Original Article

Height and Mental Health and Health Utility Among Ethnic Chinese in a Polyclinic Sample in Singapore

Yin Bun Cheung, [1,2,3] *PhD*, Hwee Lin Wee, [4,5] *BSc(Pharm)(Hons), PhD*, Nan Luo, [6] *BSc, MSc, PhD*, Chee Beng Tan, [7] *MBBS(S'pore), MMed(Fam Med), FCFP*, Kok Yong Fong, [1,5,8] *MBBS (S'pore), MMed (Int Med), FRCP(UK)*, Julian Thumboo, [1,5,8] *MRCP(UK), MMed(Int Med), FRCP(Edin)*

Abstract

Introduction: Whether final height is associated with quality of life and mental health is a matter of epidemiological and medical concern. Both social and biological explanations have been previously proposed. This study aims to assess the associations in ethnic Chinese in Singapore. Materials and Methods: A cross-sectional study of 4414 respondents aged at least 21 years seen at a major polyclinic was performed. Socioeconomic and behavioural features of the sample and the Singapore population of similar ages were comparable. Height was measured by clinic nurses using an ultrasonic height senor. Participants were interviewed for socioeconomic, behavioural, health and quality of life information. Clinical morbidity data was collected from the participants' treating physicians. The SF-6D utility index and its Mental Health domain were the main endpoints. Linear and ordinal logistic regression models were used to analyse the utility index and the Mental Health scores, respectively. Results: Having adjusted for age and gender, the Mental Health domain (*P* <0.01) was associated with height but the utility index was not. Further adjustment for health, socioeconomic and behavioural covariates made little difference. Analyses based on height categories showed similar trends. Conclusion: Adult height has a positive association with mental health as measured by the SF-6D among ethnic Chinese in Singapore. Socioeconomic status and known physical health problems do not explain this association. Adult height had no association with SF-6D utility index scores.

Ann Acad Med Singapore 2013;42:73-9

Key words: Depression, Growth, Height, Health utility, Mental health, Social inequality

Introduction

Several studies have found adult height predictive of mental health and emotional well-being. A study of Swedish conscripts demonstrated an inverse association between height at age 18 to 19 and suicide mortality over 15 years of follow-up.[1] Similarly, a study of Filipinos demonstrated an inverse association between height at age 18 and suicidal ideation.[2] Having adjusted for covariates, an increase of one height Z-score at age 18 years was associated with a 38% reduction in the odds of suicidal ideation. A large scale cross-sectional survey of Americans found that taller height was associated with better emotional well-being.[3] A study of adolescents in the United States also demonstrated an inverse association between height and depression.[4] However, a cohort study of Norwegian adults found no relation between height and depression or suicide.[5] It has been suggested that such associations may indicate the role of childhood growth in the aetiology of adult mental health or social favouritism experienced by taller people.[1] The American cross-sectional survey found that, having adjusted for socioeconomic status, the association between height and well-being almost entirely disappeared,[3] thus favouring the social explanation. However, analysis in the Swedish study did not support this social explanation.[1]

[1]Office of Clinical Sciences, Duke-NUS Graduate Medical School, Singapore
[2]Department of Biostatistics, Singapore Clinical Research Institute, Singapore
[3]Department of International Health, University of Tampere, Finland
[4]Department of Pharmacy, National University of Singapore, Singapore
[5]Department of Rheumatology & Immunology, Singapore General Hospital, Singapore
[6]Department of Epidemiology and Public Health & Centre for Health Services Research, National University of Singapore, Singapore
[7]Geylang Polyclinic, Singapore Health Services, Singapore
[8]Department of Medicine, Yong Loo Lin School of Medicine, National University of Singapore, Singapore
Address for Correspondence: Professor Yin Bun Cheung, Singapore Clinical Research Institute, Biopolis Way, Singapore 138669.
Email: yinbun.cheung@scri.edu.sg

It should be noted that in studies involving older people, an association between height and health and quality of life outcomes may be attributable to height loss due to physical health problems in later life,[6,7] in addition to the other explanations. So, the interpretation may not be straightforward, especially if the quality of life measures are dominated by physical health issues. Furthermore, being exceptionally tall may lead to psychological disadvantages as it can affect self-concept and body image and it relates to difficulties in socialising.[8] A study of Australian women whose parents had sought a medical opinion about their tall stature when they were on average 11 years old were later found to have higher prevalence of depression than population samples in Australia and the US when they were on average 39 years old.[8]

In addition to the epidemiological perspective aforementioned, the impact of short stature on quality of life is also an important issue in paediatrics. Short stature has been reported to lead to stigmatisation and social isolation.[9] Coping with actual or perceived disadvantages due to short stature is suspected of influencing psychosocial well-being.[10] Improvement in quality of life of the child and future adult is a major justification of recombinant growth hormone therapy for children and adolescents.[9-11] This is especially important in the treatment of idiopathic short stature and in view of the expensiveness of the therapy. Reviews of clinical studies of children with growth disorders and in short but healthy children have shown conflicting results about the effect of growth hormone therapy on quality of life.[9-11] Evidence for the use of the therapy in idiopathic short stature remains moot.

Data in this area have come mainly from the Caucasian populations. It is known that patterns of early growth failure vary across geographical regions.[12] It is plausible that the degree of social favouritism, if any, may vary across cultures. While about one-fifth of the world's population use Chinese as their primary language,[13] assessment of quality of life using validated instruments is a relatively new development in Chinese societies. To our knowledge, there is as yet no information on whether height is related to quality of life or mental health in Chinese culture. Singapore is a multiethnic society in Southeast Asia, with approximately two-thirds of its population being ethnic Chinese. Drawing on data from a cross-sectional study of 4414 ethnic Chinese adults in Singapore, we answer this question.

Materials and Methods

Sample and Study Design

The Singapore population consists of 3 major ethnic groups, namely Chinese, Malay, and Indian. Approximately 65% of Singapore residents are literate in Chinese, and one-third of the population is bilingual in English and Chinese.[14]

The present study is a secondary analysis of data from a cross-sectional study of ethnic Chinese seen at a primary care facility (Geylang Polyclinic, one of 18 governmentally funded polyclinics in the country) and aged at least 21 years, in which half of the participants were randomised to one of the 2 modes of data collection. The main purpose of the study was to assess the use of a multimedia computer programme[15] versus face-to-face interview for health and quality of life assessment. The main results about mode of data collection will be reported separately. The recruitment was from February to December 2005. The research assistants attempted to approach all who walked in. All participants understood Mandarin, the language used in the multimedia programme. In addition to filling in a questionnaire concerning health, quality of life, socioeconomic situations and health-related behaviour either via face-to-face interviewer-administration or a touchscreen multimedia programme, morbidity data were also collected from the treating physicians of the participants. Written informed consent was obtained from all participants. The study was approved by the Institutional Review Board of the SingHealth Polyclinics and conformed to the principles embodied in the Declaration of Helsinki.

Measures

The SF-6D questionnaire covers 6 domains of health and quality of life, including Mental Health. It is an ordered categorical variable whose value ranges from 1 to 5, with value 1 indicating no problem at all. The Chinese version of the SF-6D was derived from the SF-36 which had been previously validated in Singapore.[16] Furthermore, the Chinese and English versions of SF-6D had been demonstrated to achieve measurement and functional equivalence in the Singaporean population.[17] An established algorithm was used to map the responses to SF-6D to a utility index.[18] With reference to the literature about body stature, we were mainly interested in the Mental Health score, but we also include an analysis of the summary SF-6D utility index, whose value ranges from 0.29 to 1, with 1 representing full health. A difference of 0.04 in the SF-6D health utility is considered minimally important.[19]

Height was measured using an ultrasonic height senor (Avamech, Model B1000), which has an accuracy of up to ±0.5 cm and range of 85 to 201 cm. Measurement was performed by the clinic nurses who do this for all patients seen at the polyclinics as a standard practice. Participants were required to stand upright and look ahead as per standard polyclinic measurement protocol. Covariates include age, gender, mode of interview (computer versus face-to-face), clinician-reported chronic morbidities (diabetes, hypertension, hyperlipidaemia, ischaemic heart disease, stroke, osteoarthritis, and asthma) and any acute conditions on the day of outpatient visit, self-reported use of walking aids, body mass index (BMI), socioeconomic variables (highest education level attained, types of housing, work status and marital status), and smoking. The categorisations of these variables are shown in Table 1 and are self-explanatory.

Statistical Analysis

Height was analysed both as a continuous variable (in cm) and a categorical variable based on age-and-sex specific 5th and 95th percentiles. The percentiles were separately estimated from males and females in this sample using quantile regression,[20,21] with age and age-squared as predictors. Those below the 5th, between 5th to 95th, and above the 95th percentiles were considered to have short, normal and tall statures.

To untangle the complex nature of relationship among these variables, linear regression was performed on the SF-6D utility index in a sequential manner with a view to infer how the groups of variables affect the outcomes and each other. Model I related health utility to height, adjusted for age, gender and mode of interview. Model II further adjusted for chronic morbidities, use of walking aids, presence of any acute conditions and BMI. Model III further adjusted for socioeconomic variables and smoking. Ordinal logistic regression was performed on Mental Health and other individual domains using the same sequential approach for covariate adjustment.[22]

Table 1. Participant Characteristics, by Height Groups*

Characteristics	Category	Short (n = 219)	Normal (n = 3977)	Tall (n = 218)	*P* value†
Mean (SD) Height (in cm)		145.2 (6.9)	159.0 (7.9)	171.3 (7.3)	<0.001
Mean (SD) BMI		26.1 (5.2)	24.6 (4.2)	24.0 (4.2)	<0.001
Mean (SD) Age (in years)		56.3 (13.6)	56.2 (13.8)	56.4 (13.8)	0.977
Gender	Female	61.9%	61.6%	61.9%	0.998
Mode of Interview	Computer-administered	53.0%	50.7%	49.1%	0.714
With Chronic	Diabetes	17.8%	16.3%	14.2%	0.589
Conditions	Ischaemic heart disease	5.5%	4.5%	3.7%	0.653
	Hypertension	42.9%	44.7%	43.6%	0.836
	Hyperlipidaemia	33.8%	31.1%	25.2%	0.123
	Stroke	1.8%	1.7%	1.4%	0.923
	Osteoarthritis	0.5%	0.9%	1.8%	0.253
	Asthma	0.5%	0.8%	1.8%	0.183
Use Walking Aids	Yes	8.2%	5.5%	2.8%	0.043
With Acute Conditions	Yes	40.2%	43.2%	46.3%	0.431
Highest Education	Primary	23.7%	34.6%	39.9%	<0.001
	Secondary	63.5%	47.7%	39.0%	
	Tertiary	12.8%	17.8%	21.1%	
Type of Housing	Public (1/2 rooms)	14.2%	8.6%	6.9%	0.001
	Public (3/4 rooms)	69.0%	60.2%	58.3%	
	Public (5 rooms)	10.5%	15.3%	15.1%	
	Executive condominium	1.4%	2.0%	0.9%	
	Private/condominium	3.7%	8.0%	11.0%	
	Landed property	1.4%	5.0%	7.3%	
	Temporary structure	0%	1.0%	0.5%	
Work Status	Not working	45.2%	44.3%	43.1%	0.906
Marital Status	Single	26.5%	16.3%	15.6%	0.002
	Married	60.3%	73.0%	75.2%	
	Divorced/separated	3.7%	3.2%	3.7%	
	Widowed	9.6%	7.5%	5.5%	
Smoking	Current smoker	9.6%	10.2%	10.6%	0.944

BMI: body mass index; SD: standard deviation

*Short and tall stature defined as below the 5th and above the 95th age-and-gender specific percentiles, respectively

†ANOVA for continuous variables and chi-square for categorical variables

Interaction between height and age was explored by including their cross-product term in the analysis. Non-linear age effect was explored by including an age-squared term. A subgroup analysis in those less than 60 years of age was conducted to focus on the effect of final height before height loss in old age.

Results

Descriptive Summary

A total of 4804 participants were recruited, of whom 197 did not complete most parts of the interview (e.g. age not reported) and were not entered into the research database as they failed to satisfy the requirement of the main study; 193 had missing values in the variables needed for the present analyses (17 of these were not measured for height because they were on wheelchair or did not feel well to stand). The analyses here included 4414 participants. There were no statistically significant (*P* >0.05) difference between the 4414 included participants and the 193 excluded in terms of the characteristics in demographic and health variables aforementioned (shown in Table 1), except that the excluded participants had a higher prevalence of osteoarthritis (3.1% versus 0.9%, *P* = 0.010; sample size varied between 95 to 193 out of the 193 participants across variables due to missing values).

The mean (SD) height was 158.9 (8.9) cm. The quantile regression assigned 219 (5.0%) and 218 (4.9%) participants to the short and tall stature groups, respectively. The estimated quantiles as a quadratic function of age are shown in Table 2.

Table 2. Percentiles of Height (cm) as a Quadratic Function of Age (Years) Estimated by Quantile Regression

Gender	Percentile	Equation
Male	5th	173.57 − 0.4795×age + 0.0025×age-squared
Male	95th	191.12 – 0.2934×age + 0.0004×age-squared
Female	5th	152.62 – 0.0688×age − 0.0010×age-squared
Female	95th	175.92 – 0.2014×age − 0.0002×age-squared

Table 1 shows the characteristics of the participants, by height categories. The 3 groups did not differ in age and gender, demonstrating the appropriateness of the generation of the percentiles. The oldest participant was 96 years old; the 99th percentile was 80. The 3 groups were largely similar in health conditions, except that there was a trend of inverse association between height and the use of walking aids (*P* = 0.043). Taller people clearly had a better educational background and housing situation (i.e. more in public housing with 5 rooms, private housing and landed property), and they were more likely to be married (each *P* <0.01).

The mean (SD) SF-6D health utility value was 0.850 (0.114). The lowest and highest utility values observed were 0.377 and 1.0 respectively. The distribution of the utility and Mental Health scores are shown in Table 3, by height group. Without adjustment for covariates, better Mental Health was significantly associated with taller stature (*P* = 0.038), but health utility was not (*P* = 0.091). We further analysed the distribution of the responses on the other 5 SF-6D domains. They did not significantly differ across height groups (each *P* >0.05).

Regression Analysis

Table 4 shows linear regression models on SF-6D health utility values and ordinal logistic regression models on SF-6D Mental Health score among all the study participants (n = 4414). The upper panel concerns using height in cm as a continuous exposure variable. Adjusting for only age, gender and mode of interview, height had a marginally significant association with health utility (*P* = 0.051). For every one cm taller, health utility increased by 0.00054. Further adjustment for health covariates (Model II) and socioeconomic and behavioural covariates (Model III) made some reduction in the association. Ordinal logistic regression models shows an association between taller height and better (smaller value) Mental Health score (each *P* <0.01). Adjustment for covariates had little impact on the findings.

Table 3. Distribution of SF-6D Health Utility and Mental Health Score, by Height Groups*

SF-6D measure	Value	Short (n = 219)	Normal (n = 3977)	Tall (n = 218)	*P* value†
Utility	Mean (SD)	0.842 (0.118)	0.850 (0.113)	0.864 (0.119)	0.091
	Range	0.471 to 1	0.377 to 1	0.501 to 1	
Mental Health	1 (Best)	45.2%	54.5%	59.2%	0.038
	2	42.9%	34.0%	29.4%	
	3	7.8%	8.3%	6.4%	
	4	3.7%	2.2%	3.7%	
	5 (Worst)	0.5%	1.1%	1.4%	

SD: standard deviation

*Short and tall stature defined as below the 5th and above the 95th age-and-gender specific percentiles, respectively

†ANOVA for continuous variables and Chi-square for categorical variables

Table 4. Linear Regression Analyses of SF-6D Health Utility and Ordinal Logistic Regression Analysis of SF-6D Mental Health Score on Height (N = 4414), Adjusted for Covariates*

Endpoint	Exposure	Regression coefficient (*P* value)		
		Model I	**Model II**	**Model III**
SF-6D Health Utility	Height (in cm)	0.00054 (0.051)	0.00048 (0.084)	0.00045 (0.106)
Mental Health	Height (in cm)	– 0.014 (0.004)	– 0.014 (0.004)	– 0.015 (0.002)
SF-6D Health Utility	Normal	Reference	Reference	Reference
	Short	– 0.008 (0.298)	– 0.007 (0.388)	– 0.004 (0.614)
	Tall	0.015 (0.061)	0.015 (0.055)	0.014 (0.073)
Mental Health	Normal	Reference	Reference	Reference
	Short	0.301 (0.020)	0.309 (0.018)	0.317 (0.016)
	Tall	– 0.151 (0.277)	– 0.161 (0.250)	– 0.153 (0.276)

*Model I adjusted for age, gender and mode of interview; Model II further adjusted for chronic conditions, use of walking aids, acute conditions and BMI; Model III further adjusted for socioeconomic status and smoking (see Table 2 for variables and categorisations)

The lower panel of Table 4 shows analyses using height as a categorical exposure variable, with the normal stature group as reference. Short stature was associated with poorer Mental Health regardless of covariate adjustment ($P \leq 0.02$). The difference in Mental Health between the tall and normal stature groups were smaller (and statistically non-significant) than that between the short and normal stature groups. Although there was a pattern of lower health utility values in shorter people and higher utility values in taller people, none of the coefficients were statistically significant (each $P > 0.05$).

Since the regression coefficients in an ordinal logistic regression model is not easy to interpret, we used results from Model III in the lower panel of Table 4 to obtain the predicted probability distribution of Mental Health score, by height categories, setting covariates at their mean level. The results are shown in Table 5. The predicted probability of having the best level of Mental Health was 11.2% lower (47.0% vs 58.2%) in the short stature than the tall stature group, while the predicted probability of having the worst level was 0.5% higher (1.3% vs 0.8%) in the short than the tall stature group.

Table 5. Predicted Distribution of SF-6D Mental Health Domain, by Height, Adjusted for Covariates*

SF-6D measure	Value	Short (n = 219)	Normal (n = 3977)	Tall (n = 218)
Mental Health	1 (Best)	47.0%	54.6%	58.2%
	2	38.6%	34.4%	32.1%
	3	10.1%	7.8%	6.9%
	4	3.0%	2.2%	1.9%
	5 (Worst)	1.3%	1.0%	0.8%

*Adjustment based on Model III in Table 4; Figures may not sum to 100% due to rounding.

Inclusion of an age-squared term in the models did not improve the fit in any regression models aforementioned (each $P > 0.10$). Inclusion of an interaction term for age and height did not improve the fit either (each $P > 0.10$). At the suggestion of a reviewer, we further added the physical domains of SF-6D (physical functioning, pain and vitality) as covariates to Model III for the analysis of mental health. The ordinal logistic regression coefficient on the mental health outcome was – 0.013 ($P = 0.010$) per one cm increase in height. Comparing this to the results in Table 4, it can be seen that the adjustment for physical domains had very limited impact on the association between height and mental health.

Table 6 shows the results of analysis limited to those aged below 60 (n = 2513). The upper panel shows the analyses using height as a continuous variable. Although the regression coefficients on SF-6D health utility weakened, the ordinal logistic regression analyses on the Mental Health scores in this younger group remained statistically significant (each $P \leq 0.017$) and the ordinal regression coefficients were slightly stronger than those estimated in the whole sample. Using height as a categorical variable (lower panel of Table 6), none of the regression coefficients were statistically significant but the gradient of better Mental Health in relation to taller stature remained. When the 3 SF-6D physical domains were added to Model III as aforementioned, the OR changed slightly from – 0.016 ($P = 0.010$) to – 0.019 ($P = 0.005$).

Discussion

Western studies have not been conclusive about the presence or absence of an association between height and mental health. Furthermore, there is no consensus on how to explain the association between height and quality of life and mental health outcomes, which has been reported

Table 6. Linear Regression Analyses of SF-6D Health Utility and Ordinal Logistic Regression Analysis of SF-6D Mental Health Score on Height in Subgroup Aged <60 (N = 2513), Adjusted for Covariates*

Endpoint	Exposure	Regression coefficient (*P* value)		
		Model I	Model II	Model III
SF-6D Health Utility	Height (in cm)	0.00029 (0.430)	0.00025 (0.500)	0.00030 (0.416)
Mental Health	Height (in cm)	− 0.015 (0.017)	− 0.015 (0.016)	− 0.016 (0.010)
SF-6D Health Utility	Normal	Reference	Reference	Reference
	Short	0.0001 (0.992)	0.0002 (0.983)	0.0011 (0.921)
	Tall	0.0093 (0.384)	0.0089 (0.405)	0.0093 (0.383)
Mental Health	Normal	Reference	Reference	Reference
	Short	0.220 (0.204)	0.257 (0.140)	0.277 (0.115)
	Tall	− 0.236 (0.201)	− 0.223 (0.231)	− 0.198 (0.290)

*Model I adjusted for age, gender and mode of interview; Model II further adjusted for chronic conditions, use of walking aids and acute conditions; Model III further adjusted for socioeconomic status, smoking and BMI (see Table 2 for variables and categorisations)

in some studies. One biological explanation is that adult height is an indicator of growth in early life,[1,23] which is hypothesised to have an impact on hypothalamic-pituitary-adrenocortical (HPA) axis hormonal responses in adulthood, which in turn may have an impact on mental health.[2,24] An alternative, social explanation is that society favours taller and discriminates against shorter people, leading to differences in socioeconomic status, which in turn affects quality of life and mental health.[1,3] These explanations are not mutually exclusive. Regardless of the true causes, the association is an important concern from both epidemiological and clinical perspectives.

A previous American study and a Swedish study disagreed on whether association between height and mental health was a result of social processes.[1,3] This raises doubt about how sociocultural context modified the impact of height on health. Culture and child growth patterns, as well as their potential impact, can be different across populations. We have used data from a survey of ethnic Chinese in Singapore to address this issue. To our knowledge, this study is the first of its kind in Asia. Comorbidity data were obtained from clinicians; a wealth of other health, social and behavioural factors was self-reported. It is known that self-reported height may have limited level of accuracy. Our study used a highly accurate ultrasonic machine for height measurement performed by nurses. The SF-6D has multiple quality of life domains and an overall health utility index. Our analyses were guided by the literature to focus on the Mental Health domain and the health utility index as a summary measure.

The main limitation of the present work is that it is a cross-sectional study. It is unable to be definitive in identifying causal relation. A lot of interest in this area concerns changes in height from early childhood to adulthood. We are only able to look at a snapshot of adult life in this study. Another limitation is that the sample was recruited from a polyclinic, which may limit the generalisability. Furthermore, due to the busy polyclinic setting, we did not count the number of people approached and reasons of non-participation. However, the socioeconomic and behavioural features of the sample were similar to the Singapore population. For example, in 2007, 21.2% male and 3.6% female ethnic Chinese Singaporean residents aged 18 to 69 were smokers,[25] whereas the figures were 20.6% and 3.6% in the present sample of male and female ethnic Chinese aged at least 21 (exclusion of respondents aged above 69 gave similar figures; details not shown). In the Tanjong Pagar Survey,[26] which was a community study of 40 to 79 years old Chinese people on the electoral register, the mean age was 58.1 and mean height was 1.59 metres. These compared well with the present sample. The polyclinic sample does not appear to be atypical although a representative random sample of the general population would be ideal. Furthermore, the analyses were adjusted for a range of covariates, meaning we are comparing people against others with the same profile within the sample. So, we do not think there is a bias in the estimates of association due to the choice of polyclinic setting. Ideally mental health should be evaluated by more comprehensive and precise measurements than the SF-6D domain. The reason for using this endpoint was that this is a secondary analysis of data collected for other purpose. One may criticise that this is a crude measure and may not pick up small differences. However, we have demonstrated an association between height and mental health as measured by the SF-6D domain; we would expect that the use of more precise measures would reproduce this pattern of association.

In this sample of 4414 ethnic Chinese adults in Singapore, the association between height and the SF-6D Mental Health domain was robust to definition of the height variable and covariate adjustment. However, the practical significance was not clear. While the group with height below 5th percentile clearly had a lower probability of reporting the best level of Mental Health, they did not have a big increase in the probability of reporting the worst level either (Table 5). Adjustment for a range of clinician- and self-reported health conditions did not affect the pattern either, suggesting the association was not mediated by known physical health problems. A biological explanation concerning the HPA axis remains a possible candidate.

Height in older people can be a combined result of early height gain and height loss in old age.[6] In subgroup analyses that only included those under age 60, the association between height and SF-6D Mental Health score persisted. The ordinal logistic regression coefficients were stable although the P values increased from <0.005 to <0.02. The increase was expected as the sample size for this subanalysis reduced by about half.

Conclusion

In conclusion, adult height has a positive association with mental health as measured by SF-6D among the ethnic Chinese people in Singapore. Socioeconomic status and physical health status do not explain this association. Adult height had no association with health utility as measured by SF-6D.

Acknowledgements

This project was funded by grant 03/1/27/18/226 from the Biomedical Research Council of Singapore. The first author (YBC) was supported by the Singapore Ministry of Health's National Medical Research Council under its Clinician Scientist Award scheme.

The authors thank Dr Chow Mun Hong of the SingHealth Polyclinics Headquarters for granting us permission to carry out the study at SingHealth Polyclinics (Geylang); Drs Loke Wai Chiong, Gilbert Tan, Ruth Lim and Mtiesh Shah, Ms Coralie Ang, Ms Gladys Yap, Sister Malini and other clinical, nursing and administrative staff at SingHealth Polyclinics (Geylang) for providing logistics and administrative support; Research Nurse Ms Elizabeth Ow for managing study logistics, data collection and data cleaning.

REFERENCES

1. Magnusson PK, Gunnell D, Tynelius P, Davey Smith G, Rasmussen F. Strong inverse association between height and suicide in a large cohort of Swedish men: evidence of early life origins of suicidal behavior? Am J Psychiatry 2005;162:1373-5.
2. Cheung YB, Ashorn P. Linear growth in early life is associated with suicidal ideation in 18-year-old Filipinos. Paediatr Perin Epidemio 2009;23:463-71.
3. Deaton A, Arora R. Life at the top: the benefits of height. Econ Hum Biology 2009;7:133-6.
4. Rees DI, Sabia JJ, Argys LM. A head above the rest: height and adolescent psychological well-being. Econ Hum Biology 2009;7:217-8.
5. Bjerkeset O, Romundstad P, Evans J, Gunnell D. Association of adult body mass index and height with anxiety, depression, and suicide in the general population: the HUNT study. Am J Epidemiol 2008;167:193-202.
6. Leon DA, Smith GD, Shipley M, Strachan D. Adult height and mortality in London: early life, socioeconomic confounding, or shrinkage? J Epidemiol Community Health 1995;49:5-9.
7. Masunari N, Fujiwara S, Nakata Y, Nakashima E, Nakamura T. Historical height loss, vertebral deformity, and health-related quality of life in Hiroshima cohort study. Osteop Int 2007;18:1493-9.
8. Bruinsma FJ, Venn AJ, Patton GC, Rayner JA, Pyett P, Werther G, et al. Concern about tall stature during adolescence and depression in later life. J Affect Disord 2006;91:145-52.
9. Bullinger M, Kołtowska-Häggström M, Sandberg D, Chaplin J, Wollmann H, Noeker M, et al. Health-related quality of life of children and adolescents with growth hormone deficiency or idiopathic short stature - part 2: available results and future directions. Horm Res 2009;72:74-81.
10. Radcliffe DJ, Pliskin JS, Silvers JB, Cuttler L. Growth hormone therapy and quality of life in adults and children. Pharmacoeconomics 2004;22:499-524.
11. Bryant J, Baxter L, Cave CB, Milne R. Recombinant growth hormone for idiopathic short stature in children and adolescents. Cochrane Database Syst Rev 2007;18:CD004440.
12. Villar J, Altobelli L, Kestler E, Beliźan J. A health priority for developing countries: the prevention of chronic fetal malnutrition. Bull WHO 1986;64:847-51.
13. Graddol D. The future of language. Science 2004;303:1329-31.
14. Department of Statistics Corporate Author: Singapore Census of Population, 2000. Singapore: Department of Statistics; 2001.
15. Thumboo J, Wee HL, Cheung YB, Machin D, Luo N, Fong KY. Development of a Smiling Touchscreen multimedia program for HRQoL assessment in subjects with varying levels of literacy. Value Health 2006;9:312-9.
16. Thumboo J, Chan SP, Machin D, Soh CH, Feng PH, Boey ML, et al. Measuring health-related quality of life in Singapore: normal values for the English and Chinese SF-36 Health Survey. Ann Acad Med Singapore 2002;31:366-74.
17. Wee HL, Cheung YB, Fong KY, Luo N, Machin D, Thumboo J. Are English- and Chinese-language versions of the SF-6D equivalent? A comparison from a population-based study. Clin Ther 2004;26:1137-48.
18. Brazier J, Roberts J, Deverill M. The estimation of a preference-based measure of health from the SF-36. J Health Econ 2002;21:271-92.
19. Walters SJ, Brazier JE. Comparison of the minimally important difference for two health state utility measures: EQ-5D and SF-6D. Qual Life Res 2005;14:1523-32.
20. Koenker R. Quantile Regression. Cambridge, UK: Cambridge University Press, 2005.
21. Chitty LS, Altman DG. Charts of fetal size: kidney and renal pelvis measurements. Prenat Diagn 2003;23:891-7.
22. Agresti A. Categorical Data Analysis, 2nd edition. Hoboken, NJ: Wiley, 2002.
23. Howe LD, Tilling K, Galobardes B, Smith GD, Gunnell D, Lawlor DA. Socioeconomic differences in childhood growth trajectories: at what age do height inequalities emerge? J Epidemiol Community Health 2012;66:143-8.
24. Barker DJ, Osmond C, Rodin I, Fall CH, Winter PD. Low weight gain in infancy and suicide in adult life. BMJ 1995;311:1203.
25. Ministry of Health, Singapore: National Health Surveillance Survey 2007. Singapore: Ministry of Health; 2009.
26. Wong TY, Foster PJ, Johnson GJ, Klein BE, Seah SK. The relationship between ocular dimensions and refraction with adult stature: the Tanjong Pagar Survey. Invest Ophthalmol Vis Sci 2001;42:1237-42.