls have worse average mental health than boys across all outcomes?*

11

12 On average, girls have worse mental health across all indicators (Table 1). Life satisfaction and

13 psychological distress have the largest mean differences between the sexes, 0.41 (0.33 s.d) and -1.1

14 (0.34 s.d) respectively, whereas hedonia and eudaemonia have smaller gender gaps, 0.10 (0.39 s.d)

15 and 0.15 (0.27 s.d) respectively. The correlation matrix shows that individual-level correlations

16 between mental health outcomes are weak-moderate - none reach 0.5 (Table 1, top half). The

17 country-level correlations between the gender gaps (Table 1, bottom half) are all greater than 0.5

18 indicating that countries with large gender gaps in one outcome are likely to have large gender gaps

19 in others.

20

21 In most countries girls have worse life satisfaction, and in all countries girls report more psychological

22 distress than boys (Fig. 1). Hedonia and eudaemonia show greater cross-cultural variation with some

23 countries exhibiting worse average outcomes for boys, such as Jordan and Saudi Arabia (Fig. 1).

24 Some regional patterns emerge; wealthier European nations consistently have worse average mental

25 health for girls across all outcomes apart from hedonia; the Eastern Mediterranean countries

26 consistently have some of the smallest gender gaps, and for hedonia and eudaemonia have better

27 average outcomes for girls. Particular countries consistently have some of the largest gender gaps in

28 mental health, including Sweden, Finland, Slovenia and South Korea. For each outcome there was

29 strong evidence for heterogeneity in the gender differences - both within and between regions with $I^2 >$

1　95% for all outcomes, p <0.001 (Fig S1). Country distributions of mental health outcomes indicate that

2　gender differences are driven by different parts of the wellbeing distribution; boys have higher upper

3　values of life satisfaction (9/10 out of 10) (Fig. S2); while for psychological distress (Fig. S3) the

4　female distribution is overall shifted to the right, indicating a higher frequency of feelings of distress in

5　girls across the spectrum. Hedonia is also largely left skewed (Fig. S4) and the distributional gender

6　differences are less prounounced. Eudaemonia peaks at 9 for both boys and girls in most of the

7　countries and the gender difference looks uniform across the distribution (Fig. S4). Thus, despite

8　different overall distributions, the mental health gender gap remains, although where the gap appears

9　in the distribution differs by outcome.

10

11　*Country Level Associations*

12

13　The proportion of total variance attributable to differences between countries was estimated to be

14　5.6% for life satisfaction, hedonia and eudaemonia and 7.3% for psychological distress (using the

15　variance partition coefficient from the baseline multi-level model (Table 2 Model A). Overall, the final

16　model explains 37.5% of the between country variance in life satisfaction, 12.33% in psychological

17　distress, 17.8% in hedonia, and 46.4% in eudaemonia. Figure 2 presents the associations between

18　the country-level indicators and each mental health outcome by gender.

19

20　*What is the association between the economic indicators - GDP and income inequality - and mental*

21　*health outcomes in each gender?*

22

23　Higher GDP per capita was associated with lower life satisfaction (β -0.032 [0.01sd], p<0.01), hedonia

24　(-0.023 [0.012sd], p>0.05) and eudaemonia (-0.033 [0.009sd], p<0.001) and higher psychological

25　distress (0.028 [0.013sd], p<0.05) for both boys and girls (Fig. 2&3 a1-d1, Table 2 model C). For all

26　outcomes (except hedonia) the gender gap was larger for wealthier nations mainly driven by steeper

27　slopes for females.

28

29　Higher income inequality was associated with slightly lower life satisfaction for boys and slightly

30　higher life satisfaction for girls and thus a slightly smaller gender gap in more unequal countries (Fig.

9

1   2: a2). Higher income inequality was associated with marginally more psychological distress for both

2   genders (0.0007 [0.004sd], p>0.05), but this association is slightly stronger for boys than girls and

3   thus more equal countries have larger gender gaps (Fig. 2: b2). By contrast, lower income inequality

4   was associated with lower hedonia (0.009 [0.004sd], p<0.05) and eudaemonia (0.003 [0.003sd],

5   p>0.05) and slightly larger gender gaps (Fig.3: c2 & d2). Thus, while more equal countries have

6   larger gender gaps across all outcomes the direction of association between Gini and mental health

7   differs by outcome.

8

9   *What is the association between gender equality and mental health in each gender?*

10

11 More gender equality was associated with a larger gender gap across all mental health outcomes

12 (Fig. 2 & 3; Table 2). The processes underlying this larger gender gap differed by outcome. The larger

13 gap in life satisfaction and psychological distress was mostly driven by positive correlations with male

14 mental health but negative correlations with female mental health, apart from the association between

15 GGGI and female life satisfaction which was weakly positive (Fig. 2: a5). The widening gap in hedonia

16 and eudaemonia was mostly due to stronger negative correlations with female mental health and

17 weaker negative correlations with male mental health, apart from the association between GGGI and

18 male hedonia which was positive (0.18 [0.054sd], p<0.01 Table 2; Fig 2&3). The interaction terms

19 between GGGI and gender are large so there is fairly strong evidence that the effect for gender differs

20 with GGGI for all mental health outcomes, apart from eudaemonia (Table 2).

21

22 *Additional and sensitivity analyses*

23

24 Firstly, results were similar when analyses are controlled for age, socioeconomic status, and

25 immigration status at the individual level (S5-8). Secondly, the interactions between gender and

26 gender equality are robust to the use of the GSNI instead of the GGGI (Table S10). Thirdly, models

27 and main conclusions are robust to the removal of country outliers identified by cook's distance (Table

28 S9). Lastly, following Zuckerman et. al (Zuckerman et al., 2017) we plot quadratic country-level

29 associations (Fig. S6 & 7) and find that inferences drawn are largely similar to the linear associations,

30 with richer and more gender equal countries having larger gaps. However, confidence intervals

1 overlapped more, compared to the linear regressions, particularly for life satisfaction and

2 psychological distress, thus caution is required in inferring deviation from linearity"

3

4 **Discussion**

5 Across four mental health outcomes - life satisfaction, psychological distress, hedonia, and

6 eudaemonia - we find that girls typically had worse mental health than boys. Whilst there is

7 considerable cross-cultural variation in the size of this average difference, it appears largely

8 ubiquitous in this global sample - particularly for life satisfaction and psychological distress. Perhaps

9 counterintuitively, richer European countries including the Scandinavian nations, such as Sweden and

10 Finland, have some of the largest gender gaps in mental health. By contrast, countries with worse

11 society gender equality scores – such as Jordan, Saudi Arabia, and Lebanon - have some of the

12 smallest gender gaps and the direction of the gap is sometimes reversed (with boys having worse

13 mental health). The outcomes vary in their distributions and where in the distribution the gender gap

14 appears, indicating that mean differences are driven by different parts of the mental health distribution

15 for the different outcomes. This highlights the importance of considering the underlying distributions of

16 any mean differences observed. An identical mean difference may be driven by different parts of the

17 population distribution, and this may have public health consequences. For example, we found that

18 girls were less likely than boys to report the highest life satisfaction score, rather than having

19 particularly higher counts in the lower part of the life satisfaction distribution. Previous research

20 typically only focuses on mean differences – future research to understand cross-national differences

21 in mental health may benefit from such analyses.

22

23 Higher GDP per capita was associated with a larger gender gap, albeit the magnitude of effect was

24 small. This contrasts with other findings where a positive relationship between GDP and adolescent

25 wellbeing has been found (Torsheim et al., 2006), and this may be due to our inclusion of a wider

26 range of countries beyond rich Western economies. The Easterlin paradox of increasing per capita

27 wealth not associating with increasing wellbeing is well known (Easterlin, 2003) — once basic

28 requirements are met, material desires often increase with increasing incomes so that one is never

29 completely satisfied (Carol Graham et al., 2010). This however does not completely explain the

30 negative association with mental health we found in both genders, or the larger mental health gender

1 gap in richer countries. In line with previous literature we find an inconsistent and weak relationship

2 between income inequality and mental health outcomes (Ngamaba et al., 2018), although it is

3 associated with a wider gender gap in all cases. It could be the case that income inequality and GDP

4 per capita are not particularly important amongst adolescents, and a more specific measure such as

5 the purchasing power of adolescents might be more relevant. Or, for income inequality, the

6 association may be dependent on a country's level of development, with higher income inequality

7 associating with better mental health in developing nations and worse mental health in developed

8 nations (Ngamaba et al., 2018).

9

10 More gender equal countries had larger gender gaps across all outcomes examined, consistent with

11 previous literature in adults (Zuckerman et al., 2017). While the gender equality measures used are

12 not specifically designed to capture exposures directly experienced by adolescents, they reflect

13 multiple dimensions of gender equality which influence experiences through all live stages in these

14 countries and hence provide relevant information about the societal experiences for each gender.

15 Whilst the nature of the associations between gender equality and adolescent mental health were

16 inconsistent across outcomes it was striking that where the association was positive, it was

17 particularly strong for males. This is in contrast to previous findings that show an equivalent positive

18 relationship between gender equality and life satisfaction in boys and girls (Looze et al., 2018). Whilst

19 previous work has shown that social norms of gender equality may be particularly important for

20 mental health outcomes (Tesch-Römer et al., 2008) it is unclear if the multiple available gender

21 equality indicators we used fully capture this. The newly created gender social norms index (GSNI),

22 despite attempting to capture the distinct attitudinal aspects of gender equality, does not appear to

23 measure gender equality in a qualitatively different way than the GII as they are highly correlated. By

24 contrast, the GGGI captures a greater detail of gender equality by including more and more diverse

25 indicators (Table S3), making it more granular, whilst also separating itself from a country's level of

26 development. For example, the GGGI includes five indicators for economic participation, such as ratio

27 of female earned income to male, and ratio of female professional and technical workers to males,

28 compared to the GII's one measure of female and male labour force participation rates.

29

1   Our results present a complex picture for the relationship between gender equality and the adolescent

2   gender mental health gap. While the feminist movement is itself old, extensive judicial and social

3   change towards gender equality is a fairly recent development, with the UN Convention on the

4   Elimination of all Forms of Discrimination Against Women (CEDAW) only being instituted in 1981.

5   Graham and Pettinato (C. Graham & Pettinato, 2002) coined the term 'frustrated achievers' to

6   describe individuals that experience improvements in wealth but report negative perceived past

7   mobility and lower happiness, as a result of still facing discriminatory practices and barriers to their

8   continued ascent. In terms of women, whilst gains have been made, there remain many barriers to full

9   equality that may explain part of our association between gender equality and worse female mental

10   health, or only very slightly better female mental health in the case of life satisfaction. Similarly,

11   expectations of equality may rise faster than actual experience of equality and this may result in

12   worse mental health as women are not able to realise their goals. Another characteristic of upwardly

13   mobile groups is that their reference categories for social comparison are usually beyond their original

14   cohort (Easterlin, 2003). Thus, women or girls attempting to achieve the same successes as men and

15   boys will look to them as their reference group and this may highlight the inequalities between them,

16   producing lower life satisfaction and mental health, while in less gender equal countries reference

17   groups might be limited to their own sex (Costa et al., 2001). Furthermore, in a number of more

18   gender unequal countries, boys and girls might be more socially segregated at adolescence

19   26/01/2021 09:53:00 which reduce between gender comparisons.

20

21   In more gender equal countries girls and women are now faced with a double burden of balancing

22   both increased economic and political participation as well as the traditional female responsibilities

23   and norms. While in more gender equal countries women have entered traditionally male dominated

24   areas of employment, men have not entered female dominated areas of employment to the same

25   extent, nor do they do equal amounts of domestic work (England & Folbre, 2005; Garcia & Tomlinson,

26   2020). In countries with lower gender equality women's roles are more fixed, whereas in more gender

27   equal countries they are less prescribed, leading to potential conflict between roles, which may affect

28   mental health (Hopcroft & Bradley, 2007).

29

13

1   Adolescence and puberty marks a particular period of changing identity (Blakemore & Mills, 2014)

2   including developing conceptions of what it means to be a man or a woman (Greene & Patton, 2020),

3   and while there are cross-cultural differences in experience of adolescence, identity development is

4   common (Gibbons & Poelker, 2019). Adolescence can be particularly stressful when the norms of

5   femininity potentially contradict with the norms of gender equality and attempting to balance the two

6   may be additionally difficult. Previous research indicates that stress and educational pressure is

7   particularly correlated with worse mental health in adolescent girls (M.a et al., 1999; Wiklund et al.,

8   2012). Indeed, changing norms of female education and economic participation can increase

9   educational stress and psychological distress for girls whilst they are still burdened with traditional

10   anxieties related to maintaining a female identity and appearance (West & Sweeting, 2003) - and

11   adolescent girls experience many more anxieties related to their appearance than boys (Smolak,

12   2004). Additionally, evidence suggests that individuals who violate gender stereotypes may receive

13   backlash (Rudman et al., 2012), which may have negative consequences for mental health. Overall,

14   adolescence marks a period of emerging new stressors which may negatively affect girl's mental

15   health to a greater degree than boys, and in more gender equal countries there may be more of these

16   stressors. For example, having to balance multiple gender norms, or the stress related to the

17   mismatch between expected and experienced gender equality and opportunities, which is potentially

18   greater in countries perceived to have higher gender equality.

19

20   Future research should examine some of the theories we have highlighted above to better understand

21   the individual level mechanisms. For example, to examine whether girls who attempt to satisfy

22   multiple gender norms, such as being - femininely attractive, high achieving, and 'one of the boys' -

23   have worse mental health. Additionally, examination of other country-level indicators may yield further

24   results to help explain country-level differences in the gender gap, such as, availability and access to

25   mental health support (Saraceno et al., 2007), levels of stigma and literacy around mental health

26   (Corrigan & Watson, 2002), and broader factors such as estimates of environmental degradation,

27   which may have gendered impacts (Patel et al., 2020).

28

29   *Limitations*

1 Firstly, our study relies exclusively on cross-sectional cross-country correlations; thus, we cannot

2 make any strong conclusions regarding the causal pathways involved. However, cross-country

3 comparisons are necessary to elucidate risk factors that operate at the population level (Pearce,

4 2000), such as indicators of gender and income inequality. Secondly, whilst we cannot exclude

5 cultural differences on likert scale responses, such as positivity biases, that may confound cross-

6 country differences (Oishi, 2010) invariance testing of the measures indicated that the measures

7 behaved similarly across gender and region. Thirdly, the gender gap itself may partly be a product of

8 reporting bias – with boys being less willing to report negative mental health than girls. However, self-

9 reports are necessary to measure mental health and wellbeing, and the extent and distributions of the

10 gender gap being different across mental health outcomes suggests reporting biases might not be the

11 only explanation. Fourthly, there could be systematic differences across genders in school attendance

12 amongst the countries in our sample that could potentially bias comparison of gender gaps across

13 countries. However, investigation of the gender ratio in secondary enrolment (obtained from the

14 GGGI) suggests that there are not large differences in our sample. The female to male ratio in

15 secondary enrolment ranges from 0.9 to 1.1 for our whole sample, apart from Germany (0.89), the

16 Philippines (1.19) and Qatar (1.25). Lastly, our measure of gender was binary in nature and does not

17 allow investigation of non-binary gender identities on mental health.

18

19 *Conclusion*

20 Our findings demonstrate that overall girls have worse mental health than boys, but the direction and

21 size of the gender gap and distribution varies across a range of mental health outcomes and a large

22 sample of countries. Wealthier and more gender-equal countries, contrary to expectation, have larger

23 mental health gender gaps. For life satisfaction and psychological distress, this was driven by

24 negative associations in females but positive associations in males. Findings point to the complex

25 nature of gender disparities in mental health and possible incongruence between expectations and

26 reality in more gender equal countries.

27 **References**

28 Albert, P. R. (2015). Why is depression more prevalent in women? *Journal of Psychiatry &*

29 *Neuroscience : JPN, 40*(4), 219–221. https://doi.org/10.1503/jpn.150205

1   Asparouhov, T. (2006). General Multi-Level Modeling with Sampling Weights. *Communications*

2   *in Statistics - Theory and Methods*, *35*(3), 439–460.

3   https://doi.org/10.1080/03610920500476598

4   Bann, D., Fitzsimons, E., & Johnson, W. (2019). Determinants of the population health

5   distribution, or why are risk factor-body mass index associations larger at the upper end

6   of the BMI distribution? *BioRxiv*, 537829. https://doi.org/10.1101/537829

7   Blakemore, S.-J., & Mills, K. L. (2014). Is Adolescence a Sensitive Period for Sociocultural

8   Processing? *Annual Review of Psychology*, *65*(1), 187–207.

9   https://doi.org/10.1146/annurev-psych-010213-115202

10 Bolognini, M., Plancherel, B., Bettschart, W., & Halfon, O. (1996). Self-esteem and mental health

11   in early adolescence: Development and gender differences. *Journal of Adolescence*, *19*(3),

12   233–245. https://doi.org/10.1006/jado.1996.0022

13 Bradshaw, J., Martorano, B., Natali, L., & de Neubourg, C. (2013). Children's Subjective Well-

14   Being in Rich Countries. *Child Indicators Research*, *6*(4), 619–635.

15   https://doi.org/10.1007/s12187-013-9196-4

16 Bradshaw, J., & Rees, G. (2017). Exploring national variations in child subjective well-being.

17   *Children and Youth Services Review*, *80*, 3–14.

18   https://doi.org/10.1016/j.childyouth.2017.06.059

19 Carle, A. C. (2009). Fitting multilevel models in complex survey data with design weights:

20   Recommendations. *BMC Medical Research Methodology*, *9*(1), 49.

21   https://doi.org/10.1186/1471-2288-9-49

22 Caro, D. H., & Biecek, P. (2017). intsvy: An R Package for Analyzing International Large-Scale

23   Assessment Data. *Journal of Statistical Software*, *81*(1), 1–44.

24   https://doi.org/10.18637/jss.v081.i07

25 Cavallo, F., Zambon, A., Borraccino, A., Raven-Sieberer, U., Torsheim, T., Lemma, P., & the HBSC

26   Positive Health Group. (2006). Girls growing through adolescence have a higher risk of

poor health. *Quality of Life Research*, *15*(10), 1577–1585.

https://doi.org/10.1007/s11136-006-0037-5

Corrigan, P. W., & Watson, A. C. (2002). Understanding the impact of stigma on people with

mental illness. *World Psychiatry*, *1*(1), 16–20.

Costa, P. T., Terracciano, A., & McCrae, R. R. (2001). Gender differences in personality traits

across cultures: Robust and surprising findings. *Journal of Personality and Social*

Psychology, *81*(2), 322–331. https://doi.org/10.1037/0022-3514.81.2.322

Das, J. K., Salam, R. A., Lassi, Z. S., Khan, M. N., Mahmood, W., Patel, V., & Bhutta, Z. A. (2016).

Interventions for Adolescent Mental Health: An Overview of Systematic Reviews. *Journal*

of Adolescent Health, *59*(4, Supplement), S49–S60.

https://doi.org/10.1016/j.jadohealth.2016.06.020

Easterlin, R. A. (2003). Explaining happiness. *Proceedings of the National Academy of Sciences of*

the United States of America, *100*(19), 11176–11183.

https://doi.org/10.1073/pnas.1633144100

Elgar, F. J., Pförtner, T.-K., Moor, I., De Clercq, B., Stevens, G. W. J. M., & Currie, C. (2015).

Socioeconomic inequalities in adolescent health 2002-2010: A time-series analysis of 34

countries participating in the Health Behaviour in School-aged Children study. *Lancet*

(London, England), *385*(9982), 2088–2095. https://doi.org/10.1016/S0140-

6736(14)61460-4

England, P., & Folbre, N. (2005). Gender and Economic Sociology. In N. J. Smelser & R. Swedberg

(Eds.), *The Handbook of Economic Sociology* (pp. 627–649). Princeton University Press.

http://www.proquest.com/docview/189251597/abstract/8EB9BA91B33E4BFDPQ/27

Garcia, R., & Tomlinson, J. (2020). Rethinking the Domestic Division of Labour: Exploring

Change and Continuity in the Context of Redundancy. *Sociology*, 0038038520947311.

https://doi.org/10.1177/0038038520947311

1 Gibbons, J. L., & Poelker, K. E. (2019). Adolescent Development in a Cross-Cultural Perspective.

2   In K. D. Keith (Ed.), *Cross-Cultural Psychology: Contemporary Themes and Perspectives*

3   (pp. 190–215). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781119519348.ch9

4 Graham, C., & Pettinato, S. (2002). Frustrated Achievers: Winners, Losers and Subjective Well-

5   Being in New Market Economies. *Journal of Development Studies*, *38*(4), 100–140.

6   https://doi.org/10.1080/00220380412331322431

7 Graham, Carol, & Chattopadhyay, S. (2013). Gender and well-being around the world.

8   *International Journal of Happiness and Development*, *1*(2), 212–232.

9   https://doi.org/10.1504/IJHD.2013.055648

10 Graham, Carol, Chattopadhyay, S., & Picon, M. (2010). The Easterlin and Other Paradoxes: Why

11   Both Sides of the Debate May Be Correct. In E. Diener, D. Kahneman, & J. Helliwell (Eds.),

12   *International Differences in Well-Being* (pp. 247–290). Oxford University Press.

13   https://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780199732739.001.0

14   001/acprof-9780199732739-chapter-9

15 Greene, M. E., & Patton, G. (2020). Adolescence and Gender Equality in Health. *Journal of*

16   *Adolescent Health*, *66*(1), S1–S2. https://doi.org/10.1016/j.jadohealth.2019.10.012

17 Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *The*

18   *Behavioral and Brain Sciences*, *33*(2–3), 61–83.

19   https://doi.org/10.1017/S0140525X0999152X

20 Higgins, J. P. T., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in

21   meta-analyses. *BMJ*, *327*(7414), 557–560. https://doi.org/10.1136/bmj.327.7414.557

22 Hopcroft, R. L., & Bradley, D. B. (2007). The Sex Difference in Depression Across 29 Countries.

23   *Social Forces*, *85*(4), 1483–1507. https://doi.org/10.1353/sof.2007.0071

24 Huppert, F. A. (2014). The State of Wellbeing Science: Concepts, Measures, Interventions, and

25   Policies. In C. L. Cooper (Ed.), *Wellbeing* (pp. 1–49). John Wiley & Sons, Ltd.

26   https://doi.org/10.1002/9781118539415.wbwell036

1   Huppert, F. A., & Whittington, J. E. (2003). Evidence for the independence of positive and

2   negative well-being: Implications for quality of life assessment. *British Journal of Health

3   Psychology*, *8*(1), 107–122. https://doi.org/10.1348/135910703762879246

4   Kaye-Tzadok, A., Kim, S. S., & Main, G. (2017). Children's subjective well-being in relation to

5   gender—What can we learn from dissatisfied children? *Children and Youth Services

6   Review*, *80*, 96–104. https://doi.org/10.1016/j.childyouth.2017.06.058

7   Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime

8   prevalence and age-of-onset distributions of DSM-IV disorders in the National

9   Comorbidity Survey Replication. *Archives of General Psychiatry*, *62*(6), 593–602.

10   https://doi.org/10.1001/archpsyc.62.6.593

11 Klocke, A., Clair, A., & Bradshaw, J. (2014). International Variation in Child Subjective Well-

12   Being. *Child Indicators Research*, *7*(1), 1–20. https://doi.org/10.1007/s12187-013-

13   9213-7

14 Looze, M. E. de, Huijts, T., Stevens, G. W. J. M., Torsheim, T., & Vollebergh, W. a. M. (2018). The

15   Happiest Kids on Earth. Gender Equality and Adolescent Life Satisfaction in Europe and

16   North America. *Journal of Youth and Adolescence*, *47*(5), 1073–1085.

17   https://doi.org/10.1007/s10964-017-0756-7

18 Lund, C., Breen, A., Flisher, A. J., Kakuma, R., Corrigall, J., Joska, J. A., Swartz, L., & Patel, V. (2010).

19   Poverty and common mental disorders in low and middle income countries: A

20   systematic review. *Social Science & Medicine (1982)*, *71*(3), 517–528.

21   https://doi.org/10.1016/j.socscimed.2010.04.027

22 M.a, P. K. S., Gotlib, I. H., & Hayward, C. (1999). Gender differences in correlates of depressive

23   symptoms in adolescents. *Journal of Adolescent Health*, *25*(2), 98–108.

24   https://doi.org/10.1016/S1054-139X(99)00038-5

25 Ngamaba, K. H., Panagioti, M., & Armitage, C. J. (2018). Income inequality and subjective well-

26   being: A systematic review and meta-analysis. *Quality of Life Research*, *27*(3), 577–596.

27   https://doi.org/10.1007/s11136-017-1719-x

19

1   OECD. (2018). *2018 Database—PISA*. https://www.oecd.org/pisa/data/2018database/

2   OECD. (2020). *PISA 2018 Technical Report—PISA*.

3   https://www.oecd.org/pisa/data/pisa2018technicalreport/

4   Oishi, S. (2010). Culture and Well-Being: Conceptual and Methodological Issues. In E. Diener, D.

5   Kahneman, & J. Helliwell (Eds.), *International Differences in Well-Being* (pp. 34–70).

6   Oxford University Press.

7   https://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780199732739.001.0

8   001/acprof-9780199732739-chapter-3

9   Oishi, S., Kesebir, S., & Diener, E. (2011). Income Inequality and Happiness. *Psychological*

10   *Science*, *22*(9), 1095–1100. https://doi.org/10.1177/0956797611417262

11 Ostberg, V., Alfven, G., & Hjern, A. (2006). Living conditions and psychosomatic complaints in

12   Swedish schoolchildren. *Acta Paediatrica (Oslo, Norway: 1992)*, *95*(8), 929–934.

13   https://doi.org/10.1080/08035250600636545

14 Ottova, V., Erhart, M., Vollebergh, W., Kökönyei, G., Morgan, A., Gobina, I., Jericek, H., Cavallo, F.,

15   Välimaa, R., de Matos, M. G., Gaspar, T., Schnohr, C. W., & Ravens-Sieberer, U. (2012). The

16   Role of Individual- and Macro-Level Social Determinants on Young Adolescents'

17   Psychosomatic Complaints. *The Journal of Early Adolescence*, *32*(1), 126–158.

18   https://doi.org/10.1177/0272431611419510

19 Patel, A., Lotia, H., Malik, A. A., Mundt, M. D., Lee, H., & Rafiq, M. A. (2020). Gendered Impacts of

20   Environmental Degradation in Informal Settlements: A Comparative Analysis and Policy

21   Implications for India, Bangladesh, and Pakistan. *Journal of Comparative Policy Analysis:*

22   *Research and Practice*, *0*(0), 1–17. https://doi.org/10.1080/13876988.2020.1829454

23 Pearce, N. (2000). The ecological fallacy strikes back. *Journal of Epidemiology & Community*

24   *Health*, *54*(5), 326–327. https://doi.org/10.1136/jech.54.5.326

25 Pickett, K. E., & Wilkinson, R. G. (2010). Inequality: An underacknowledged source of mental

26   illness and distress. *The British Journal of Psychiatry*, *197*(6), 426–428.

27   https://doi.org/10.1192/bjp.bp.109.072066

1 Rehm, J., & Shield, K. D. (2019). Global Burden of Disease and the Impact of Mental and Addictive

2   Disorders. *Current Psychiatry Reports*, *21*(2), 10. https://doi.org/10.1007/s11920-019-

3   0997-0

4 Rözer, J., & Kraaykamp, G. (2013). Income Inequality and Subjective Well-being: A Cross-

5   National Study on the Conditional Effects of Individual and National Characteristics.

6   *Social Indicators Research*, *113*(3), 1009–1023. https://doi.org/10.1007/s11205-012-

7   0124-7

8 Rudman, L. A., Moss-Racusin, C. A., Glick, P., & Phelan, J. E. (2012). Chapter four - Reactions to

9   Vanguards: Advances in Backlash Theory. In P. Devine & A. Plant (Eds.), *Advances in*

10   *Experimental Social Psychology* (Vol. 45, pp. 167–227). Academic Press.

11   https://doi.org/10.1016/B978-0-12-394286-9.00004-4

12 Salinas-Jiménez, M. del M., Artés, J., & Salinas-Jiménez, J. (2016). Are Education and Occupational

13   Status Affecting Men's and Women's Satisfaction in Different Ways? A Cross-National

14   Perspective on Gender Inequality. In M. L. Connerley & J. Wu (Eds.), *Handbook on Well-*

15   *Being of Working Women* (pp. 603–632). Springer Netherlands.

16   https://doi.org/10.1007/978-94-017-9897-6_34

17 Saraceno, B., van Ommeren, M., Batniji, R., Cohen, A., Gureje, O., Mahoney, J., Sridhar, D., &

18   Underhill, C. (2007). Barriers to improvement of mental health services in low-income

19   and middle-income countries. *The Lancet*, *370*(9593), 1164–1174.

20   https://doi.org/10.1016/S0140-6736(07)61263-X

21 Smolak, L. (2004). Body image in children and adolescents: Where do we go from here? *Body*

22   *Image*, *1*(1), 15–28. https://doi.org/10.1016/S1740-1445(03)00008-1

23 Steptoe, A. (2019). Happiness and Health. *Annual Review of Public Health*, *40*(1), 339–359.

24   https://doi.org/10.1146/annurev-publhealth-040218-044150

25 Tesch-Römer, C., Motel-Klingebiel, A., & Tomasik, M. J. (2008). Gender Differences in Subjective

26   Well-Being: Comparing Societies with Respect to Gender Equality. *Social Indicators*

27   *Research*, *85*(2), 329–349. https://doi.org/10.1007/s11205-007-9133-3

1   Torsheim, T., Ravens-Sieberer, U., Hetland, J., Välimaa, R., Danielson, M., & Overpeck, M. (2006).

2   Cross-national variation of gender differences in adolescent subjective health in Europe

3   and North America. *Social Science & Medicine*, *62*(4), 815–827.

4   https://doi.org/10.1016/j.socscimed.2005.06.047

5   Viner, R. M., Ross, D., Hardy, R., Kuh, D., Power, C., Johnson, A., Wellings, K., McCambridge, J.,

6   Cole, T. J., Kelly, Y., & Batty, G. D. (2015). Life course epidemiology: Recognising the

7   importance of adolescence. *J Epidemiol Community Health*, *69*(8), 719–720.

8   https://doi.org/10.1136/jech-2014-205300

9   Wade, T. J., Cairney, J., & Pevalin, D. J. (2002). Emergence of Gender Differences in Depression

10   During Adolescence: National Panel Results From Three Countries. *Journal of the*

11   *American Academy of Child & Adolescent Psychiatry*, *41*(2), 190–198.

12   https://doi.org/10.1097/00004583-200202000-00013

13   Walker, E. R., McGee, R. E., & Druss, B. G. (2015). Mortality in mental disorders and global

14   disease burden implications: A systematic review and meta-analysis. *JAMA Psychiatry*,

15   *72*(4), 334–341. https://doi.org/10.1001/jamapsychiatry.2014.2502

16   West, P., & Sweeting, H. (2003). Fifteen, female and stressed: Changing patterns of psychological

17   distress over time. *Journal of Child Psychology and Psychiatry, and Allied Disciplines*,

18   *44*(3), 399–411. https://doi.org/10.1111/1469-7610.00130

19   WHO. (2018). *Mental health: Strengthening our response*. https://www.who.int/news-

20   room/fact-sheets/detail/mental-health-strengthening-our-response

21   WHO. (2020). *Adolescent mental health*. https://www.who.int/news-room/fact-

22   sheets/detail/adolescent-mental-health

23   WHO International Consortium in Psychiatric Epidemiology. (2000). Cross-national

24   comparisons of the prevalences and correlates of mental disorders. *Bulletin of the World*

25   *Health Organization*, *78*(4), 413–426.

26   Wiklund, M., Malmgren-Olsson, E.-B., Öhman, A., Bergström, E., & Fjellman-Wiklund, A. (2012).

27   Subjective health complaints in older adolescents are related to perceived stress,

1   anxiety and gender – a cross-sectional school study in Northern Sweden. *BMC Public*

2   *Health*, *12*(1), 993. https://doi.org/10.1186/1471-2458-12-993

3 World Economic Forum. (2018). *The global gender gap report 2018*. World Economic Forum.

4 Zuckerman, M., Li, C., & Diener, E. F. (2017). Societal Conditions and the Gender Difference in

5   Well-Being: Testing a Three-Stage Model. *Personality and Social Psychology Bulletin*.

6   https://doi.org/10.1177/0146167216684133

7 Zuckerman, M., Li, C., & Hall, J. A. (2016). When men and women differ in self-esteem and when

8   they don't: A meta-analysis. *Journal of Research in Personality*, *64*, 34–51.

9   https://doi.org/10.1016/j.jrp.2016.07.007

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1 **Table 1:** Descriptive statistics for all mental health outcomes: means; individual level correlations
2 between mental health outcomes; and country-level correlations between the average gender gap.

Outcomes	Average Mental Health Scores				Correlations (r)*			
	Males (SD)	Females (SD)	Unstandardised Gender Gap (SD)	Standardised Gender Gap (SD)	Life Satisfaction	Psychological Distress	Hedonia	Eudaemonia
Life Satisfaction	7.3 (2.5)	6.9 (2.5)	0.41 (0.33)	0.16 (0.13)		-0.34	0.49	0.40
Psychological Distress	9.1 (2.3)	10.0 (2.1)	-1.1 (0.34)	-0.46 (0.14)	-0.67		-0.23	-0.21
Hedonia	16.2 (2.7)	16.1 (2.6)	0.10 (0.39)	0.04 (0.14)	0.69	-0.53		0.41
Eudaemonia	8.8 (2.1)	8.7 (2.0)	0.15 (0.27)	0.07 (0.12)	0.79	-0.54	0.53	

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5 **Table 1:** Descriptive statistics for all mental health outcomes showing the mean (and standard
6 deviation and the individual-level correlations between mental health outcomes and country-level
7 correlations between average gender gaps. Both unstandardised and standardised mean country
8 gender gap are shown. Note that a positive gender gap indicates worse outcomes for girls apart from
9 for psychological distress where a negative gender gap indicates worse outcomes for girls. *the non-
10 shaded top half of the correlation matrices contains individual-level correlations between mental
11 health outcomes. The shaded bottom half contains country-level correlations between the average
12 gender gaps in mental health outcomes.

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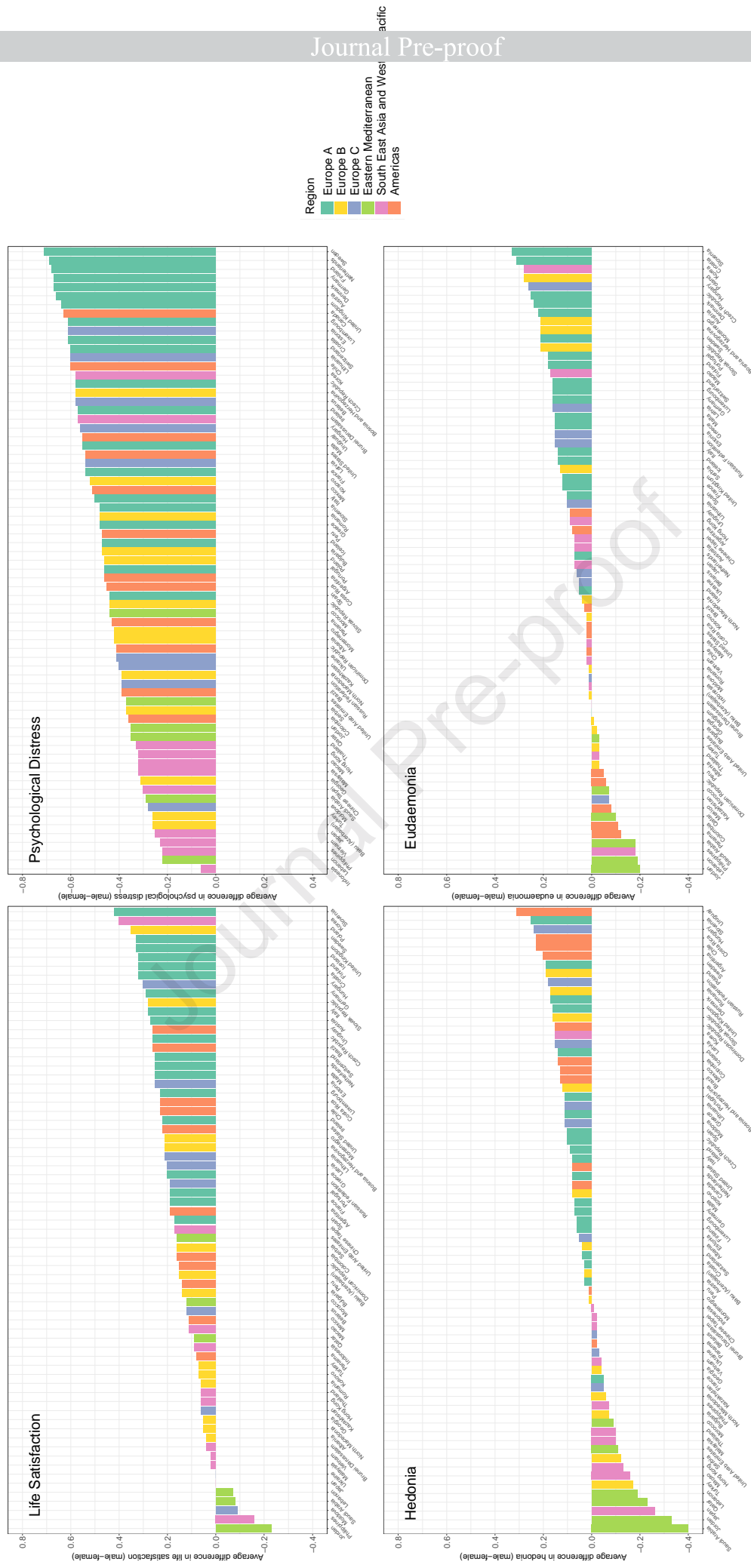|	Life Satisfaction Coef (SE)	Psychological Distress Coef (SE)	Hedonia Coef (SE)	Eudaemonia Coef (SE)
Model A: Baseline model				
Country VPC	5.6%	7.3%	5.6%	5.6%
Model B: including gender				
Female	-0.16 (0.015) ***	0.46 (0.016) ***	-0.035 (0.016)*	-0.069 (0.014)***
Country VPC	5.5%	8.1%	6.1%	4.3%
Model C: including country indicators				
Female	-0.16 (0.016)***	0.47 (0.017)***	-0.042 (0.017)*	-0.069 (0.015)***
GGGI * 10	0.17 (0.047)***	-0.003 (0.059)	0.15 (0.054)**	0.029 (0.04)
GDP per cap x 10^{-4}	-0.032 (0.011)**	0.028 (0.013) *	-0.023 (0.012)	-0.033 (0.009) ***
Gini	-0.00003 (0.004)	0.0007 (0.004)	0.009 (0.004)*	0.003 (0.003)
Country VPC	3.5%	6.7%	4.6%	3.1%
Model D : cross level interactions				
Female	0.40 (0.22)	-0.18 (0.21)	1.08 (0.23) ***	0.14 (0.20)
GGGI x 10	0.17 (0.047)***	-0.069 (0.06)	0.18 (0.054)**	0.008 (0.044)
GDP per capita x $^{10-4}$	-0.031 (0.011)**	0.013 (0.014)	-0.024 (0.012)	-0.035 (0.010)***
Gini	-0.0001 (0.004)	0.002 (0.004)	0.010 (0.004)*	0.006 (0.003)
GGGI x10 X Female	-0.081 (0.028)**	0.095 (0.027) ***	-0.16 (0.029)***	-0.065 (0.025)*
GDP per cap x 10^{-4} X Female	-0.017 (0.006)*	0.021 (0.006)***	0.006 (0.006)	-0.006 (0.006)
Gini X Female	0.002 (0.002)	-0.003 (0.002)	-0.0007 (0.002)	0.008 (0.002)***
Country VPC	3.5%	6.4%	4.6%	3.0%

2

3   **Table 2:** Regression coefficients with standard errors (SE) from multilevel models. Model A presents
4   the baseline model to calculate the country variance partition coefficient (VPC). Model B includes only
5   sex, Model C contains all country-level factors and Model D contains all cross-level interactions
6   between sex female and country-level factors. The GGGI scale runs from 0-1 so we multiply it by 10
7   so the coefficient for GGGI represents a 0.1-point increase in the scale. GDP per capita is divided by
8   10,000, so that the coefficient represents the association with an increase of 1 x 10^{4} GDP per capita.
9   Note that higher values of Gini indicate greater income inequality and that a positive coefficient for
10   psychological distress indicates worse mental health in contrast to the other outcomes. Only the

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1   GGGI as a measure of gender equality is used due to the high correlations between the GII and GSNI
2   and the economic variables (Table S3). *p<0.05 **p<0.01 ***p<0.001

Figure 1. Average standardised gender difference (male − female) in mental health across each outcome by country and coloured by region

Figure 1. Average gender difference in mental health outcomes (life satisfaction, psychological distress, hedonia, and eudaemonia) for each country coloured by region. Gender difference is calculated by subtracting the female from the male mean. The y-axis of the psychological distress scale is reversed to allow visual comparison with the other mental health outcomes as a more negative difference for psychological distress indicates worse outcomes for girls.

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Fig 1: Life Satisfaction enlarged
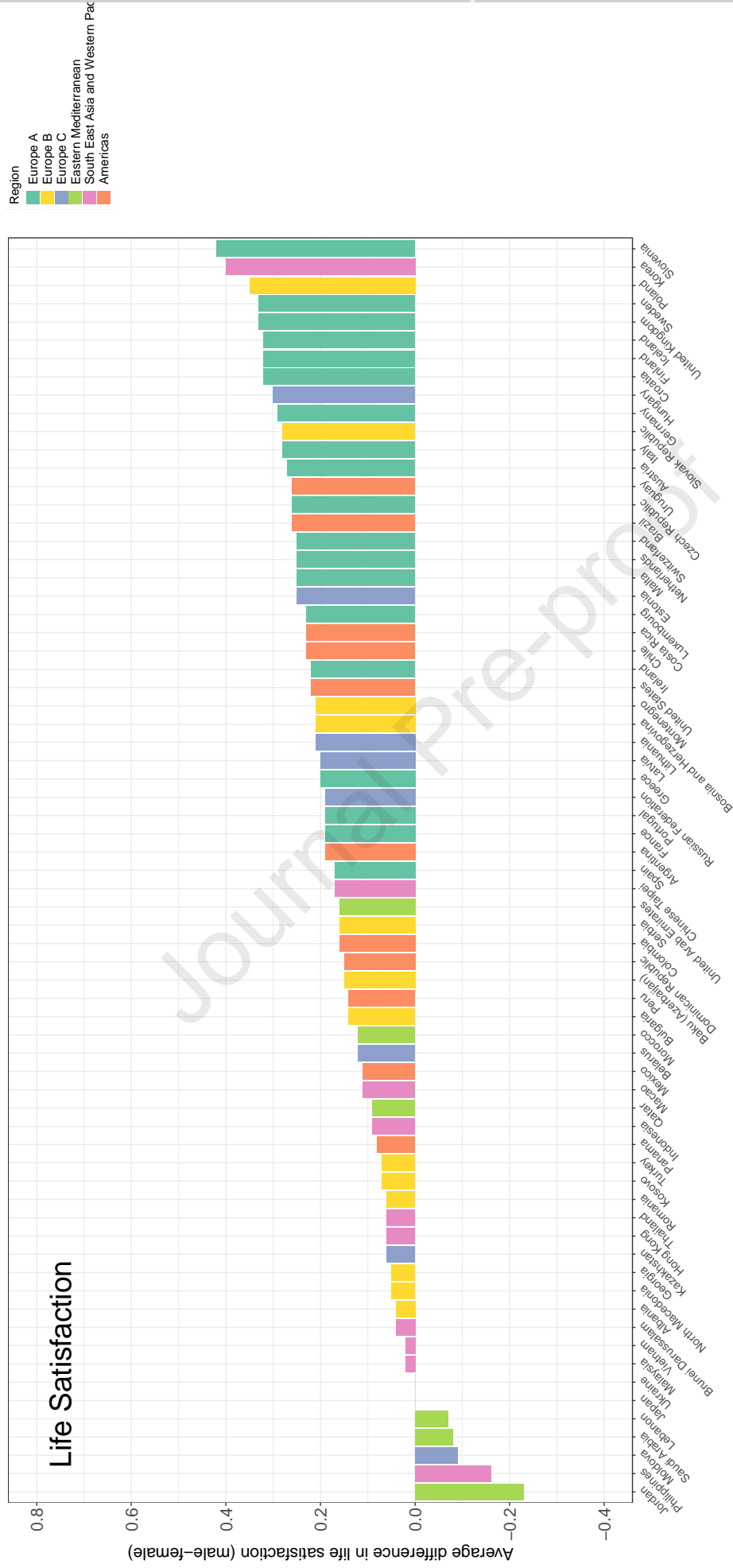
Fig 1: Psychological Distress enlarged

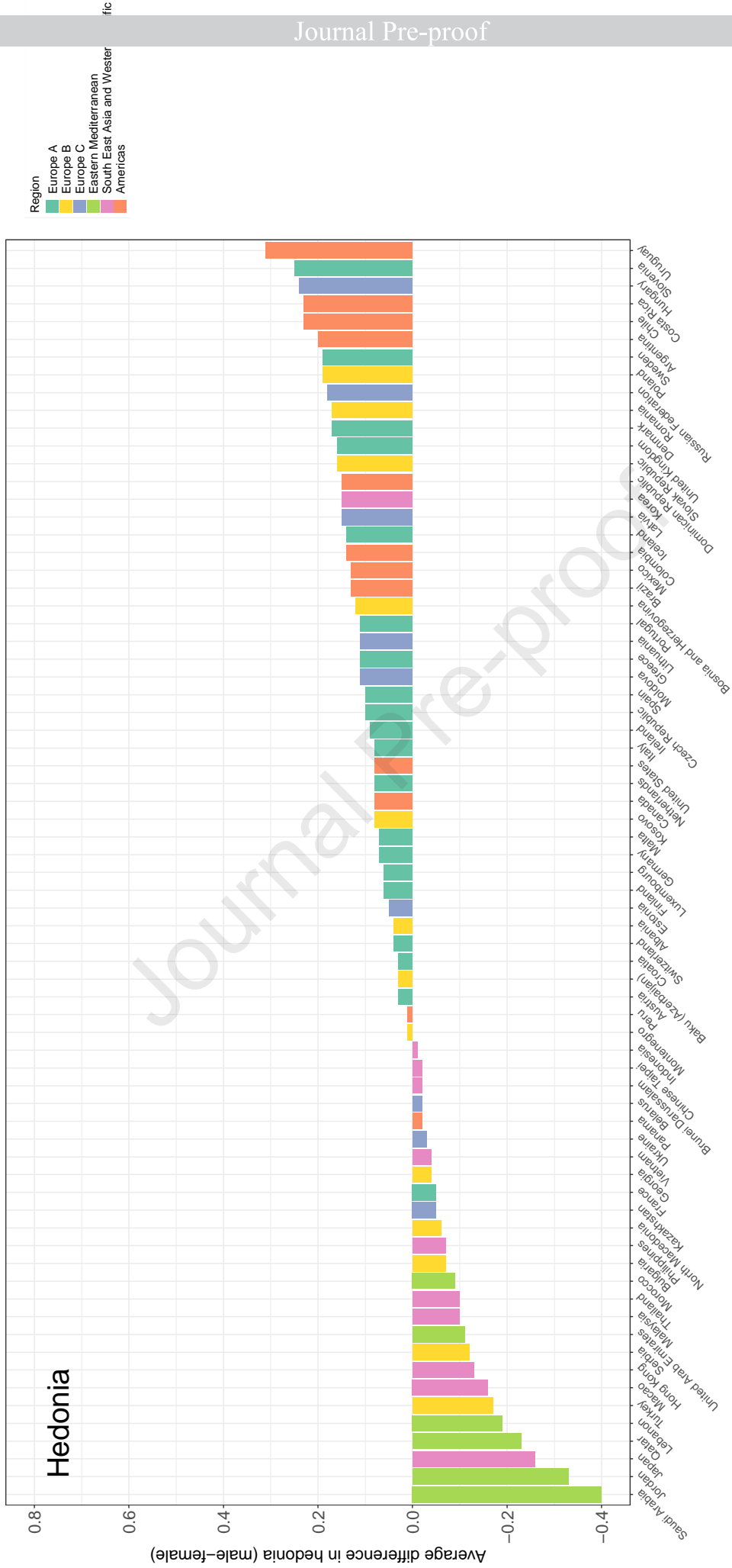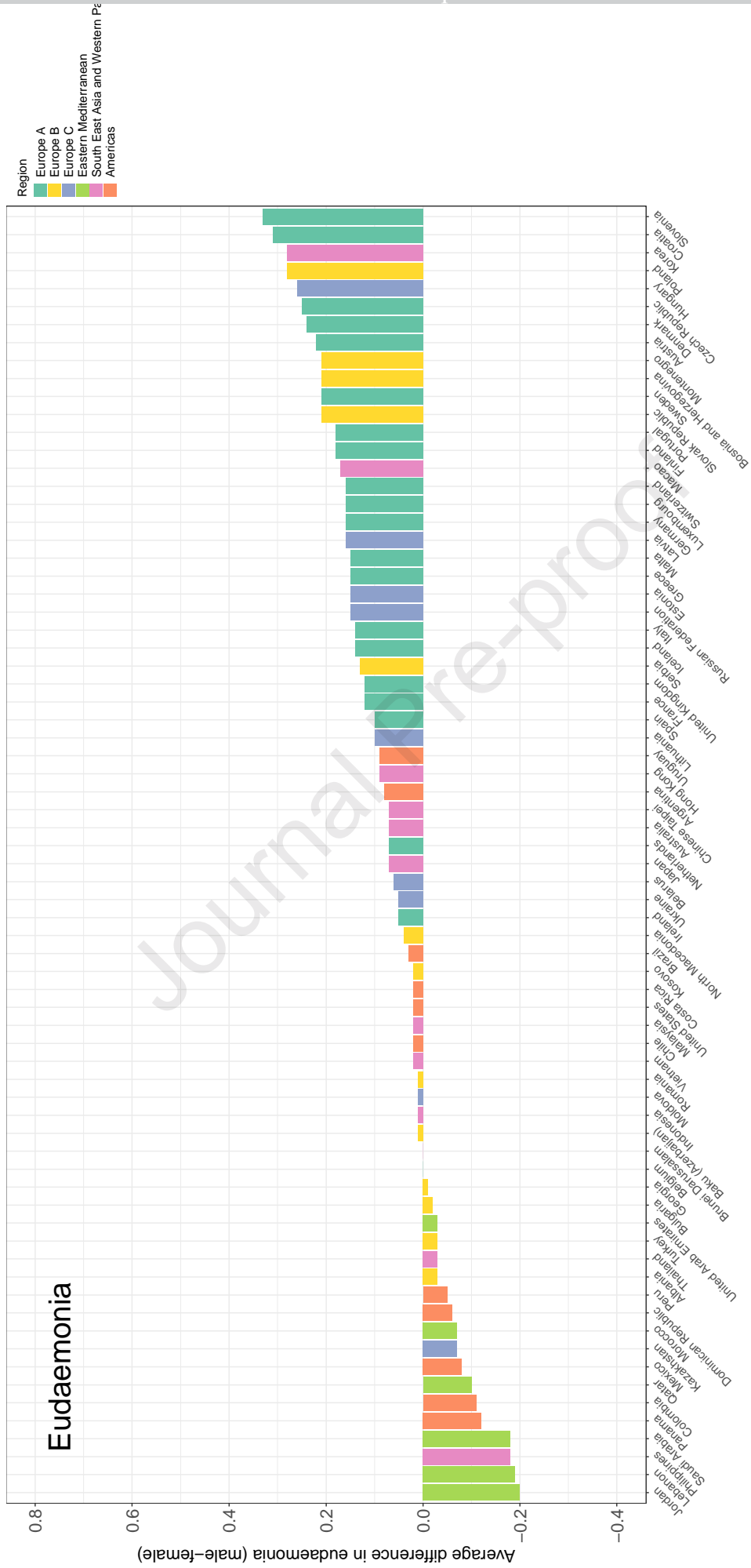Psychological Distress
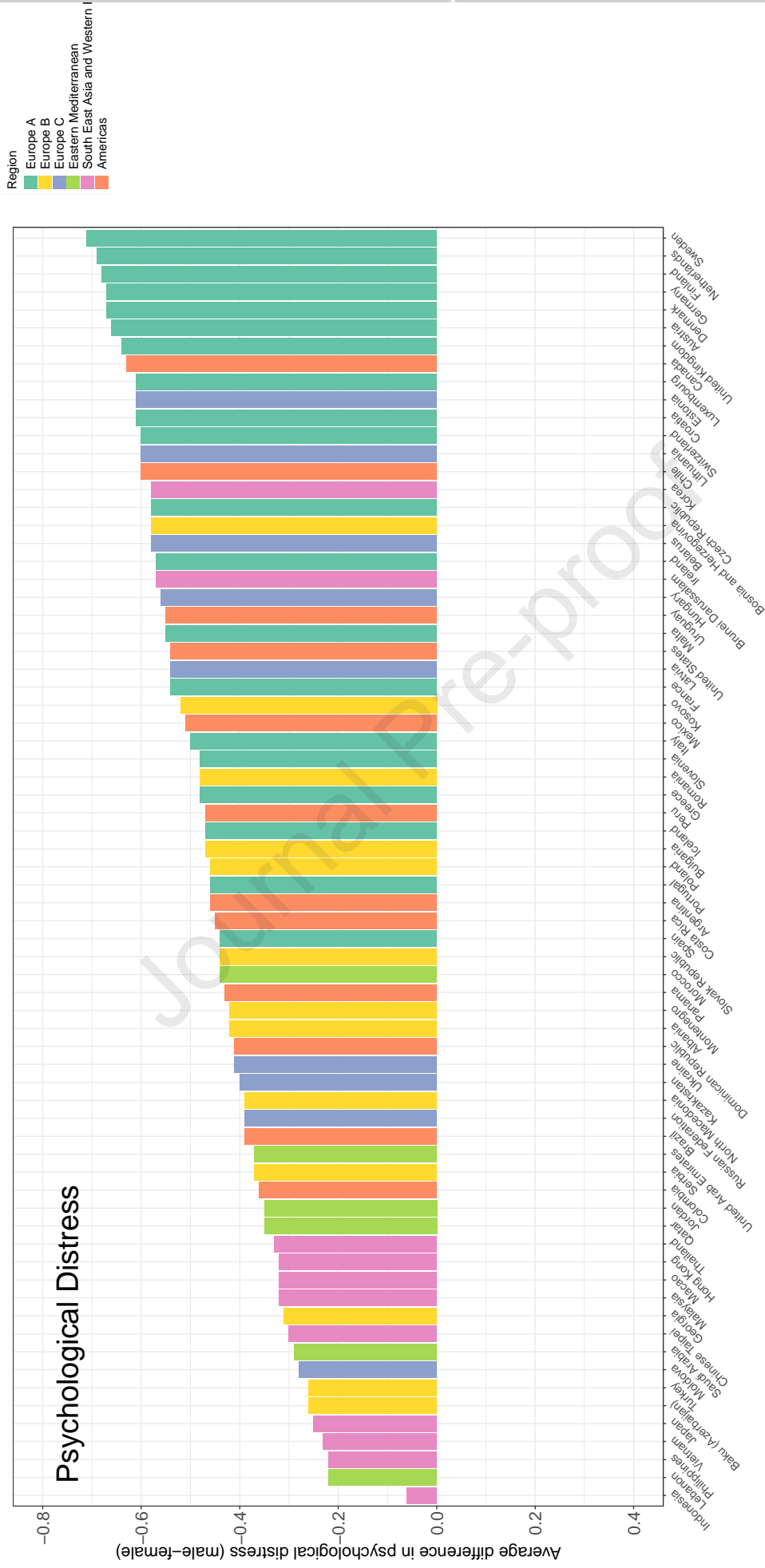
Fig 1: Hedonia enlarged

Fig 1: Eudaemonia enlarged

Figure 2: Associations of country-level economic and gender equality indicators with average life satisfaction and psychological distress.
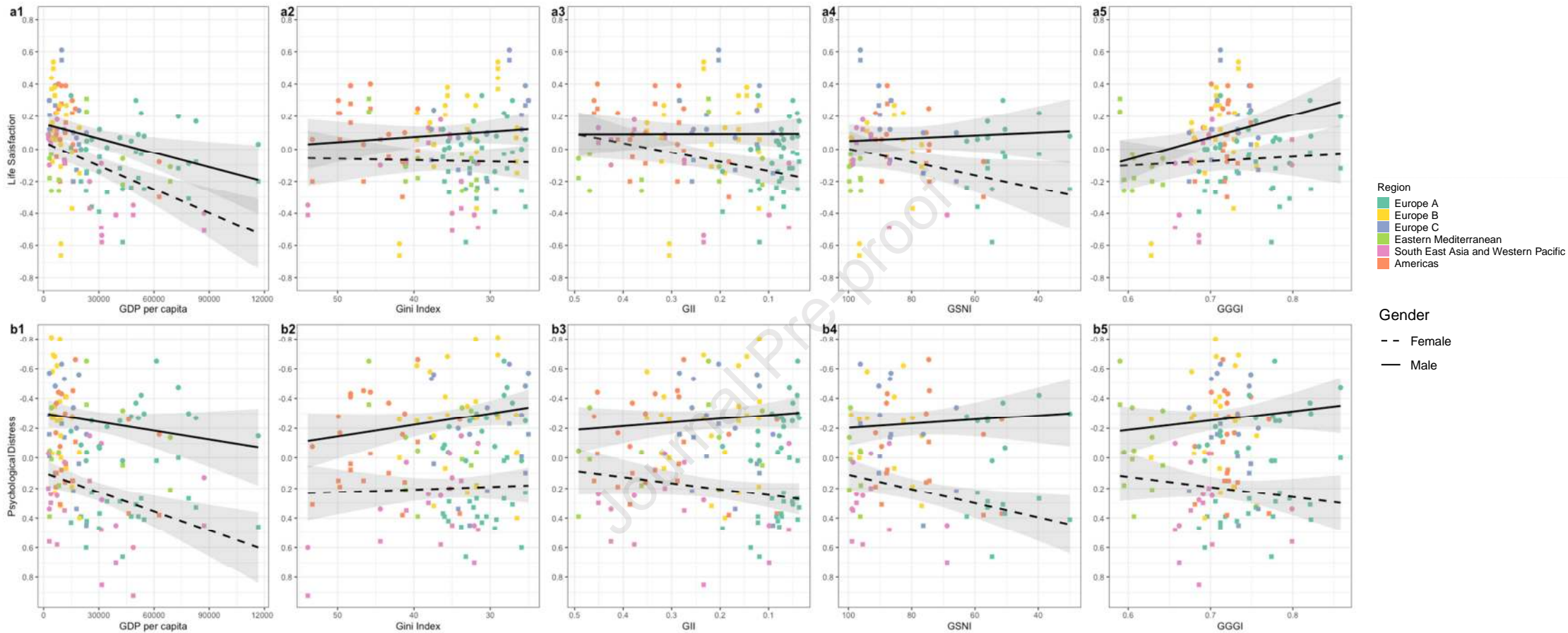

Fig 2: Country-level associations of economic indicators (GDP per capita and Gini) and gender equality indicators (GII, GSNI, and GGGI) with average standardised life satisfaction (a1-5) and psychological distress (b1-5) for females and males and coloured by region. The GII, GSNI and Gini scales are reversed so that all x-axis run from less equal to more equal. The psychological distress scale is reversed so that a negative relationship indicates worse mental health across all outcomes. A larger distance between the regression lines indicates a larger gender gap. Abbreviations: Gini = income inequality, GII = gender inequality index, GSNI = gender social norms index, GGGI = global gender gap index.

Figure 3: **Associations of country-level economic and gender equality indicators with average hedonia and eudaemonia.**
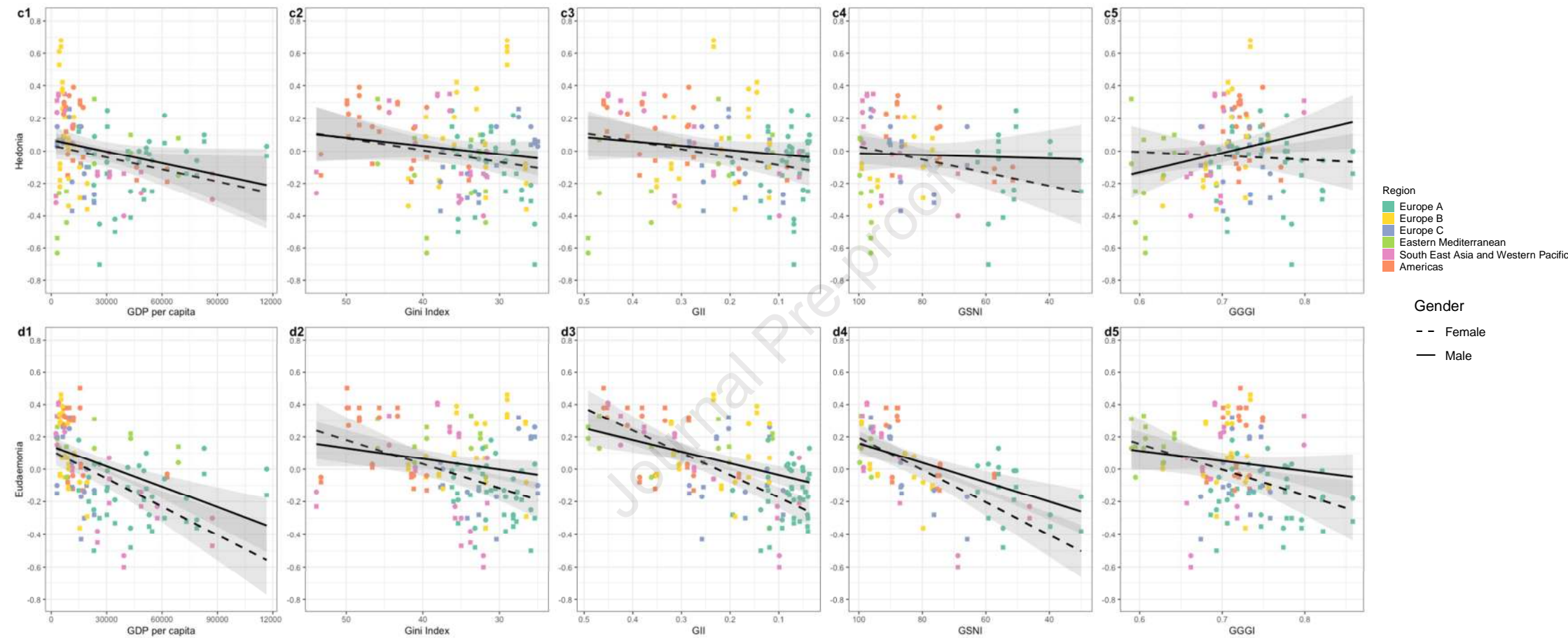

Fig 3: Country-level associations of economic indicators (GDP per capita and Gini) and gender equality indicators (GII, GSNI, and GGGI) with average standardised hedonia (c1-5) and eudaemonia (d1-5) for females and males and coloured by region. The GII, GSNI and Gini scales are reversed so that all x-axis run from less equal to more equal. The psychological distress scale is reversed so that a negative relationship indicates worse mental health across all outcomes. A larger distance between the regression lines indicates a larger gender gap. Abbreviations: Gini = income inequality, GII = gender inequality index, GSNI = gender social norms index, GGGI = global gender gap index.

- Girls have worse average mental health than boys across 4 measures of mental health
- The gender gap in mental health is largely ubiquitous cross-culturally.
- The gap is most pronounced for psychological distress and life satisfaction.
- More gender equal countries have larger gender gaps in mental health.
- Gender equality correlates with less psychological distress in boys but more in girls.

Ethical Statement

All individual level data used in the research article is secondary data and publicly available. The mental health data is collected by the OECD's Programme for International Student Assessment (PISA). All data is anonymised by PISA. Due to the secondary nature of the data ethical clearance was not required to be sought from University College London.

The authors declare no competing interests or have any financial declarations to make.

Gender

Female

Male

Gender

– – Female

—— Male

Region

- Europe A
- Europe B
- Europe C
- Eastern Mediterranean
- South East Asia and Western Pacific
- Americas