Disparities in the Impact of Community Hypertension Education Programme across Age, Gender, Race and Housing Type

May O Lwin[a], Shelly Malik[a], Vernon Beng Tat Kang[b], Grace Peimin Chen[b]

[a]Wee Kim Wee School of Communication and Information, Nanyang Technological University, Singapore
[b]Singapore Heart Foundation, Singapore

Abstract

Objective: This study investigated the extent to which the efficacy of a hypertension awareness programme in Singapore may differ based on age, gender, race and housing type (as proxy for income).
Methods: Pre- and post-programme survey responses on blood pressure (BP) knowledge and beliefs from 9,960 grade five students were assessed. Post-programme responses from 5,361 adult family members were also evaluated.
Results: Female students were more likely to show better BP knowledge and beliefs. As compared to Chinese students, Malay students had lower levels of BP knowledge and attitudes, while Indian students possessed stronger attitudes. Programme efficacy among students in the most affordable housing was the least favourable. In the adult family member sample, Malay and Indian adults had higher self-confidence and intention to measure their BP in the future than the Chinese. Adult respondents in the most affordable housing possessed the least favourable beliefs toward BP measurement. Older adults, men, Malays and residents in affordable housing types had higher odds of being found with hypertension when tested at home.
Conclusion: Despite the same hypertension education programme being implemented, disparities in programme impact were apparent in both student and adult sample across race, housing type and, to a lesser extent, gender. Future interventions should consider these disparities when developing health education programmes.

Keywords: Hypertension, Inequality, Disparities, Gender, Race, Housing type, Singapore

Corresponding author
May O. Lwin, Wee Kim Wee School of Communication and Information, Nanyang Technological University - 31 Nanyang Link, Singapore 639798
Email: tmaylwin@ntu.edu.sg

APA Citation:
Lwin, M. O., Malik, S., Kang, V. B. T., & Chen, G. P. (2018). Disparities in the impact of a community hypertension education programme across age, gender, race and housing type. *Health Education Journal, 77*(5), 555-570.

Introduction

Hypertension, the dominating risk factor for adult mortality and cardiovascular diseases (e.g., Ezzati et al., 2002), poses a serious public health challenge (Kearney et al., 2004). A considerable number of individuals are unaware of their condition, and among those who are aware, many receive insufficient treatment (Kearney et al., 2004). Barriers to hypertension awareness and control can be intensified by lack of knowledge of the consequences and treatment methods, suggesting the need for increased public awareness and knowledge of hypertension, its risks and prevention (Petrella et al., 2005).

Hypertension is highly prevalent in Singapore, especially among members of the elderly population (Malhotra et al., 2010). Among Singapore residents aged 30 to 69 years, nearly one in four have been found to have hypertension (Ministry of Health, 2010), and this number tripled to reach at 74.1% in 2015 among those aged 60 years-old and above (Seow et al., 2015). There is thus strong consensus on the need to enhance public education regarding hypertension awareness, treatment and control in Singapore (Malhotra et al., 2010; Seow et al., 2015; Wee and Koh, 2012).

Hypertension awareness, treatment, and suboptimal blood pressure (BP) control is significantly associated to socio-demographic factors, including age, gender, ethnicity, education and housing type (Malhotra et al., 2010). These socio-demographic differences suggest the existence of health disparities in hypertension, where unequal access to health care, specifically in screening and treatment, is present (Adler and Stewart, 2010).

The chance of being diagnosed with hypertension increases with age, more so from 40 years onwards (Ministry of Health, 2010; Malhotra et al., 2010), and consequently, younger people were less likely to be aware of their hypertension status (Wu et al., 2009). Disparities across socio-demographic groups in hypertension awareness and treatment, however, cannot be fully accounted for by age differences (Wu et al., 2009). Race-based health disparities have been posited to derive from a variety of historical and social factors (Krieger, 2003). In Singapore, people of Malay ethnicity were generally more likely to be associated with unfavourable outcomes of hypertension awareness, treatment and suboptimal BP control as compared to those of Chinese ethnicity (Seow et al., 2015; Wu et al., 2009; Malhotra et al., 2010; Ministry of Health, 2010).

The link between gender and hypertension awareness and treatment has been found to differ across countries, but aggregate worldwide data revealed non-significant gender association (Kearney et al., 2005). The association is unclear in Singapore too, with men lacking hypertension awareness, treatment and control in at least one study (Malhotra et al., 2010), but not in other research (Seow et al., 2015; Wu et al., 2009).

Socioeconomic status (SES), namely education and income, reportedly has an inverse association with hypertension (Banegas et al., 2002; Hypertension Study Group, 2001). This may be because individuals from the lower-SES group tend to experience greater stress and possess less resources to manage their health (Wister, 1996; Fong et al., 2007; Fukuda et al., 2005a; Fukuda et al., 2005b). Likewise in Singapore, those of low SES have been found with poorer hypertension awareness, treatment, and control as compared to those of higher SES (Wee and Koh, 2012).

Hypertension prevalence is also lower among elderly with higher education level and those living in larger housing (Malhotra et al., 2010). The cost of screening and treatment has been cited as the barrier to better hypertension management among those of lower SES (Wee and Koh, 2012).

While these health disparities are well documented, it is less well understood as to whether intervention and education have a similar impact on different communities. Therefore, this study set out to understand the extent to which socio-demographic variables influence the impact of a hypertension education programme.

There is a unanimous agreement on the need to promote hypertension awareness and screening in Singapore (Seow et al., 2015; Wee and Koh, 2012; Malhotra et al., 2010). The proportion of those unaware of their hypertension and untreated among the elderly is 30.3% and 32.0%, respectively (Malhotra et al., 2010). The Singapore Heart Foundation (SHF) has risen to this challenge through the BP Initiative @ Schools, a nationwide programme which aims to provide health education on BP management to the wider population using grade five students as agents of health education information (Lwin et al., 2016).

Nevertheless, there remain questions as to whether health disparities across varying socio-economic groups link to disparities in the reception of health education. We thus utilise the data resources gathered from the BP Initiative @ Schools programme to test the hypothesis that hypertension education programmes have a differing impact on participants depending on their age, gender, race and housing type.

Inequality in Health Education

Health promotion interventions have been identified as effective ways to reduce health disparities (Freimuth and Quinn, 2004; Salmi et al., 2015) as health education can reach individuals across varying socio-demographic backgrounds through common avenues (Lim et al., 2007). Health communication can raise individuals' awareness of health issues and solutions and transform their beliefs and behaviours; it can also influence social norms, policies and health services (Freimuth and Quinn, 2004); and it can empower by enhancing a personal sense of self-efficacy to make positive behaviour change (Centers for Disease Control and Prevention, 2007). Health education in the management of hypertension has likewise demonstrated positive impacts, such as lowering the BP level of hypertensive patients (Xu et al., 2014) and enhancing the management of BP levels (Holder, 2007).

However, while health promotion may help to alleviate health problems and difficulties, there exists the possibility that the impact of such intervention programmes differs substantially across socio-demographic groups. In relation to gender, the degree to which men and women hold decision making power and have access to resources may influence the impact of health promotion programmes (Östlin et al., 2006). Age-wise, older adults are often less willing to participate in health promotion programmes (Han et al., 2007; Robroek et al., 2009; Resnick, 2000) as they tend to feel less motivated to engage in health-related issues and may be dubious about the effectiveness of health screenings (Resnick, 2000; Dutta-Bergman, 2005; Nielsen et al., 2004). Older adults from low-SES group are also less likely to seek information related to their health issues or to engage with the health information provided by their doctors (Wiltshire et al., 2009). A study among low income housing residents in Singapore revealed a relatively low rate (35.1%) of willingness to participate in health promotion programmes (Ng et al., 2012). Among the unwilling group, adults aged 45 years-old and above and of Chinese ethnicity, as compared to those of Malay ethnicity, were more hesitant to participate in health promotion programmes due to lack of time and interest. In particular, Chinese respondents' fatalistic attitudes toward life may also predispose them against participation in health programmes (Straughan and

Seow, 1998; Ong et al., 2002). In short, low levels of motivation and compliance among the disadvantaged groups to modify their health behaviours in response to health education may further exacerbate health disparities (Schou and Wight, 1994).

Despite this evidence, studies examining disparities in health education programmes have been relatively few. In view of this, we aimed to assess the extent to which socio-demographic variables, namely gender, race, age, and housing status (as a proxy of income) influence the impact of health education programmes in Singapore. Unlike many interventions which focused on certain ethnic minorities (Salmi et al., 2015), the hypertension awareness programme we studied is unique in that it seeks to involve all groups. The programme targets grade five children and their adult family members, allowing the simultaneous evaluation of potential disparities in health education impact on two different developmental groups. While health education disparities have been examined among adults, to our knowledge, few studies have evaluated its effects among children.

Singapore provides a unique setting for examining disparities in the impact of a health education programme across gender, race, age and housing status given the country's multi-ethnic population and unique housing policy. The majority of Singapore residents live in public housing whose type and size is positively linked to their income level (Department of Statistics Singapore, 2015), allowing for an examination of disparities by housing type as a proxy of income.

Method

Participants and Procedure

We used an existing SHF data set collected over a three-year period between 2011 and 2013. Prior to the study, consent was obtained from respondents and ethical approval was given from Nanyang Technological University's Institutional Review Board (IRB) and by Singapore's Ministry of Education. The BP education initiative conducted by SHF staff consisted of a lecture, followed by live demonstration and hands-on practice on performing BP testing using an automatic BP monitor (Omron BP HEM 7203). Each student then took home the BP monitor for a day in order to measure the BP of family members and share the BP information they obtained. One family member of each student completed a short pen-and-paper survey after having his/her BP measured. Prior to the lecture and training, student respondents participated in a short pre-programme survey. After returning the BP monitor, students completed a post-programme survey. Both student's pre-programme and post-programme surveys were mostly administered in a classroom setting, where a teacher or a research assistant was present. A small number of schools opted to administer the surveys online or asked the students to complete the post-programme survey at home due to a shortage of time during curriculum hours at school.

Instruments

Students' pre- and post-programme survey

The pre-programme survey instrument assessed BP knowledge (seven true-and-false questions) and attitudes towards acquiring and sharing BP knowledge (three 5-point Likert scale questions from strongly disagree to strongly agree), created by the research team in

consultation with physicians at SHF. The post-programme survey comprised the same measures as assessed in the pre-programme survey, with added measures grounded in Protection Motivation Theory (PMT) constructs (Rogers and Prentice-Dunn, 1997) pertaining to the students' beliefs toward performing BP testing and getting a regular BP test. Self-efficacy (perceived ease and confidence; two questions) in performing BP measurement on their family members and response efficacy (perceived benefits; three questions) from getting a regular BP test were assessed on a 5-point Likert scale adapted from Lwin and Saw (2007). Attitudes toward taking a BP measurement (seven items) were adapted from Lowe, Eves, and Carroll's (2002) affective and instrumental attitude scale. Student respondents were asked to complete a statement "For me, taking blood pressure measurement is ...", on a 5-point semantic-differential scale, such as "stressful-relaxing" and "useless-useful". Students were also asked to indicate the number of family members who they performed BP measurement on as well as their demographic profile comprising gender, age, race and housing type.

Family Member's Survey

The first two questions in this survey asked respondents whether they had been previously diagnosed with hypertension by a health professional (self-report hypertension) and whether they had a BP monitor at home. The next seven questions assessed respondents' beliefs toward BP measurement using measures grounded in PMT (Rogers and Prentice-Dunn, 1997) and adapted from Lwin and Saw (2007), on a 5-point Likert scale. The PMT measures assessed were self-efficacy towards having a regular BP test (two items), response efficacy from regular BP testing (two items), vulnerability or the likelihood of getting hypertension (one item), severity or the likelihood of developing heart diseases when suffering from hypertension (one item), and intention to check their BP regularly (one item). The family member's BP measurement results were also recorded together with their demographic profile information.

Statistical analyses

Data analyses were performed using SPSS software version 22. The sample characteristics were first explored using descriptive statistics such as frequencies and means. Multiple regression analyses were conducted to examine the effects of socio-demographic variables on the hypertension awareness programme outcomes among student respondents. When available, the student's pre-programme measures were included as controls in a hierarchical regression analysis. Similarly, hierarchical regression analyses were performed among family member respondents to assess hypertension education impact across socio-demographic groups, with self-reported hypertension included in the first block as a control, followed by gender, race, housing type and age in the second block. Multiple logistic regression analyses were performed to assess the impact of socio-demographic variables on family member's hypertension prevalence and ownership of a BP meter. One-way Analysis of Variance (ANOVA) utilising the Scheffe post-hoc test was performed to compare differences across gender, racial groups and housing types for the study's dependent variables among the student respondents. When available, the student's related pre-programme measures were included in the analysis as a covariate and thus Analysis of Covariance (ANCOVA) was employed. ANCOVA with a post-hoc Scheffe test was performed among the adult family

member respondents to compare differences across gender, racial groups and housing types on the study's outcomes, with self-report hypertension included as covariate. Statistical significance was established at $p < .05$.

Results

Sample characteristics

Of the student sample of 10,624 studied, the racial/ethnic group proportions, which comprised 69.2% Chinese, 17.3% Malay, 6.9% Indian, and 5.1% from other racial groups (1.4% did not specify their race), reflected the racial/ethnic proportions of the Singapore population generally (Department of Statistics Singapore, 2010). We excluded those from other racial groups in the analysis, generating a final sample of 9,960 student respondents. The demographic profile of this sample is shown in Table 1. Mean and standard deviation (SD) scores (or adjusted mean and standard errors (SE) when pre-programme measures were included as covariates) of the student respondents' beliefs toward BP measurement are shown in Appendix 1, together with the results of the one-way ANOVA (or ANCOVA when pre-programme measures are included as covariates) to compare their beliefs across gender, racial group and housing type.

Responses from 5,745 adult family member respondents were studied. The proportion of the racial/ethnic groups of the family member respondents, which comprised 70.9% Chinese, 15.4% Malays, 7.1% Indians, and 4.9% other racial groups (1.8% did not state their racial group), also reflected the racial/ethnic composition of the population of Singapore. After excluding the "other" racial/ethnic group from the analysis, a final sample of 5,361 adult family member respondents was derived. The characteristics of the final family member sample are shown in Table 2. The adjusted mean and SE scores of the adult family member respondents, after including self-report hypertension as covariates, are shown in Appendix 1, together with the ANCOVA results to compare beliefs across gender, racial group and housing type.

Tables 1 and 2 about here

Health Education Disparities among the Student Sample

Table 3 presents the multiple regression analyses to examine the effect of socio-demographic variables on students' BP knowledge and beliefs towards knowledge sharing and BP testing. For the BP knowledge and attitude toward knowledge sharing dependent variables, a hierarchical regression was conducted with pre-programme measures for the respective dependent variables entered in Block 1 as control, while the socio-demographic variables entered in Block 2.

Female students were more likely to show better BP knowledge, attitudes toward knowledge sharing, as well as self-efficacy and attitude towards performing BP measurement. Conversely, male students were more likely to have a higher level of response efficacy or believe that regular BP testing could have favourable effects in terms of preventing future health risks.

As compared to Chinese students, Malay students tended to have lower levels of BP knowledge, attitudes toward knowledge sharing, self-efficacy, and response efficacy toward

performing BP testing. In contrast, Indian students possessed better attitudes toward knowledge sharing, self-efficacy and attitudes toward BP testing than Chinese students. Malay and Indian students performed a BP measurement on more family members (means of 3.61 and 3.84, respectively) than Chinese students (mean of 3.36).

Across housing type, programme outcomes among students in the most affordable housing were generally the least favorable. There was an exception in the number of family members whose BP were measured, where almost no significant difference was noted between the smaller and larger housing types.

Table 3 about here

Health Education Disparities among the Family Member Sample

Table 4 presents the hierarchical regression results examining the effect of socio-demographic variables on adult family members' beliefs toward BP testing and getting hypertension, with self-report hypertension included as a control. Men felt more susceptible to getting hypertension as compared to women. There was no significant gender difference for the rest of the dependent variables.

Malay and Indian adults showed greater levels of self-efficacy and intention to check their BP regularly in the future, and were more likely to perceive the health education programme as useful compared to the Chinese. Malays felt more vulnerable to developing hypertension but were less likely to believe that hypertension would increase their chance of heart attack (severity) as compared to the Chinese. Conversely, Indians reported a lower level of vulnerability, but a perceived higher level of severity than the Chinese. There was no significant difference between the racial groups in response efficacy toward BP testing.

Adult respondents in the most affordable housing type possessed lower levels of self-efficacy, response efficacy, severity and intention than those in better housing. They did not differ significantly from the rest of the housing types in their perceived vulnerability and perceived health education programme usefulness.

After taking into account self-report hypertension status, age was significantly related only to intention to check their BP regularly, with older respondents being more likely to have higher intention. Age was not a significant predictor of the other dependent variables.

Table 5 presents the multiple logistic regression results that examine the effect of socio-demographic variables on hypertension prevalence. Older adults, men, Malays and residents in affordable housing types had higher odds of having been previously diagnosed with hypertension and being found to have hypertension when tested by students at home. Malays and those in affordable housing also tended not to own a BP meter at home.

Tables 4 and 5about here

Discussion

This study sought to examine whether health education programmes impacted participants differently across gender, age, race and SES. The hypertension education programme investigated centred on raising hypertension awareness and testing in Singapore, targeted

two types of audience, grade five students and their family members. Findings reveal that health education disparities were apparent in both childhood and adulthood samples across racial group and housing type, albeit with nuanced variation. Disparity by age was largely not present among the family member respondents, except for intention to perform regular BP testing.

Gender effects were present among student respondents, but not among adult family members. Women, in general, are thought of to have less decision making power and resources, placing them at a disadvantage in accessing health information and receiving health services. Singapore, however, is ranked top among Asian nations in gender equality and 13th out of 155 countries worldwide in 2015 (Kok, 2015). The quality of the healthcare system in Singapore (Kearney et al., 2005; Hein et al., 2013) may also have benefited both genders. This may explain the non-significant gender difference in the health education disparity among the adult respondents. Gender differences among students, in contrast, may be related to how girls in elementary schools in Singapore tend to have better academic performance as compared to boys (Teng, 2017), hence, predisposing girls in this study to have more favourable programme outcomes given the nature of the present programme being conducted in school.

There were some variations in the results by race/ethnicity but the general trend was for less favourable health education outcomes among ethnic Malay students as compared to the Chinese. In contrast, ethnic Malay and ethnic Indian family members had higher levels of self-efficacy and intention to undergo regular BP testing than the ethnic Chinese. The differing results between the children and adult sample are interesting. Some scholars have posited that health disparity in racial or ethnic group are closely related to the socio-economic backgrounds of a particular ethnic group, while others have suggested that racial differences persisted even after taking into account their SES background (see Farmer and Ferraro, 2005: for a review). In Singapore, ethnic Malays tend to have lower levels of income (Singapore Department of Statistics, 2011), and this may inhibit them from receiving the optimal outcomes of health education programmes. Ethnic/racial differences among students remain for most health education outcomes even after taking into account the effect of housing type, which is a proxy for income, indicating that racial/ethnic differences alone may have an impact on the health education disparity, as the same health education programme did not yield similar improved outcomes for Malay children as compared to Chinese and Indian children. Further research is needed to assess the cause of this racial disparity. The health education impact among adults, in contrast, may have been interfered by the fact that adults are at a much higher risk of getting hypertension than children, and older ethnic Malays in particular generally have a higher level of hypertension concern (Seow et al., 2015; Wu et al., 2009; Malhotra et al., 2010). It is interesting to note, however, that our findings showed that even after taking into account previous hypertension diagnosis, ethnic Malay adults tended to feel most vulnerable to getting hypertension as compared to the other groups, and this may lead to the more favourable health education outcomes among the Malays. In addition, ethnic Malay and ethnic Indian adults had higher levels of self-efficacy and intention to perform regular BP measurement as compared to ethnic Chinese adults. The lack of intention among Chinese adults to perform BP testing may be attributed to their hesitance to partake in health promotion programmes (Ng et al., 2012), plausibly driven by their beliefs that suffering from an illness is pre-destined regardless of whether they undertake preventive measures (Straughan and Seow, 1998; Ong et al., 2002). Alternatively, the lower level of intention among the ethnic Chinese adults

may be due to them having a better control of their BP level and participating in hypertension testing more regularly, as compared to the ethnic Malays and ethnic Indians (Wee et al., 2013). Nevertheless, whether Malay or Indian adults translate their favourable attitudes toward BP testing into behaviour require further assessment.

Health education disparities were also prominent by housing type, with those in the most affordable housing type less likely to perform as well as those in better housing. It is particularly encouraging that although there was no significant difference in the perceived susceptibility of having hypertension among the adult sample, those in better housing types responded more favourably in their beliefs toward performing regular BP testing. This is in line with the relationship between SES and hypertension prevalence documented elsewhere (Wee and Koh, 2012; Banegas et al., 2002; Hypertension Study Group, 2001), and may be linked to access to health care and health information and the response cost associated with acting on the health information received. Those in lower socio-economic group may have less monetary resources and time (Wee et al., 2013) to follow-up on the health information received, resulting in lower motivation and confidence to improve on their health. This study also found that there were no significant differences across different housing types in the number of family members whose BP was measured by the students. This suggests that the approach regarding the bringing home of BP monitors could prove to be an effective intervention to reach the wider population regardless of socio-economic status. Such a joint activity could serve as an opportunity to share information about hypertension among students' family members. Further investigation is necessary, though, to examine whether the types of family members targeted and the quality of the information shared differ across housing type.

Upon examining the impact of the present BP health education programme across socio-demographic groups, it appears possible that health education can perpetuate, rather than alleviate, inequalities (Barić, 1989). This is likely to be the case if a health education programme assumes that there is no difference in decision making processes and access to resources across the population, and hence, the programme is not tailored to the needs of different socio-demographic groups. Our findings showed a potential interaction effect between age group and socio-demographic group, in which children and adults from the same racial/ethnic or socio-economic group may respond differently to health education programmes. Health promotion efforts thus need to be adapted to targeted communities and age groups. In general, it appears that low-SES communities need to be worked with more intensively than other groups. Failing to do so may further exacerbate the disparities as higher SES groups are more likely to follow up on the information received (Adler & Newman, 2002).

Limitations

Like all studies, this study has its weaknesses and can be improved in a number of ways. First, the True and False knowledge questions may likely result in some "false positive" responses, although we attempted to minimise this by including a "Don't Know" response option.

Second, BP measurement in the programme was performed at home, and hence, it lacks validation as to whether the BP testing has been properly conducted. This validation issue was minimised by having parent volunteers and SHF staff validate students' BP testing skills during training in school. However, the detection of hypertension was not the main

objective of the present programme. Instead, we hope to positively influence beliefs toward hypertension and BP testing, particularly by showing how easy and painless it is to perform a BP test, through knowledge sharing and joint activities.

Third, we did not administer a pre-programme survey to the family members so as not to reduce the response rate. Future studies, however, should include a family member pre-programme survey, perhaps with a monetary incentive to attain a satisfactory level of response rate, in order to better assess programme efficacy, particularly on the changes in the knowledge and beliefs toward BP measurement.

Fourth, the previous diagnosis of heart disease may have influenced family members' responses, such as on the vulnerability and severity measures. We did not include a question about this as we wanted to maintain a good balance between the length of the family member's survey versus and a good response rate. Future studies, should take respondents' prior health conditions into account, including prior cardiovascular health.

Fifth, future studies could include an assessment of literacy levels or cognitive status of the respondents as these may relate to differences by race/ethnicity and housing as found in the present study.

Finally, certain phrases in the surveys, such as the term "regular BP measurement" can be interpreted differently by the respondents, despite the explanations given to the students during the BP lecture. Future surveys should include clearer definitions of terminology in the questionnaire.

Conclusion

Despite the same hypertension education programme being implemented across the population, disparities in the programme impact were apparent. While there were some similarities in the patterns of health education disparities across housing type among children and adult samples, differences showed up in terms of gender and racial/ethnic disparities. Future interventions should be tailored towards targeted communities keeping in mind age group, socio-cultural differences, response cost and other challenges specific to disadvantaged groups.

Funding

This study was funded by the Singapore Heart Foundation.

References

Adler NE and Stewart J. (2010) Health disparities across the lifespan: meaning, methods, and mechanisms. *Annals of the New York Academy of Sciences* 1186: 5-23.

Banegas JR, Rodríguez-Artalejo F, Ruilope LM, et al. (2002) Hypertension magnitude and management in the elderly population of Spain. *Journal of Hypertension* 20: 2157-2164.

Barić L. (1989) Inequalities in health (education). *Journal of the Institute of Health Education* 27: 30-33.

Centers for Disease Control and Prevention. (2007) *Community and Individual Behavior Change Interventions, Program Operations Guidelines for STD Prevention*. Available at: https://www.cdc.gov/std/program/community.pdf

Department of Statistics Singapore. (2015) *Key Household Income Trends*. Available at: https://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/household_income_and_expenditure/pp-s22.pdf

Dutta-Bergman MJ. (2005) Developing a profile of consumer intention to seek out additional information beyond a doctor: The role of communicative and motivation variables. *Health Communication* 17: 1-16.

Ezzati M, Lopez AD, Rodgers A, et al. (2002) Selected major risk factors and global and regional burden of disease. *The Lancet* 360: 1347-1360.

Farmer MM and Ferraro KF. (2005) Are racial disparities in health conditional on socioeconomic status? *Social Science & Medicine* 60: 191-204.

Fong C, Bhalla V, Heng D, et al. (2007) Educational inequalities associated with health-related behaviours in the adult population of Singapore. *Singapore Medical Journal* 48: 1091.

Freimuth VS and Quinn SC. (2004) The contributions of health communication to eliminating health disparities. *American Journal of Public Health* 94: 2053-2055.

Fukuda Y, Nakamura K and Takano T. (2005a) Accumulation of health risk behaviours is associated with lower socioeconomic status and women's urban residence: a multilevel analysis in Japan. *BMC Public Health* 5: 53.

Fukuda Y, Nakamura K and Takano T. (2005b) Socioeconomic pattern of smoking in Japan: income inequality and gender and age differences. *Annals Of Epidemiology* 15: 365-372.

Han H-R, Kang J, Kim KB, et al. (2007) Barriers to and strategies for recruiting Korean Americans for community-partnered health promotion research. *Journal of Immigrant and Minority Health* 9: 137-146.

Hein T, Loo G, Tai B-C, et al. (2013) Myocardial infarction in singapore: ethnic variation in evidence-based therapy and its association with socioeconomic status, social network size and perceived stress level. *Heart, Lung and Circulation* 22: 1011-1017.

Holder KK. (2007) Interventions to improve blood pressure control in patients with hypertension. *American Family Physician* 76: 373-374.

Hypertension Study Group. (2001) Prevalence, awareness, treatment and control of hypertension among the elderly in Bangladesh and India: a multicentre study. *Bulletin of the World Health Organization* 79: 490-500.

Kearney PM, Whelton M, Reynolds K, et al. (2005) Global burden of hypertension: analysis of worldwide data. *The Lancet* 365: 217-223.

Kearney PM, Whelton M, Reynolds K, et al. (2004) Worldwide prevalence of hypertension: a systematic review. *Journal of Hypertension* 22: 11-19.

Kok XH. (2015) *Singapore is top Asian nation for gender equality: UN report*. Available at: http://www.straitstimes.com/singapore/singapore-is-top-asian-nation-for-gender-equality-un-report.

Krieger N. (2003) Does racism harm health? Did child abuse exist before 1962? On explicit questions, critical science, and current controversies: an ecosocial perspective. *American Journal of Public Health* 93: 194-199.

Lim W-Y, Ma S, Heng D, et al. (2007) Gender, ethnicity, health behaviour & self-rated health in Singapore. *BMC Public Health* 7: 184-190.

Lowe R, Eves F and Carroll D. (2002) The influence of affective and instrumental beliefs on exercise intentions and behavior: A longitudinal analysis. *Journal of Applied Social Psychology* 32: 1241-1252.

Lwin MO, Malik S, Chua TS, et al. (2016) Intergenerational transfer of blood pressure knowledge and screening: a school-based hypertension awareness program in Singapore. *Global Health Promotion* 23: 27-36.

Lwin MO and Saw S-M. (2007) Protecting children from myopia: a PMT perspective for improving health marketing communications. *Journal of Health Communication* 12: 251-268.

Malhotra R, Chan A, Malhotra C, et al. (2010) Prevalence, awareness, treatment and control of hypertension in the elderly population of Singapore. *Hypertension Research* 33: 1223-1231.

Ministry of Health. (2005) MOH Clinical Practice Guidelines 2/2005. 13.

Ministry of Health. (2010) *National Health Survey*. Available at: http://www.moh.gov.sg/content/moh_web/home/Publications/Reports/2011/national_health_survey2010.html

Ng CWL, Heng BH, Molina JA, et al. (2012) Demographic and lifestyle characteristics associated with non-willingness to participate in health promotion programmes among adults of a lower socioeconomic status in Singapore. *Global Health Promotion* 19: 9-19.

Nielsen K-DB, Dyhr L, Lauritzen T, et al. (2004) “You can't prevent everything anyway” A qualitative study of beliefs and attitudes about refusing health screening in general practice. *Family Practice* 21: 28-32.

Ong KJ, Back MF, Lu JJ, et al. (2002) Cultural attitudes to cancer management in traditional South-East Asian patients. *Australasian Radiology* 46: 370-374.

Östlin P, Eckermann E, Mishra US, et al. (2006) Gender and health promotion: A multisectoral policy approach. *Health Promotion International* 21: 25-35.

Petrella RJ, Speechley M, Kleinstiver PW, et al. (2005) Impact of a social marketing media campaign on public awareness of hypertension. *American Journal Of Hypertension* 18: 270-275.

Resnick B. (2000) Health promotion practices of the older adult. *Public Health Nursing* 17: 160-168.

Robroek SJ, Van Lenthe FJ, Van Empelen P, et al. (2009) Determinants of participation in worksite health promotion programmes: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity* 6: 26-37.

Rogers RW and Prentice-Dunn S. (1997) Protection motivation theory. In: Gochman DS (ed) *Handbook of health behavior research 1: Personal and social determinants.* New York: Plenum Press, 113-132.

Salmi L-R, Barsanti S, Bourgueil Y, et al. (2015) Interventions addressing health inequalities in European regions: the AIR project. *Health Promotion International* 32: 430-441.

Schou L and Wight C. (1994) Does dental health education affect inequalities in dental health? *Community Dental Health* 11: 97-100.

Seow LSE, Subramaniam M, Abdin E, et al. (2015) Hypertension and its associated risks among Singapore elderly residential population. *Journal of Clinical Gerontology and Geriatrics* 6: 125-132.

Singapore Department of Statistics. (2011) *Census of Population 2010*. Available at: http://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/cop2010/census_2010_release2/cop2010sr2.pdf

Straughan PT and Seow A. (1998) Fatalism reconceptualized: a concept to predict health screening behavior. *Journal of Gender, Culture and Health* 3: 85-100.

Teng A. (2017) *Girls lead in primary school but boys catch up: MOE study*. Available at: http://www.straitstimes.com/singapore/education/girls-lead-but-boys-catch-up.

Wee LE and Koh GC-H. (2012) Individual and neighborhood social factors of hypertension management in a low-socioeconomic status population: a community-based case–control study in Singapore. *Hypertension Research* 35: 295-303.

Wee LE, Wong J, Chin RT, et al. (2013) Hypertension management and lifestyle changes following screening for hypertension in an Asian low socioeconomic status community: a prospective study. *Annals, Academy of Medicine, Singapore* 42: 451-465.

Whitehead M. (1991) The concepts and principles of equity and health. *Health Promotion International* 6: 217-228.

Wiltshire JC, Roberts V, Brown R, et al. (2009) The effects of socioeconomic status on participation in care among middle-aged and older adults. *Journal of Aging and Health* 21: 314-335.

Wister AV. (1996) The Effects of Socioeconomic Status on Exercise and Smoking Age-Related Differences. *Journal of Aging and Health* 8: 467-488.

Wu Y, Tai ES, Heng D, et al. (2009) Risk factors associated with hypertension awareness, treatment, and control in a multi-ethnic Asian population. *Journal of Hypertension* 27: 190-197.

Xu L, Meng Q, He S, et al. (2014) The effects of health education on patients with hypertension in China: A meta-analysis. *Health Education Journal* 73: 137-149.

Table 1. Characteristics of student sample

	N = 9,960	
	N	%
Gender		
Male	5026	50.5
Female	4904	49.2
Race/ethnicity		
Chinese	7379	74.1
Malay	1844	18.5
Indian	737	7.4
Housing Type[a]		
HDB 1-2-room flat	388	3.9
HDB 3-room flat	1911	19.2
HDB 4-room flat	3372	33.9
HDB 5-room flat	2443	24.5
HDB Executive flat	329	3.3
Private Housing	1433	14.4
Age (Mean, SD)	10.66 (.58)	

[a.] HDB refers to public housing in Singapore managed by Housing Development Board (HDB). Around 80% of the Singapore's population live in public housing. The rest live in private housing, which is usually more expensive than public housing.

Table 2. Characteristics of participating family member sample aged 21 years-old and above

	N = 5,361	
	N	%
Gender		
Male	1909	35.6
Female	3427	63.9
Race/ethnicity		
Chinese	4071	75.9
Malay	884	16.5
Indian	406	7.6
Housing Type		
HDB 1-2-room flat	178	3.3
HDB 3-room flat	1016	19.0
HDB 4-room flat	1830	34.1
HDB 5-room flat	1342	25.0
HDB Executive flat	190	3.5
Private Housing	773	14.4
Age (Mean, SD)	44.70 (9.61)	
Previously diagnosed with hypertension	875	16.3
Own BP meter at home	1643	30.6
Blood Pressure Measurement[a]		
Normal BP (S<130, D<80)	3873	72.2
Prehypertension (S130-139, D80-89)	1058	19.7
Stage 1 hypertension (S140-159, D90-99)	116	2.2
Stage 2 Hypertension (S>=160, D>=100)	50	.9
Isolated Systolic Hypertension (S>=140, D<90)	113	2.1
Isolated Diastolic Hypertension (S<140, D>=90)	124	2.3

[a.] Blood Pressure Classification is based on Singapore's standard (Ministry of Health, 2005).
Note: HDB refers to public housing in Singapore that is managed by Housing Development Board (HDB).

Table 3. Student's knowledge and beliefs toward blood pressure measurement (Standardised regression coefficient scores)

Dependent Variables	Knowledge	Attitude toward knowledge sharing	Self-efficacy of performing BP testing	Response efficacy	Attitude toward performing BP testing	Number of family member measured
Independent Variables						
Gender (Ref = Male)	.03***	.02*	.06***	-.03**	.08***	.02
Race/ethnicity (Ref = Chinese)						
Malay	-.12***	-.05***	-.07***	-.12***	.01	.05***
Indian	-.02*	.05***	.04***	-.01	.05***	.05***
Housing Type (Ref = HDB 1-2-room flat)						
HDB 3-room flat	.07**	.05*	.07**	.05*	.02	-.01
HDB 4-room flat	.13***	.11***	.16***	.12***	.07**	.01
HDB 5-room flat	.17***	.12***	.18***	.14***	.08***	.05*
HDB Executive flat	.05***	.05***	.09***	.07***	.03*	.02
Private Housing	.16***	.09***	.16***	.11***	.06**	.02
Pre-Knowledge	.35***					
Pre-Attitude		.30***				
Total R^2	.17***	.11***	.03***	.03***	.01***	.01***

Note: HDB refers to public housing in Singapore that is managed by Housing Development Board (HDB);

*p < .05, **p < .01, ***p < .001

Table 4. Family member's beliefs toward blood pressure measurement (Standardized regression coefficient scores)

Dependent Variables	Self-efficacy	Response efficacy	Vulnerability	Severity	Intention	Benefit of BP programme
Control Variable						
Self-report hypertension	.05***	.02	.20***	.02	.08***	.00
Independent Variables						
Gender (Ref = Male)	.01	.00	-.03*	-.00	-.01	-.01
Race/ethnicity (Ref = Chinese)						
Malay	.06***	.02	.05***	-.03*	.04**	.06***
Indian	.07***	.01	-.04**	.03*	.07***	.05**
Housing Type (Ref = HDB 1-2-room flat)						
HDB 3-room flat	.08*	.08*	-.02	.05	.06	-.02
HDB 4-room flat	.13**	.14***	-.01	.11**	.09*	-.00
HDB 5-room flat	.15***	.15***	-.02	.14***	.10**	.03
HDB Executive flat	.08***	.05*	-.00	.07***	.04*	-.01
Private Housing	.14***	.11***	-.03	.14***	.09**	.03
Age	.02	-.00	.02	-.00	.03*	.02
Total R^2	.02***	.01**	.05***	.01***	.02***	.01***

Note: HDB refers to public housing in Singapore that is managed by Housing Development Board (HDB)*;*

*$p < .05$, **$p < .01$, ***$p < .001$

Table 5. Odds Ratio and 95% confidence intervals (CI) for logistic regression of family members with hypertension

	Self-report hypertension *N = 875*		Found with hypertension *N = 403*		Own BP meter *N = 1,643*	
	OR	*95% CI*	*OR*	*95% CI*	*OR*	*95% CI*
Independent Variables						
Age	1.05***	(1.04, 1.05)	1.04***	(1.03, 1.05)	1.02***	(1.01, 1.02)
Gender (Ref = Male)	.69***	(.60, .81)	.48***	(.39, .59)	.96	(.85, 1.09)
Race/ethnicity (Ref = Chinese)						
Malay	1.64***	(1.35, 1.99)	1.43**	(1.10, 1.86)	.58***	(0.48, .70)
Indian	1.13	(.85, 1.52)	1.13	(.76, 1.69)	1.00	(.80, 1.25)
Housing Type (Ref = HDB 1-2-room flat)						
HDB 3-room flat	.60*	(.40, .89)	.42***	(.26, .66)	1.77*	(1.12, 2.78)
HDB 4-room flat	.70	(.48, 1.03)	.40***	(.26, .62)	2.15***	(1.39, 3.34)
HDB 5-room flat	.66*	(.44, .97)	.40***	(.26, .63)	2.84***	(1.82, 4.42)
HDB Executive flat	.59	(.34, 1.01)	.21***	(.09, .47)	3.66***	(2.18, 6.16)
Private Housing	.56**	(.37, .86)	.24***	(.14, .42)	3.61***	(2.29, 5.67)

Note: HDB refers to public housing in Singapore that is managed by Housing Development Board (HDB); *$p < .05$, **$p < .01$, ***$p < .001$

Appendix 1

Table 1. Students' beliefs toward blood pressure measurement (Mean and Standard Deviation or Standard Error when a covariate was included)

	Knowledge[#]		Attitude toward knowledge sharing[#]		Self-efficacy of performing BP testing		Response efficacy		Attitude toward performing BP testing		Number of family member measured	
	Mean	SE	Mean	SE	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gender												
Male	4.90[a]	.02	3.56[a]	.01	4.09[a]	1.04	3.72[a]	.98	4.16[a]	.77	3.39[a]	2.68
Female	5.01[b]	.02	3.61[b]	.01	4.21[b]	.96	3.67[b]	.94	4.28[b]	.66	3.49[b]	2.24
F	14.99***		8.54**		38.10***		6.77**		73.16***		4.16*	
Race/ethnicity												
Chinese	5.07[a]	.02	3.60[a]	.01	4.18[a]	.99	3.76[a]	.95	4.21[a]	.71	3.36[a]	2.33
Malay	4.52[b]	.03	3.46[b]	.02	3.97[b]	1.07	3.44[b]	.92	4.21[a]	.74	3.61[b]	2.45
Indian	4.92[c]	.05	3.79[c]	.03	4.32[c]	.94	3.72[a]	1.01	4.35[b]	.72	3.84[c]	3.64
F	104.58***		40.71***		45.08***		86.46***		13.29***		15.56***	
Housing Type												
HDB 1-2-room flat	4.39[c]	.07	3.37[a]	.04	3.79[a]	1.18	3.41[a]	1.02	4.13[a]	.79	3.40[abc]	2.57
HDB 3-room flat	4.72[d]	.03	3.50[b]	.02	3.98[b]	1.09	3.56[b]	.99	4.16[a]	.77	3.27[a]	2.22
HDB 4-room flat	4.91[a]	.03	3.60[c]	.01	4.15[c]	.98	3.70[c]	.95	4.23[b]	.72	3.37[ab]	2.19
HDB 5-room flat	5.13[b]	.03	3.64[c]	.02	4.23[d]	.96	3.78[d]	.92	4.26[b]	.67	3.62[c]	2.97
HDB Executive flat	5.01[ab]	.08	3.64[c]	.05	4.34[d]	.90	3.85[d]	.88	4.25[b]	.65	3.57[bc]	2.23
Private Housing	5.26[e]	.04	3.63[c]	.02	4.30[d]	.93	3.80[d]	.97	4.23[b]	.68	3.46[bc]	2.37
F	41.47***		11.11***		33.38***		23.08***		5.82***		4.80***	

Note: ANOVA post-hoc comparison performed using Scheffe. *SE* = Standard Error, *SD* = Standard Deviation. HDB refers to public housing in Singapore that is managed by Housing Development Board (HDB). Values with different subscripts within columns indicate a difference that is significant; [#] Pre-knowledge and Pre-attitude toward sharing were entered as covariates for their respective post-measure analysis. Adjusted mean and SE are shown for these dependent variables; $*p < .05$, $***p < .001$

Table 2. Family members' beliefs toward blood pressure measurement (Mean and Standard Error

	Self-efficacy		Response efficacy		Vulnerability		Severity		Intention		Benefit of BP programme	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Gender												
Male	4.00[a]	.02	4.05[a]	.02	2.87[a]	.03	4.24[a]	.02	3.74[a]	.02	4.37[a]	.96
Female	4.01[a]	.02	4.05[a]	.02	2.79[b]	.02	4.25[a]	.02	3.73[a]	.02	4.34[a]	.99
F	.25		.11		5.01*		.11		.36		.70	
Race/ethnicity												
Chinese	3.97[a]	.01	4.04[a]	.01	2.80[a]	.02	4.27[a]	.02	3.69[a]	.02	4.32[a]	.02
Malay	4.07[b]	.03	4.07[a]	.03	2.98[b]	.04	4.12[b]	.03	3.79[b]	.04	4.45[b]	.03
Indian	4.20[c]	.04	4.08[a]	.05	2.62[c]	.06	4.36[a]	.05	3.98[c]	.05	4.48[b]	.05
F	15.9***		.48		13.47***		9.51***		14.84***		9.57***	
Housing Type												
HDB 1-2-room flat	3.78[a]	.07	3.81[a]	.07	2.87[a]	.09	3.98[a]	.08	3.55[a]	.08	4.37[abc]	.08
HDB 3-room flat	3.94[b]	.03	3.98[b]	.03	2.78[a]	.04	4.11[a]	.03	3.69[a]	.03	4.29[b]	.03
HDB 4-room flat	3.99[bc]	.02	4.07[c]	.02	2.82[a]	.03	4.23[b]	.02	3.74[a]	.03	4.33[bc]	.02
HDB 5-room flat	4.05[cd]	.02	4.10[c]	.03	2.88[a]	.03	4.31[c]	.03	3.76[a]	.03	4.40[a]	.03
HDB Executive flat	4.10[cd]	.06	4.02[bc]	.07	2.83[a]	.09	4.39[c]	.07	3.74[a]	.08	4.29[abc]	.07
Private Housing	4.07[d]	.03	4.08[c]	.03	2.73[a]	.04	4.39[c]	.04	3.80[a]	.04	4.40[ac]	.04
F	5.33***		4.74***		1.86		10.74***		1.85		2.25*	

Note: ANOVA post-hoc comparison performed using Scheffe. *SE* = Standard Error. HDB refers to public housing in Singapore that is managed by Housing Development Board (HDB). Self-report hypertension was entered as covariate for all dependent variables. Values with different subscripts within columns indicate a difference that is significant; ****p* < .001