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# Body mass index and risk of mental disorders in the general population: Results from the Singapore Mental Health Study

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ABSTRACT

*Objective:* The aims of the current study were to elucidate the association between Body Mass Index (BMI) and mental disorders and to examine whether these associations are moderated by socio-demographic correlates and comorbid physical disorders.
*Methods:* The Singapore Mental Health Study (SMHS) surveyed adult Singapore Residents (Singapore Citizens and Permanent Residents) aged 18 years and above. The survey was conducted from December 2009 to December 2010. The diagnoses of mental disorders were established using the World Mental Health Composite International Diagnostic Interview version 3.0 (CIDI 3.0). BMI was calculated using height and weight which were self-reported by respondents. The Euro-Qol-5Dimensions (EQ-5D) was used to measure the health related quality of life (HRQoL) in the sample.
*Results:* Six thousand and six hundred sixteen respondents completed the study (response rate of 75.9%) and constituted a representative sample of the adult resident population in Singapore. Being underweight was associated with both lifetime (adjusted odds ratio (OR): 2.3) and 12-month obsessive–compulsive disorder (adjusted OR: 4.4). Obesity was associated with 12-month alcohol dependence (adjusted OR: 8.4). There were no significant differences in the EQ-5D indices or the EQ-VAS scores among the four BMI groups in the population.
*Conclusions:* Our findings are somewhat unique and different from those reported in research from Western countries. There is a need for further cross-cultural research to explore and identify genetic, metabolic and cultural differences that underlie the interaction between obesity and mental illnesses.


## Introduction

Obesity has become a worldwide problem with significant increases in global obesity rates over the past few decades. A recent study that analyzed data from over 199 countries found that between 1980 and 2008, the mean BMI worldwide increased by 0.4 kg/m$^2$ per decade for men and 0.5 kg/m$^2$ per decade for women. The age-standardized prevalence of obesity worldwide was 9.8% in men and 13.8% in women. The study estimated that 205 million men and 297 million women worldwide were obese in 2008 [1]. Obesity is a serious public health problem, as it significantly increases the risk of chronic diseases such as cardiovascular diseases, type-2 diabetes, coronary-heart diseases, osteo-arthritis and certain cancers [2–4]. Thus, at a societal level, obesity has substantial direct and indirect cost that puts a strain on healthcare and social resources.

The relationship between obesity and mental illnesses has received considerable attention in the past decade and a systematic review that explored the association between obesity and depression found a moderate level of evidence from prospective cohort studies that obesity was associated with a future occurrence of depression outcomes (it should be noted that of the four prospective studies reviewed, three were from the same population). Data from cross-sectional studies from the United States supported an association between obesity and prevalence of depression outcomes especially for women, but most cross-sectional studies from populations other than the United States failed to find such associations [5]. Various mechanisms have been proposed for the association between obesity and depression including the social undesirability of obesity and associated dieting [6], stigmatization and low self-esteem among obese people [7], life style factors such as lack of exercise which may be associated with depression [8], and the association of obesity with physical illnesses which may in turn result in depression.

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It has also been suggested that depression and obesity may have a shared biology of genetic or hormonal causes or mediators [9,10].

Anxiety disorders have also been found to be associated with overweight and/or obesity [11–14]. The data on the association between overweight and/or obesity and substance use disorders has been mixed. In some studies, these disorders have been reported to be less prevalent among the obese population [14]; especially among women where past 12 month intake of alcohol has been found to be inversely related to the level of BMI [15]. In a longitudinal study, alcohol use disorder at a younger age was found to be a risk for future obesity [16]. However, most studies did not find any association between obesity and alcohol use disorders [11–13] or drug use disorders [11,12,17].

Research among Asian populations has shown somewhat contrary results to the Western studies. A longitudinal study from Taiwan [18] found a significant association between increased body mass index (BMI) and a lower risk of mood disorders in women. Yu et al. [19] found that underweight men were significantly more likely to have depressive symptoms than normal weight men while obese women were significantly less likely to have depressive symptoms than normal weight women. A study on elderly Koreans found obese elderly women to be less likely to suffer from depressive symptoms as compared to those with apparently normal weight [20]. On the whole, the body of knowledge on the relationship between BMI and mental illness among Asians is scanty and limits definitive conclusions.

Singapore is an island city-state nation in South-East Asia. In 2009, the population was just under 5 million of which 3.7 million were Singapore residents (citizens and permanent residents). Of its residents, 74.2% were of Chinese descent, 13.4% were Malays, and 9.2% were of Indian descent. A health survey of this population showed that the prevalence of obesity was 10.8% in 2010 among adults aged 18 to 69 years [21] which was a notable increase from the rate of 6.9% of obesity in the previous survey which was done in 2004 [22]. Significant ethnic differences were also observed — obesity was more common among Malays (24.0%) than Indians (16.9%) and the Chinese (7.9%) [21]. However, the associations between BMI, ethno cultural factors and mental disorders have not been studied in this multi-ethnic population. The aims of the current study were to study the association of BMI with mental disorders and whether these associations were moderated by socio-demographic characteristics and comorbid physical disorders.

## Methods

### *Sample*

The Singapore Mental Health Study (SMHS) surveyed adult Singapore Residents aged 18 years and above. The respondents were randomly selected from a National registry that maintains the names, socio-demographic details such as age, gender and ethnicity, and household addresses of all residents in Singapore. Disproportionate stratified sampling (by age groups and ethnicity) was used where the three main ethnic groups (Chinese, Malay, and Indian) were sampled in equivalent proportion of about 30% each and those belonging to other ethnicities constituted the remaining 10%. Individuals aged 50 years and older were also over sampled. The study was approved by the ethics committee (National Healthcare Group, Domain Specific Review Board) and all participants and parents/guardians of participants who were aged 18–21 years gave written informed consent. Residents were excluded if they were incapable of doing the face-to-face interview because of severe physical or mental conditions, language barriers, living outside the country, institutionalized or hospitalized at the time of the survey; as were those who were not contactable due to incomplete or incorrect address. The detailed methodology of the study has been described in an early article [23].

### *Fieldwork*

The survey was conducted from December 2009 to December 2010. The sample was released in replicates — the preceding replicate had to be at least 80% exhausted (i.e. either termed as ineligible, successfully interviewed or refused participation) before the release of the next replicate for the survey. The SMHS used the computerized version of the English and Chinese CIDI 3.0 while the Paper and Pencil Instrument (PAPI) version of the CIDI 3.0 was used for the Malay language.

A systematic quality assurance process was implemented to ensure integrity and high quality of data. The number of interviews completed by each interviewer was tracked, and 20% of the cases (5% through face-to-face validation and 15% via telephone calls to the respondents) were subjected to detailed verification to detect any falsification of data.

### *Assessments for psychiatric disorders*

The diagnoses of mental disorders were established using the World Mental Health Composite International Diagnostic Interview version 3.0 (CIDI 3.0) [24]. The CIDI 3.0 is a fully structured diagnostic instrument that assesses lifetime and 12-month prevalence of disorders using hierarchy rules of diagnosis. The following DSM-IV mental disorders were finally included in the survey: mood disorders (major depressive disorder (MDD), dysthymia and bipolar disorder), anxiety disorders (generalized anxiety disorder (GAD) and obsessive compulsive disorder (OCD)) and alcohol use disorders (alcohol abuse and dependence). In studies of cross-national reliability and validity, the DSM-IV diagnoses generated by CIDI 3.0 in the World Mental Health (WMH) surveys have been compared to diagnoses based on follow-up interviews with the clinician-administered non-patient edition of the Structured Clinical Interview for DSM-IV (SCID). Moderate to good individual-level CIDI-SCID concordance was found for lifetime prevalence estimates of most disorders. The area under the ROC curve was in the range 0.62–0.93 for individual disorders. CIDI-SCID concordance for 12-month prevalence estimates for anxiety disorder and any mood disorder was also high (AUC = 0.88, and 0.83 respectively) [25].

### *Body Mass Index*

Height and weight were self-reported by all respondents. BMI was defined as the weight in kilograms divided by the square of the height in meters ($kg/m^2$), and for comparisons, standard World Health Organization (WHO) cut-offs were used. Those with BMI of less than 18.5 were classified as underweight; 18.5 to 24.9 as normal weight; ≥25.0 up to 30.0 were classified as overweight and a BMI of ≥30.0 was classified as obese [26]. Self-report measures are widely used to collect data on height and weight and these have the advantages of practicality and low cost, they are also quick and easy to administer and are a good method for sampling large numbers of individuals. However, they are also subject to bias arising from respondents giving socially desirable answers, as well as being limited by non-standardized measurements. A systematic review that compared direct with self-report measures for assessing height and weight in observational and experimental studies of adult populations concluded that the data showed trends of underestimating weight and BMI and overestimating height in self report measures, although the degree of the trend varied for men and women, and between studies; the variability in the estimates was high and no overall effect size could be estimated [27].

### *Health Related Quality of Life (HRQoL)*

The Euro-Qol-5Dimensions (EQ-5D) was used to measure the HRQoL in the sample [28]. It comprises a descriptive system and a