**The WEIRD problem in a “non-WEIRD” context: A meta-research on the representativeness of human subjects in Chinese psychological research**

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**Abstract**

Psychological science aims at understanding human mind and behaviour, but it primarily relies on subjects from Western, Educated, Industrialized, Rich, and Democratic regions, i.e., the WEIRD problem. This lack of diversity and representativeness of subjects compromised the generalizability of psychological science. To address this issue, large-scale international collaborative projects were initiated, and more data are collected from non-WEIRD regions. However, it is unknown whether subjects from “non-WEIRD” regions can represent their local population. In this meta-research, we plan to survey the characteristics of Chinese subjects reported in empirical studies published in five mainstream Chinese psychological journals and in large-scale international collaborations. The results will provide a realistic picture of Chinese participants in psychology, and we will discuss potential solutions to the issue of representativeness in both China and worldwide.

**Keywords:** Meta-science; Population psychology; Representativeness; WEIRD; Generalizability

**1 Introduction**

Psychological science aims at understanding human mind and behaviour. However, it largely relies on unrepresentative human samples: most human participants in published psychological studies are undergraduate students who take psychology courses from “Western, Educated, Industrialized, Rich, and Democratic” (WEIRD) regions (Henrich et al., 2010; Henry, 2008; Sears, 1986). For example, Arnett (2008) analysed articles in six premier American Psychology Association (APA) journals and found that 96% relied on samples drawn from Western industrialized nations (Europe, North America, Australia, or Israel). More recent surveys found little change in the past decade (Nielsen et al., 2017; Pollet & Saxton, 2019; Rad et al., 2018). However, the population in WEIRD regions is only consistent less than ¼ of the global population (Henrich et al., 2010). The lack of representativeness in psychological science and related fields (such as cognitive neuroscience, (Zuo et al., 2019)) limits our understanding of the whole picture of human mind and behaviour (Apicella et al., 2020; Barrett, 2020; Jones, 2010) and may lead to incorrect policies (Arnett, 2008). This issue, combined with other methodological issues, created a generalizability crisis in psychology (Yarkoni, 2020).

As a starting point to solve this problem, researchers in the field started to include more diverse data. Many international collaborative projects have been initiated (Gordon et al., 2020; Moshontz et al., 2018). Typically, these projects invite collaborators globally, especially those from non-WEIRD regions, such as Asia, Middle East, Latin America, and Africa. These efforts are applaudable and indeed increased the geographical diversity and sample size of psychological science. These projects, however, have not examined whether data collected from non-WEIRD regions are representative of the local population. Left this issue unaddressed, these large collaboration projects may create an illusion that the diversity problem can be solved by involving more researchers from non-WEIRD regions, ignoring the fact that data collected from non-WEIRD regions may suffer a problem of representativeness (see also Forscher et al., 2021). In fact, there are great variations within non-WEIRD regions (Ghai, 2021). However, the convenient sampling method employed by psychologists will cause the problem of unrepresentativeness in both WEIRD and non-WEIRD regions.

To understand how representative is the sample in psychological research from a typical non-WEIRD, China, we propose to survey the studies conducted by Chinese psychological researchers. China is the second-largest economy and has the largest population in the world, yet with a very different history and cultural tradition from the West. In recent years, Chinese researchers have been actively participated in international collaborations (e.g., Human Penguin Projects, Many Labs 5, Psychological Science Accelerator). However, it is unknown whether Chinese psychological participants represent the Chinese population.

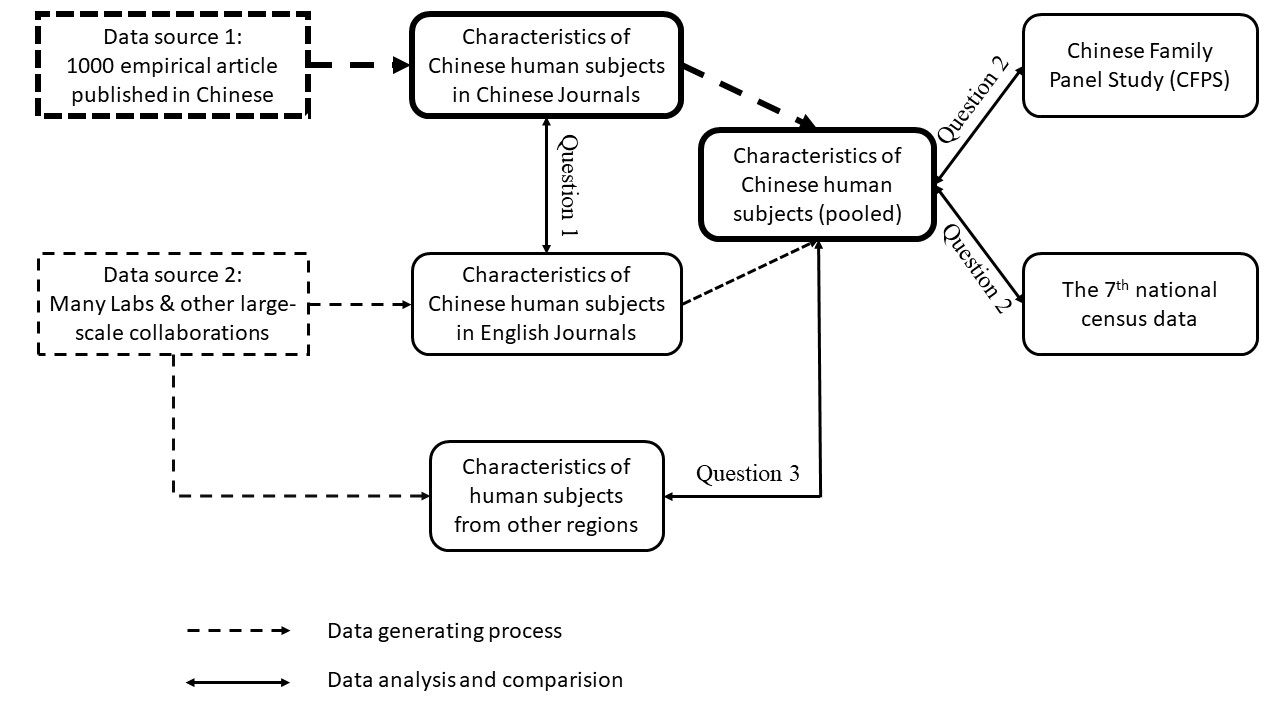
In the current study, we will explore the representativeness of Chinese psychological participants by examining three issues (see Figure 1). Firstly, whether characteristics of Chinese samples reported in large-scale international collaborations are similar to those reported in Chinese psychological journals. Secondly, to what extent the Chinese participants in psychological science represent the Chinese population, as compared with the census data from the National Bureau of Statistics of China and data from a large-scale social survey, Chinese Family Panel Study (CFPS). Lastly, we will explore the shared and distinct patterns of Chinese samples and samples from other regions. In addition, we will record ways in which participants were recruited and how the conclusions were drawn based on these samples in abstract and discussion (or conclusion).

Figure 1. Schema of the current meta-research. Question 1: Whether characteristics of Chinese participants reported in large-scale international collaboration are similar to those reported in Chinese psychological journals; Question 2: To what extent the Chinese participants in psychological science can represent the Chinese population, as compared with the census data from the National Bureau of Statistics of China and from a large-scale social survey, Chinese Family Panel Study (CFPS); Question3: What are the shared and distinct patterns of Chinese participants and participants from other regions?

**2 Method**

**2.1 Data sources**

Data will come from two sources. The first data source is 1000 empirical studies published in five mainstream Chinese journals: *Acta Psychological Sinica, Journal of Psychological Science, Chinese Journal of Clinical Psychology, Psychological Development and Education, Psychological and Behavioral Studies*. These journals cover different fields of psychological research. Of 1000 empirical papers, 500 were published between 2017 to 2018 that were selected by Wang et al. (2021). Another 500 papers will be selected from the same five journals but published at different time points. To be specific, we will select 250 articles published in 2008 and 250 articles in 2020~2021. The criteria and procedure of article selection, same as Wang et al. (2021), are described as below:

Step 1: Assigning identifiers to articles. For papers published in different periods, we will obtain information of all the papers published in those journals in three different periods and assign a unique identifier to each article. Each article ID has 8 digits. The first four number represents the selected period (we will use 2008, 2018, 2021 to represent articles from three different periods), the fifth number represents the journal ID, from 1 to 5, and the last three number represent the order of the paper in the journal. For example, the first article in *Acta Psychologica Sinica* from 2008 is coded as 20081001, the second article in *Acta Psychologica Sinica* at the same year is coded as 20081002. All articles and their ID can be found at https://osf.io/avb7t/?view\_only=a7e4610491374093851fc2b7da57e85c.

Step 2: Random sampling from all articles. We will use the `*sample*` function of R base to randomly select a certain number of papers from all the papers in each journal (see the code at https://osf.io/avb7t/?view\_only=a7e4610491374093851fc2b7da57e85c). The number of papers sampled from each journal will be weighted by the total number of papers published in that year (the total papers each period and the number of sampled papers, see Table 1). After getting the identifiers of the selected papers, two independent researchers will check each article to make sure that it is an empirical study. If not, we will replace the article with the empirical article, which has the smallest distance to the article whose identifier is sampled.

The second source of data will come from large-scale international collaborations that are aimed at addressing the WEIRD problem. More specifically, we will check the data from all Many Labs projects (especially Man Lab 2 (Klein et al., 2018)), the Human Penguin Project (Hu et al., 2019; IJzerman et al., 2018), and all finished projects from PSA (Jones et al., 2021; Wang et al., 2021). These projects were chosen because they opened raw data. If possible, we will also include data from other large-scale collaborations which contain samples from China. We will search and extract demographical characteristics of Chinese samples and other samples reported in those studies.

Table 1 The amount of different journal articles

|  |  |  |  |
| --- | --- | --- | --- |
| Journal | 2008 | 2017~2018 | 2020~2021 |
| *Acta Psychological Sinica* | 138 (39) | 246 (95) | 91 (28) |
| *Journal of Psychological Science* | 379 (107) | 299 (115) | 203 (61) |
| *Chinese Journal of Clinical Psychology* | 227 (64) | 379 (146) | 310 (94) |
| *Psychological Development and Education* | 87 (24) | 162 (62) | 95 (29) |
| *Psychological and Behavioral Studies* | 57 (16) | 213 (82) | 125 (38) |

*Note:* Each column includes the total number of articles published in each journal at that time interval and the number of articles selected (inside parentheses)

**2.2 Articles code**

We will extract the data from the first source. The data extraction procedure has three stages: pre-coding, coding, and proofreading.

In the pre-coding stage, we first developed the initial version code manual based on the previous study (Arnett, 2008; Nielsen et al., 2017; Pollet & Saxton, 2019; Rad et al., 2018). Then, at least two coders will code ten random articles independently, they will compare the results, resolve the differences and revise the manual. After that, they will code another ten articles and compare the results and revise the coding manual again. This procedure will iterate until the disagreement between two coders is negligible.

When the formal coding manual is established, we will start to code all 1000 papers. In this stage, we will randomly divide the 1000 papers into several parts. For each part, there will be two coders who independently extract data from papers based on the coding manual. Each coder will go through the methods section and further inspect the data used in those studies. Note that studies used existing data or from large-scale databases or using animals will be excluded. For the remaining studies, we will extract the following information of the study: articles IDs, source journal, article title, study number, study type, sample type, sample size, and methods for participants recruitment. More importantly, we will extract all information, if available, about participants: sex, age, socio-economic status, educational attainment, ethnicity, occupation, religion, region for participants recruitment. Additionally, we will read the abstract and discussion (or conclusion) to extract description of the authors’ claims about the generalizability of their results or conclusion. See the supplemental document "Code\_Manual\_Chin\_Subj" for more details (https://osf.io/avb7t/?view\_only=a7e4610491374093851fc2b7da57e85c).

To ensure the accuracy of the coding content, the results from the two coders are compared after completing the initial coding. Two coders rate the consistency of each article from 0 to 1, with 0 represents completely different and 1 represents identical. This consistency score will be then used for calculating the inter-rater reliability. We will use the R package *irr* for this index (Gamer et al., 2019).

**2.3 Data analysis**

We will use R 4.1.1 to pre-process and visualise data (R Core Team, 2021) and Bayes factor analyses (Hu et al., 2018; Love et al., 2019; Wagenmakers et al., 2018). Bayes factor was chosen because it can provide evidence for both null hypothesis and the alternative hypothesis (Dienes, 2016; Dienes & Mclatchie, 2018; Hu et al., 2018; Wagenmakers et al., 2018). Given that the final data we use are percentage data, we will use Bayesian multinomial test (corresponding to frequentists’ goodness-of-fit test or χ2) to test whether percentage data from two sources differ from each other on certain dimension (e.g., sex, age, education attainment). The percentage data from one source is treated as the observed and the other is treated as expected. The null hypothesis (*H0*) is that the observed percentage data are sampled from a multinomial distribution with parameters as defined by the expected percentage, the alternative hypothesis (*H1*) is that the observed proportion data are sample from a multinomial distribution with equal probability for each cell. For example, when testing whether the Chinese participants in PSA001 data (Jones et al., 2021) represent the Chinese population in terms of age, we first calculate the percentage of participants in each of seven age bins (0 ~ 9, 10 ~ 19, 20 ~ 29, 30 ~ 39, 40 ~ 49, 50 ~ 59, >= 60) for PSA001 data. The result, [0, 21, 71, 1, 5, 2, 0], is treated as the observed and compared to the expected percentage data, [11, 13, 17, 16, 17, 12, 14], which is from the 6th census data of China. In this case, the *H0* and *H1* are specified as below:

*H0*: [0, 21, 71, 1, 5, 2, 0] is sampled from a multinomial distribution with *P* = *Pr*(*x1*, *x2*, *x3*, *x4*, *x5*, *x6*, *x7* | *n* = 100, *p1* = 0.11, *p2* = 0.13, *p3* = 0.17, *p4* = 0.16, *p5* = 0.17, *p6* = 0.12, *p7* = 0.14);

*H1*: [0, 21, 71, 1, 5, 2, 0] is sampled from a multinomial distribution with *P* = *Pr*(*x1*, *x2*, *x3*, *x4*, *x5*, *x6*, *x7* | *n* = 100, *p1*, *p2*, *p3*, *p4*, *p5*, *p6*, *p7*), where *p1*, *p2*, *p3*, *p4*, *p5*, *p6*, *p7* are equal.

An uninformative prior [1, 1, 1, 1, 1, 1, 1] is chosen because it is relatively diffused and the data will update parameters of the multinomial distribution quickly, which suits our purpose. We use uninformative prior for testing all hypotheses. Note that the expected percentage data may vary in length, as we will describe below. We implement Bayesian multinomial test using R code based on JASP 16.0. Bayes factor will be interpreted as recommended in (Wagenmakers et al., 2018): *BF10* >= 10 or log(*BF10*) >= 2.303 means strong evidence for *H1*, and 6 <= *BF10* < 10 or 1.792 <= log(*BF10*) < 2.303 means moderate evidence for *H1*, *BF10* <= 1/10 or log(*BF10*) <= -2.303 means strong evidence for *H1*, and 1/10 <= *BF10* < 1/6 or -2.303 <= log(*BF10*) < -1.792 means moderate evidence for *H0*.

For our first question, whether there are differences between Chinese human subjects reported in Chinese journals and in large-scale international collaborative projects, we will first visualize the proportion of the reported information of subjects and, then, we will compare subjects from Chinese psychology journals and Chinese subjects from the international collaborative projects with regard to sex, age, and, if possible, geographical distribution and educational attainment (one important index of socioeconomic status, SES). The data from Chinese psychological journals will be as observed and the data from international collaborations will be used as the expected. More specifically, for the sex distribution, we will test whether sex ratio of subjects from Chinese psychology journals is sampled from the population with a sex ratio equals to that of the samples from international collaborative projects. The null hypothesis (*H0*) is that observed data are sampled from the population with parameter equals to that of Chinese samples from international collaborative projects). The *H1* is that the observed data are sampled from a multinomial distribution with equal probability for each.

For the age distribution, as mentioned above, seven age bins are used in the present study: 0 ~9; 10 ~ 19; 20 ~ 29; 30 ~ 39; 40 ~ 49; 50 ~ 59, and >=60. The *H0* is that the age percentage of Chinese subjects from Chinese psychology journals are sampled from a multinomial distribution with parameters same as the percentage data of Chinese subjects from international collaboration, while the *H1* is that the age percentage data Chinese sample from Chinese psychology journals are sampled a multinomial distribution with equal probability for each cell. For data extracted from journal articles, we will estimate the number of participants in each age bin using Monte Carlo simulation, based on the reported age information (i.e., mean and SD of age as reported in articles). For example, an article reported 30 participants, with age = 23.3 ± 3.5, we estimate the approximate number of participants under 20 is 5 (r code: `round((pnorm(20, mean = 23.3, sd =3.5) \* 30))`), the number of participants aged between 21 ~ 30 is 24 (r code: `round((pnorm(30, mean = 23.3, sd =3.5) \* 30)) - 5`), and participant aged between 30 ~ 40 will be 1.

Format of the data for this question is illustrated by fake data, see “figure2a\_sex\_template.jasp” for the test for sex distribution and “figure2b\_age\_template.jasp” for the test for age distribution at https://osf.io/y9hwq/.

For the second question, whether the Chinese samples come from a very narrow slice of the Chinese population, we will combine line plots and population pyramid plots to visually compare the characteristics (age, sex, etc) of the Chinese psychological sample and that of the National Bureau of Statistics and CFPS. To test our hypothesis, we will also use Bayesian multinomial test. We will use the pooled Chinese subjects’ data from both sources as the “observed” and the Census data as the “expected”. The age bins will be the same as we testing the first hypothesis. The resulting Bayes factor will be interpreted as above.

For the third question, whether Chinese psychological samples differ from other countries’ samples, we compare each countries’ data with Chinese data using Bayesian multinomial test, where the other countries’ data are treated as “observed” and Chinese data are “expected. The null hypothesis (*H0*) is that the observed sex and age distribution from the target country is same as the expected (i.e., Chinese psychological samples). The alternative (*H1*) here is that the observed is data are sampled from multinomial distributions with equal probability for each cell. The prior and interpretation of Bayes factor is the same as above.

It should be noted that the graphics mentioned above are not fixed, and we will choose the graphics that can best illustrate the data characteristics according to the actual situation. The specific analysis code will be updated in OSF (https://osf.io/avb7t/?view\_only=a7e4610491374093851fc2b7da57e85c).

**3 Results**

**3.1 Overview of participants**

[Here we will insert the graph info with China’s map; relative density of participants in different dimensions]

**3.2 Comparing Chinese papers and international collaborations**

We predict that there will be moderate to strong evidence that the Chinese samples in Chinese papers and in international collaborations have similar sex ratio, age distribution, and distribution along other dimensions (if data are available), *BF01s* ≥ 6.

[*Here we will insert Figure 2 to visualize the comparisons between two data sources. Also, Bayes factors will also be reported here*]

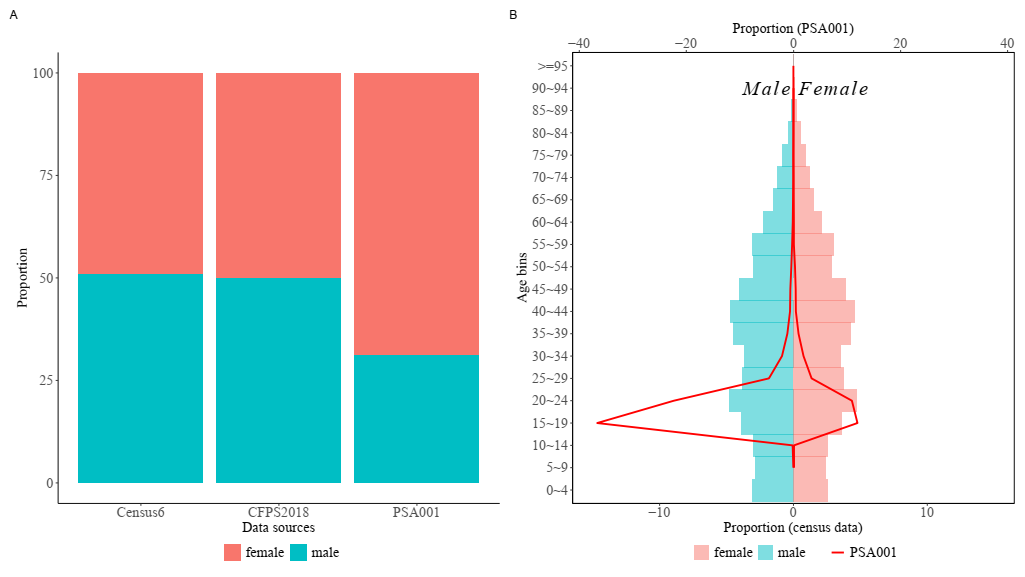
**3.3 Comparing Chinese samples and samples from census data and CFPS**

We will pool data from both data sources and compared with CFPS and census data. [The results will be reported as below, using data from international collaboration data]

*We used PSA 001 data (Jones et al., 2021) as the Chinese sample to demonstrate the analyses and visualization, see below (all code is available at osf.io/y9hwq/). Note that these results will be replaced by the final results after data collected and analyses carried out.*

*First, we compared the Chinese samples (Jones et al., 2021) with the CFPS data in 2018 with China’s censuses data. We tested whether the sex ratio in psychological sample is different from that of the census data using Bayesian multinomial test (Bayesian version of Goodness-of-fit). The results revealed strong evidence that the psychological sample data (Jones et al., 2021) is different from the census data, log(BF10) = 3.73. In contrast to psychological sample data, data from sociology, CFPS 2018 data, is not different from census data, log(BF10) = -2.06. As we can see from Figure 3.1 A, Chinese psychological science sample included significantly more female participants.*

*For the age distribution, we found that the psychological samples’ age distribution is different from that of the census data, with strong evidence from Bayesian multinomial test, log(BF10*) = 84.1*. This difference is further revealed by the demographic pyramid (See figure 3), which showed that the Chinese psychological samples consist of females aged 15~24 years.*



Figures 3. Preliminary results of the sex and age distribution from different data sources. (A) Sex ratio from the 6th census data, CFPS 2018 data, and psychological science sample (PSA 001’s data is used as an example); (B) Age distribution of the 6th census data the transparent bar plot, and psychological science samples (PSA 001’s data as an example), the y-axis is age bins, the x-axis on the top is for the line plot of PSA 001 and x-axis on the bottom is for the pyramid plot of the 6th census data.

**3.4 Comparing Chinese samples and samples from other countries**

We also explore the common and distinct pattern between Chinese psychological samples and psychological samples from other regions.

*The preliminary results from available data illustrate how the final results will look like. These results will be replaced by the final results after data collection. For sex ratio, the pairwise Bayesian multinomial test revealed that data from 14 countries have different sex ratios as compared to Chinese psychological samples (see Figure 4A). However, only one of them (Indian samples) has lower proportion of females than Chinese samples, all other 13 countries have higher proportion of female participants than Chinese samples (see Figure 4C). For age distribution, the pairwise Bayesian multinomial test revealed strong evidence that samples from all other countries are the same as Chinese psychological samples (see Figure 4B, 4D). These preliminary results indicated that the psychological samples from most regions are similar, probably most of them are college students or communities around university campus (Arnett, 2008).*

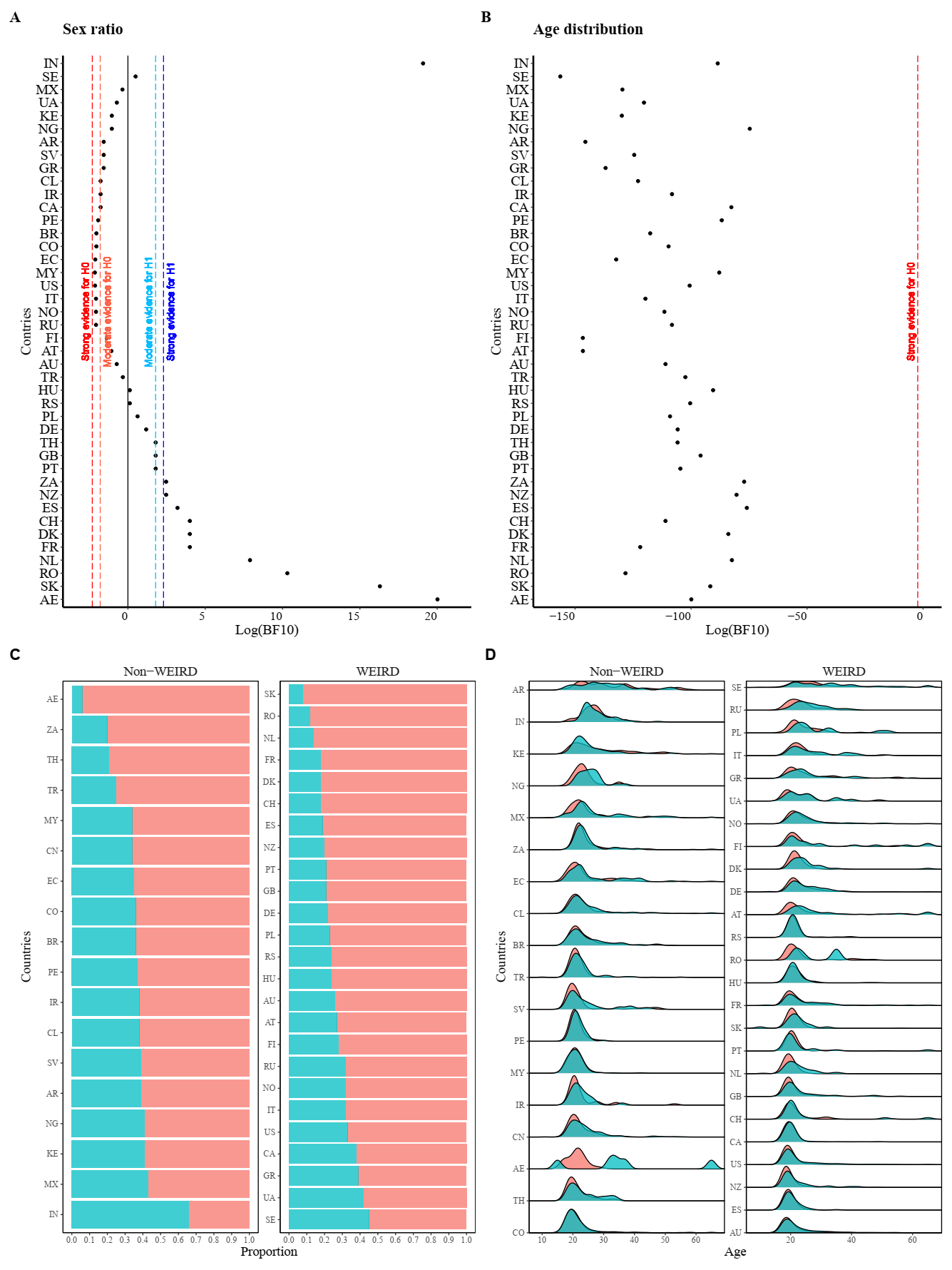


Figure 4. The sex and age distribution from PSA 001. (A) Pairwise comparisons of sex ratio between Chinese psychological sample and available data from other countries; (B) Pairwise comparisons of age distribution between Chinese psychological sample and available data from other countries; (C) Sex ratio of all data, blue = male, pink = female; (D) Age distribution of all data, blue = male, pink = female. Country code: United Arab Emirates (AE), South Africa (ZA), Thailand (TH), Turkey (TR), Malaysia (MY), China (CN), Ecuador (EC), Colombia (CO), Brazil (BR), Peru (PE), Iran (IR), Chile (CL), El Salvador (SV), Argentina (AR), Nigeria (NG), Kenya (KE), Mexico (MX), India (IN), Slovakia (SK), Romania (RO), Netherlands (NL), France (FR), Denmark (DK), Switzerland (CH), Spain (ES), New Zealand (NZ), Portugal (PT), United Kingdom (GB), Germany (DE), Poland (PL), Serbia (RS), Hungary (HU), Australia (AU), Austria (AT), Finland (FI), Russia (RU), Norway (NO), Italy (IT), United States (US), Canada (CA), Greece (GR), Ukraine (UA), Sweden (SE).

**4 Discussion**

[recap of the results]

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Overview of the research question, hypotheses, analytical plan, and interpretations of the current study

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| --- | --- | --- | --- |
| **Question** | **Hypothesis** | **Analysis Plan** | **Interpretation given**  **different outcomes** |
| 1. Whether characteristics of Chinese participants reported in large-scale international collaborative projects are similar to those reported in Chinese psychological journals? | H1: There is no difference between Chinese human subjects reported in Chinese journals and in large-scale international collaborative projects. | We visually present the proportion of subjects' information whether is reported or not extracted from Chinese psychology articles. Then, we will use descriptive statistics to compare the subject information from Chinese psychology and from the international collaborative projects in China. | H1 is supported if the background information of the subjects in the Chinese psychological articles is similar to that in the international collaborative projects.  If the subjects in the international collaborative projects are more diverse in some categories, it shows that international collaborative projects do solve the WEIRD problem to some extent. |
| 2.To what extent the Chinese participants in psychological science can represent Chinese population, as compared with the census data from the National Bureau of Statistics of China and from a large-scale social survey, Chinese Family Panel Study (CFPS). | H2: As WEIRD sample only represents a narrow slice of human beings, the Chinese samples also come from a very narrow slice of the Chinese population. | We will overlay the density plot of Chinese sample above the population pyramid, which is plotted from census data of the National Bureau of Statistics of China and CFPS, so that we can see the representativeness of Chinese psychological samples. | H2 is supported if the subject in the Chinese psychology is from a narrow slice of the entire population in China, which is estimated by the 2010 census data from the National Bureau of Statistics of China and CFPS.  If the subject information of Chinese psychology articles is similar to the National Bureau of Statistics of China and CFPS, then the sample of Chinese psychology research can represent the population situation of China. |
| 3. What are the shared and distinct patterns of Chinese participants and participants from other regions? | H3: Chinese human subjects share many characteristics as other non-WEIRD and WEIRD samples. | We will use descriptive statistics to compare their differences and draw bar chart or pie chart or density plot to show our data. | H3 is supported if the characteristics of subjects in Chinese psychology articles share many characteristics with other non-WEIRD regions or WEIRD regions in describing statistical results and visualizations.  If the characteristics of Chinese sample do not show similar pattern as other regions, it means that Chinese sample is worth further investigation. |

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