SUPPLEMENT 3

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Research Dissemination Reports

衛生及醫護服務研究基金
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研究成果報告

Health economics
衛生經濟學

Exercise/rehabilitation
運動/康復

Neurology
神經學

Tobacco control
控煙

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Health and Health Services Research Fund

Health Services Research Fund

Research Dissemination Reports

HEALTH ECONOMICS

EXERCISE/REHABILITATION

NEUROLOGY

TOBACCO CONTROL

Editorial

Dissemination reports are concise informative reports of health-related research supported by funds administered by the Food and Health Bureau, namely the *Health Services Research Fund* (HSRF) and the *Health and Health Services Research Fund* (HHSRF). In this edition, 10 dissemination reports of projects related to health economics, exercise and rehabilitation, neurology, and tobacco control are presented. In particular, three projects are highlighted due to their potentially significant findings, impact on health care delivery and practice, and/or contribution to health policy formulation in Hong Kong.

In Hong Kong, rates of obesity appear to be rising among children, with almost 20% of children at local schools classified as obese. One consequence of rising rates of overweight and obesity is the increasing incidence of type-2 diabetes mellitus in adults. McGhee et al[1] estimated the cost of diabetes in Hong Kong associated with excess body weight, and the likely changes in these costs over time under differing assumptions. Using local data wherever possible, the authors estimated that 1475 to 1648 deaths could be attributed to diabetes each year. The cost of health care for those with diabetes was HK$2.1 billion in 2006 of which around $1.8 billion was for inpatient care and the rest for outpatient care. The average annual cost per case was about HK$5000 for those under 65 years of age and HK$14 000 for those aged 65 years and over. The model developed in this project can be used to determine the impact on deaths in individuals under 65 years of age, life expectancy, years spent with diabetes, and health care costs with changes in levels of overweight or the impact of interventions to stem projected increases.

Cerebrovascular disease is the second most common cause of death and disease burden for those aged over 60 years worldwide. In Hong Kong, it is one of the three most common causes of hospital admissions, accounting for the largest number of bed days, and the most common cause for long-term residential care use, representing a considerable disease and disability burden for the local population. Woo et al[2] reviewed the recent trends in stroke incidence and mortality with respect to age group and gender with the aim of predicting the health and social care resources required for treating cerebrovascular disease in future years. The investigators found that, during the study period, there was a decline in both age-standardised stroke incidence and case fatality rate, which may reflect the impact of health promotion efforts, improved socioeconomic circumstances, and improved hospital treatment. However, they cautioned that this may not necessarily translate into a reduction in demand for rehabilitation and long-term care services, as a result of the inevitable increase in the number of elderly people with population ageing. The higher incidence of cerebrovascular disease in men compared with women showed that there was room for improvement in primary prevention in men.

Secondhand smoke (SHS) is a toxic mixture of carcinogens and other chemicals. Its impacts include cancers, chronic lung disease, heart disease, and stroke. There is increasing evidence that acute exposure to SHS can have immediate health effects particularly in those whose health is already compromised by chronic heart or lung disease. McGhee et al[3] examined the health effects of the implementation of smoke-free policy in workplaces in Hong Kong. As expected, a reduction in hospital admissions and mortality from ischaemic heart disease (IHD) was found after implementation of the smoke-free policy in most workplaces in Hong Kong. This is in line with findings from around the world. The drop in admission rates for IHD in Hong Kong of about 9% was on the lower side compared with those in other countries, but Hong Kong had allowed exemptions from the smoke-free policy until mid-2009. Further analyses of future years' data will help to refine the precise benefit to health due to amendments to the ordinance.

A research impact evaluation was conducted 2 years after the project end date for the majority of studies reported in this supplement. Impact was reported through publications in peer reviewed journals, gain of additional qualifications for project team members, career advancement, additional research funding obtained, stimulation of other research groups to conduct related research, and impact on policy and health care practices through changes in behaviour of health care professionals and/or other decision makers.

We hope you will enjoy this selection of research dissemination reports. Electronic copies of these dissemination reports and the corresponding full reports can be downloaded individually from the Research Fund Secretariat website (http://www.fhb.gov.hk/grants). Researchers interested in the funds administered by the Food and Health Bureau also may visit the website for detailed information about application procedures.

Supplement co-editors

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Economic burden of diabetes related to excess body weight in Hong Kong

SM McGhee *, GN Thomas, CM Schooling, J Chau, LC Wong

KEY MESSAGES

1. Current health care costs for diabetes amount to around $2 billion per year, about half of which are related to overweight and obesity among adults.
2. Hong Kong may witness an increase in adult obesity in future, which is predicted to lead to an 8% rise in health care costs for diabetes and a 10% rise in deaths due to diabetes in those aged <65 years.
3. The model developed in this project can be used to predict impacts on deaths in persons aged <65 years, changes in life expectancy, years lived with diabetes, and health care costs for diabetes with changes in rates of excess weight in adults.

Hong Kong Med J 2014;20(Suppl 3):S5-7
HHSRF project number: 04060601

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Introduction

In Hong Kong, rates of obesity appear to be rising, with almost 20% of children at school in 2006 being classified as obese.[1] A local survey found 21% and 18% of adults to be obese and overweight, respectively.[2] The incidence of type-2 diabetes mellitus in adults is increasing. This has implications for mortality, quality of life, and cost of health care. A model predicting the impact of changes in rates of obesity on the costs of health care due to diabetes can be of use.

This study aimed to estimate the costs of diabetes in Hong Kong associated with excess body weight and the likely changes in these costs over time under differing assumptions. The objectives were to (1) estimate the current cost of treating diabetes and its main complications, (2) estimate the risk of diabetes with increasing weight, the risk of complications in those who have diabetes, and the current levels of increased weight in the local population, and (3) build a decision-tree-based Markov model to simulate the costs of diabetes in the Hong Kong population over future years under various rates of obesity over time.

Methods

This study was conducted from April 2007 to March 2008. Local information was used to estimate the prevalence of different levels of body weight by age-groups in both adults and children and to make assumptions about possible levels of adult obesity based on levels presently prevailing among children. The Asian cut-off levels for overweight (body mass index [BMI], ≥23) and obesity (BMI, ≥25) were used.[3] The estimates for overweight and obesity in adults were taken from the measured data recorded in the Population Health Survey in 2003/4[2] and for children from the data reported by the Department of Health.[1] Asia Pacific risks of mortality from specific causes were used,[4] overseas estimates for risks of developing diabetic complications[5] and local estimates for risk by body weight of developing diabetes.[6] The population attributable risk (PAR) method was used to calculate the number of deaths attributable to diabetes and its complications each year and the number of inpatient admissions. Survey data was used to identify the likelihood of extra outpatient consultations for those with diabetes. Local data on health care costs, the annual cost of diabetes and related complications were estimated, and a cost per case derived.

Applying the PAR method using the risk of developing diabetes for those who are overweight or obese and the prevalence of excess weight, the proportion of inpatient and outpatient use for diabetes attributable to increased weight was calculated. The average cost per case of diabetes and current and future levels of overweight in the Hong Kong population were used in a Markov model along with US estimates of the probability, based on BMI, of developing diabetes during their remaining lifetime to predict future health care costs of diabetes due to excess weight.[7]

Results

Using self-reported data on weight and height, the prevalence of overweight and obesity among adults has not increased markedly over the years from 2004 to 2007 except among men (Fig 1). In 2003/4, 18% and 21% of adults were overweight and obese, respectively.[2] The prevalence of obesity among

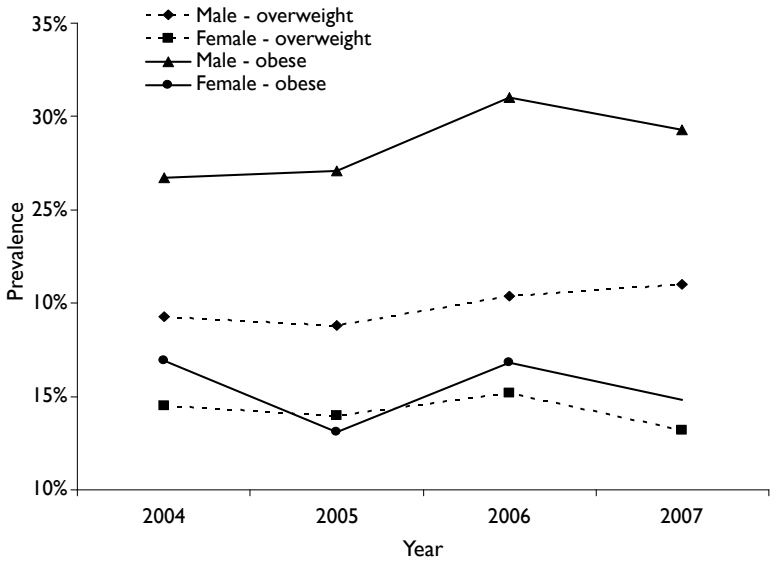

FIG 1. Prevalence of self-reported excess weight among adults, 2004-7
Source: Department of Health, Hong Kong[1]

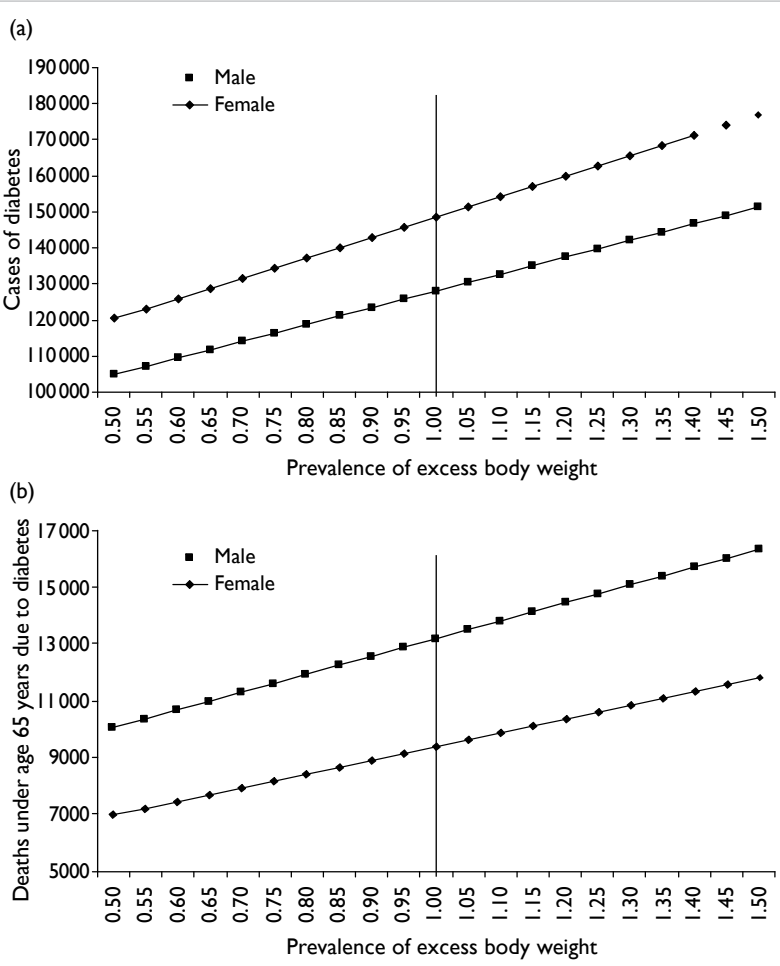

FIG 2. The number of people in one million who would (a) develop diabetes, and (b) die under the age of 65 years at specific prevalence of excess body weight relative to the present (1.00)

primary school children has increased from about 16% in 1997/1998 to 19% in 2005/2006, a rise of about 22%.

The Cardiovascular Risk Factor Study[6] showed that overweight subjects were 2.3 (95% confidence interval [CI]=1.5-3.4) times and obese subjects were 3.9 (95% CI=2.8-5.5) times more likely than those of normal or underweight to develop diabetes. Using the PAR approach, 1475 deaths (using those coded as due to diabetes or its complications) to 1648 deaths (using all-cause mortality) were estimated to be attributed to diabetes each year. The cost of health care for those with diabetes was HK$2.1 billion in 2006, of which $1.8 billion was for inpatient care and the rest for outpatient care. The average annual cost per case was about $5000 for those under 65 years and $14 000 for those ≥65 years. Of these costs, around half could be attributed to diabetes in those with excess body weight.

If we model the 2006 population of 5 653 000 inhabitants aged over 18 years, around 1.6 million cases of diabetes are expected during the cohort's lifetime, ie a lifetime risk of 28% on average. Of these cases, almost 600 000 (37%) would be among those of normal or underweight, whereas 300 000 (20%) and 700 000 (42%) among the overweight and obese people. Those with excess body weight would have diabetes at a younger age than those with normal weight. About 127 690 (8%) of the inhabitants would die before the age of 65 years and about half of these would be from the obese group.

Of the $396 billion diabetes-attributable health care costs over the lifetime of this cohort, $139 billion (35%) would be spent on those of normal weight, whereas $81 billion (20%) and $177 billion (45%) on those who are overweight and obese, respectively. On average, for each person with diabetes, $237 521 would be spent over their lifetime if he/she is of normal weight, and $14 309 and $30 890 more if he/she is overweight and obese, respectively.

On average, 13 years (for men) and 16 years (for women) from a life expectancy of 78 years and 84 years, respectively, would be spent with diabetes. For those with diabetes who are overweight the average duration of diabetes is 23 years (for men) and 26 years (for women), and for those who are obese, the respective estimates are 25 and 30 years.

This model was used to estimate the total lifetime costs for the population with an alternative scenario that the rates of adult obesity would rise by about 20%, as a result of an increase in obesity rates in primary school children 10 years previously. This would result in a 7% increase in the number of cases of diabetes (from 1.57 to 1.66 million), a 10% increase in the number of deaths under 65 years (from 128 000 to 140 000), and an 8% increase in the health care costs (from $396 to $430 billion) [Figs 2 and 3]. The impact of the current level of overweight

is shown by the vertical line from the prevalence of 1.00 in the middle of the chart, and an increase or decrease in prevalence is reflected by moving to the right or left of this point along the horizontal axis. For example, the impact of a rise in obesity rates of 50% would be indicated by a vertical line from the prevalence of 1.50.

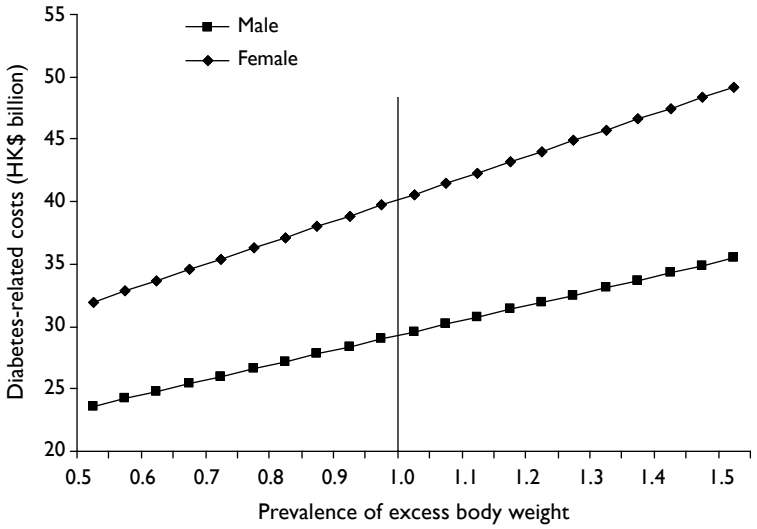

FIG 3. The costs of health care for diabetes in a population of one million at specific prevalence of excess body weight relative to the present (1.00)

Conclusions

Diabetes is a chronic disease which results in around 1500 deaths and health care costs of about $2 billion per year in Hong Kong. Around half of this cost, $1 billion, is related to excess body weight, and some of this is potentially avoidable with improved lifestyle and prevention of excess weight gain. There is no evidence that rates of obesity in adults are rising, but the rates in children are rising with an increase of 22% and 23% in primary and secondary schoolchildren over the 10 years to 2006. If a future rise of about 20% in adult obesity is estimated, a rise of about 8% in health care costs and 10% in deaths in those aged under 65 years are expected. This model can be used to determine the impact on deaths in persons aged under 65 years, life expectancy, years spent with diabetes, and health care costs with changes in rates of overweight/obesity or the impact of interventions to stem such an increase.

Acknowledgement

This study was supported by the Health and Health Services Research Fund, Food and Health Bureau, Hong Kong SAR Government (#04060601).

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Neuroeconomics of health care financing options: willingness to pay and save

H Leung *, H Mak, M Leung, KL Leung, P Kwan, KS Wong

KEY MESSAGES

1. Voluntary health care insurance plans and savings schemes are potential means of reforming the health care financing structure.
2. Willingness-to-pay and willingness-to-save are notions which may be explored by behavioural theories.
3. Willingness-to-pay may be higher in low-risk insurance plans and lower in high-risk plans.
4. Willingness-to-save may not necessarily be lower in longer saving plans but may be lower in high-amount saving plans.
5. Neuroeconomics revealed that the Prospect Theory may explain the skewing in willingness-to-pay, whereas the Hyperbolic Discounting Theory may explain factors determining willingness-to-save partially.

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Introduction

In Hong Kong, the health care financing structure consists of a publicly funded service (for in-patient care, complex, and referred cases) and a privately funded service (for family medicine and a smaller proportion of hospital care). This financing structure may not be sustainable in the future if the provision of funding is purely from public funds, owing to the ageing population and the rising cost of new diagnostic methods, treatment and drugs. Health care insurance plans and savings schemes have been explored by the Government in terms of willingness-to-pay in health care insurance plans and willingness-to-save in savings schemes by means of behavioural theories.[1-3] The Prospect Theory states that willingness-to-pay may not be linear across different options of risk and probability. Some options of gain may be preferred over others even if they are mathematically the same. The Hyperbolic Discounting Theory states that the notion of deferred gain may be considered with less importance compared with an immediate gain. Therefore, in two options with the same statistical risk, the one with a closer time-point of gain may be chosen over the other. These theories can be translated into the setting of health care financing.

We used neuroeconomics (scans of the brain during thoughtful processes to register areas of activation) to explore willingness-to-pay in insurance plans and willingness-to-save in savings schemes and whether the two behavioural theories could explain these economic phenomena. Activation of brain areas in a distributed network of the frontal cortex may correspond to the perceived 'risk centres' or 'emotional centres' of the brain.[4,5] By eliciting activations in a neuroeconomic study the validity of behavioural theories can be verified.

Methods

This study was conducted from May 2009 to August 2010. The first part was a field survey using an online health care financing questionnaire. The second and third parts were neuroeconomic studies of four health care insurance plans and four health care savings schemes. Scanning using magnetic resonance imaging (MRI) enabled visualisation of brain functions and identification of 'risk centres' or 'emotional centres', which may help understand whether the behavioural theories were at work. The first, second, and third parts of the study recruited 208, 21, and 21 participants, respectively.

Referring to the four insurance plans, package 1 covered rare but important illnesses (1/500 chance, with a treatment cost of HK$5000/year); package 2 covered treatable common illnesses (1/60 chance, with a treatment cost of HK$6000/year); package 3 was a disaster plan (1/600 chance, with a treatment cost of HK$120 000/year); and package 4 covered categorical chronic illnesses (1/50 chance, with a treatment cost of HK$150 000/year).

Referring to the four savings schemes, package 5 involved expected dependency and early saving.

The participant starts saving from the age of 25 to 65 years, and thereafter a dependency period of 10 years is assumed. The participant needs to save HK$5.29 million over 40 years. Package 6 involved less dependency and early saving. The participant starts saving from the age of 25 to 75 years, and thereafter a dependency period of only 5 years is assumed. The participant needs to save HK$3.37 million over 45 years. Package 7 involved expected dependency and late saving. The participant starts saving from the age of 45 to 65 years, and thereafter a dependency period of 10 years is assumed. The participant needs to save HK$1.99 million over 20 years. Package 8 involved less dependency and late saving. The participant starts saving from the age of 45 to 70 years, and thereafter a dependency period of 5 years is assumed. The participant saves HK$1.27 million over 25 years.

Results

For packages 1, 2, and 3, the anticipated amounts of money that people might pay were HK$10, HK$100, and HK$200, respectively. Yet the field survey found that people were willing to pay HK$43.4, HK$145.4, and HK$295, respectively (Fig). For package 4, the anticipated amount of money that people might pay was HK$3000, but participants were only willing to pay HK$2580. In the neuroeconomic study comparing the signalling of areas during thought processes for a low-value plan with that of a high-value plan, an area of activation in the lateral frontal region confirmed the same distributed network of 'risk centre' or 'emotional centre', which the Prospect Theory predicted (Table 1).

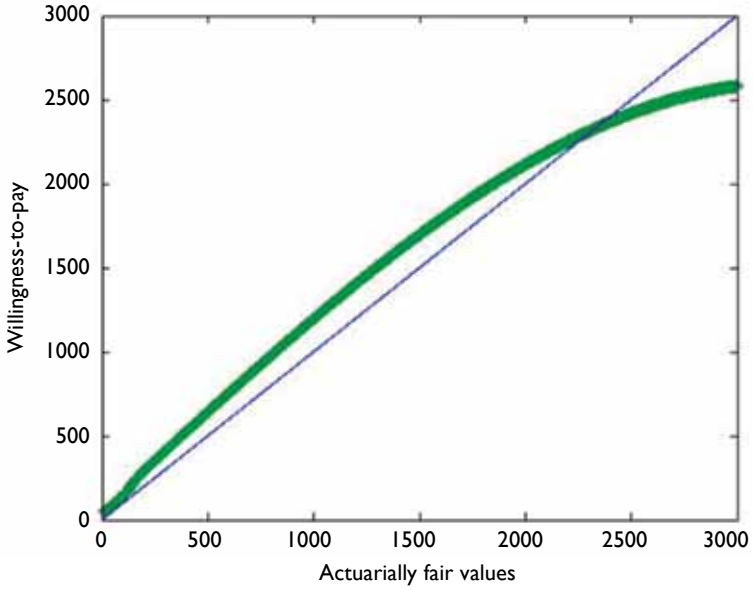
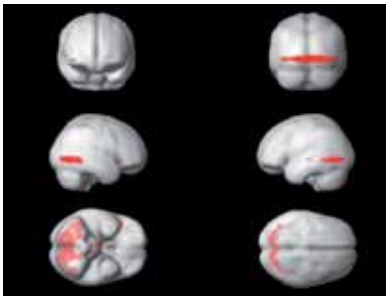


FIG. Plot of willingness-to-pay versus anticipated values

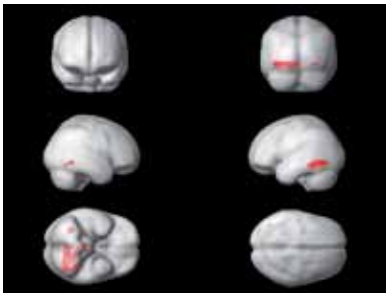
TABLE 1. Areas of activation (right inferior frontal region) in analysis of simulation of package 1 (low actuarially fair value) versus package 4 (high actuarially fair value)



Brain region	Brodmann's area	Coordinates			Z score (2-sample *t*-test)
		x	y	z	
Right frontal lobe	47	50	17	-4	3.62*
Left occipital lobe	19	-25	-88	8	4.51
Right occipital lobe	18	27	-90	10	4.68

* P<0.05 corrected, all other regions are P<0.001 uncorrected

TABLE 2. Areas of activation (left posterior temporal region and left pre-frontal region) in analysis of simulation of package 6 (low actuarially fair value) versus package 7 (high actuarially fair value)



Brain region	Brodmann's area	Coordinates			Z score (2-sample *t*-test)
		x	y	z	
Right occipital lobe	17	45	-66	-3	4.17
Left occipital lobe	18	-32	-93	-8	4.01
Left posterior temporal region	21	-63	-53	4	3.25*
Left prefrontal region	45	-56	27	1	3.02*

* P<0.05 corrected, all other regions are P<0.001 uncorrected

For packages 5 and 7, the premiums that people were expected to save were HK$1564 and HK$3132, respectively. However, the field survey found that people were only willing to save for premiums of HK$1243 and HK$2344, respectively. For packages 6 and 8, people were expected to save with premiums of HK$695 and HK$1251. Yet the participants were willing to save with HK$836 and HK$1493, respectively. In the neuroeconomic study comparing the signalling of areas during thought processes for a low-saving-amount scheme with that of a high-saving-amount scheme, an area of activation in the frontal region also pointed towards the same distributed network of 'risk centre' or 'emotional centre' (Table 2). However, when we compared the signalling during thought processes for paradigm of short-saving durations versus long-saving durations, no significant activation was found. This suggested that the Hyperbolic Discounting Theory does not explain our phenomena in its entirety, at least not with our neuroeconomic analysis.

Discussion

The synthesis of different insurance packages can produce a skewing effect for willingness-to-pay. This is called adverse selection, in which only people at risk are willing to insure. Providing insurance plans may 'activate' their risk or emotional centres, an effect which might potentially offset this phenomenon can be potentially achieved. From a more realistic point of view, packages such as those for chronic illness might also require subsidy.

As regards to saving schemes, there were some opposing forces between the monetary value and the duration of the saving scheme. The longer-duration plans were not necessarily undervalued, and participants may still be inclined to take out such schemes. However, the lack of risk or emotional centres activation when comparing the longer- with the shorter-duration schemes did not support the hyperbolic discounting effect in its entirety. Instead, the same effect when comparing the monetary values of the saving amounts indicated that the saving value per se can trigger the emotional centre.

The results of this project are referenced from a behavioural economist's point of view, and should always be interpreted together with actuarial studies of health care projects.

Acknowledgements

This study was supported by the Health and Health Services Research Fund, Food and Health Bureau, Hong Kong SAR Government (#06070461). We thank the Department of Diagnostic Radiology of The University of Hong Kong, the Department of Medicine and Therapeutics and the School of Public Health and Primary Care of The Chinese University of Hong Kong, and Dr Ka Lau Leung.

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Pedometry and 'peer support' in older Chinese adults: a 12-month cluster randomised controlled trial

GN Thomas *, DJ Macfarlane, B Guo, BMY Cheung, SM McGhee, KL Chou, JJ Deeks, TH Lam, B Tomlinson

KEY MESSAGES

1. Use of pedometers and motivation from friends significantly increased physical activity and fitness levels in older subjects.
2. These interventions significantly improved psychosocial parameters, but had minimal effects on vascular risk factors.
3. Further work is needed to find alternative or additional means to modify the behaviour of approximately 50% of subjects who did not increase their physical activity levels.

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Abstract

There is a need to increase physical activity to attenuate age-related morbidity. This 12-month factorial design cluster trial randomised 399 volunteers from 24 centres to buddy peer support, pedometry, or control group. Data were anayssed using last-observation carried-forward and intention-to-treat methods. Compared to the controls, participants in the pedometry group increased their levels of physical activity energy expenditure significantly, as did those in the buddy group. As recorded by the International Physical Activity Questionnaire [IPAQ], the respective increases amounted to 1820 (95% confidence interval [CI], 1360-2290) and 1260 (95% CI, 780-17 460) metabolic equivalent of task (MET).min.wk^{-1}. The buddy group also had significantly improved aerobic fitness after adjustment for body weight (12%; 95% CI, 4-21%), but this did not attain significance in the pedometry group (7%; 95% CI, -1 to 15%). Our results suggest that recourse to pedometers and the buddy peer support system is simple means of increasing physical activity in older subjects.

Introduction

Population ageing is associated with a high burden of physical and mental problems, which have major social and economic consequences. Epidemiological and clinical intervention studies have shown the benefits of exercise on health.[1-4] However, high levels of inactivity were noted in Hong Kong (over 30-40% in the older population).[3,5-7] In a population-based study in 1995, 25% of elderly (aged 65-74 years) Hong Kong subjects had type-2 diabetes, 53% had hypertension, and 64% had dyslipidaemia.[5,6] Physical activity programmes that improve weight loss and related metabolic parameters have shown benefits in terms of clinically relevant surrogate markers of health.[1,8-11]

Population-based exercise intervention studies should be simple, cheap, and of low maintenance.[1] Formation of small peer support groups and provision of pedometers as motivational tools are two examples. This report provides a summary of a study assessing the usefulness of these interventions in improving physical activity and fitness in an older Chinese population.

Methods

This 12-month cluster randomised controlled study aimed to evaluate the effects of providing a pedometer, and participation in a 'buddy-style' peer support programme on physical fitness and activity and cardiovascular risk factors (anthropometry and blood pressure). The main outcome measures were changes in physical activity measured by the IPAQ[12] and fitness levels. It conformed with the Declaration of Helsinki and was approved by the University of Hong Kong's Ethics Committee. All participants were given opportunities to ask questions regarding the study and gave written informed consent. The study was registered with the University of Hong Kong Clinical Trials Register.

The IPAQ had been validated in the local

population.[12,13] Anthropometric, socioeconomic, lifestyle details, personal and family medical histories were recorded. A submaximal Astrand cycle exercise test was used to assess aerobic fitness in a subgroup of 226 (56.6%) capable subjects. A number of standard tests were performed to assess physical ability. A get-up-and-go test (time taken for the subject to get up from a chair walk 2.5 m, round a marker and return) and a 30-second chair stand test (number of times a person can stand and sit in 30 seconds) were used to measure lower body strength, whereas a 30-second arm curl test (number of arm curls in 30 seconds) was used to measure arm strength.[14] Two maximal effort isometric lower body strength (hip flexion, knee extension) tests were also performed.

There were 412 eligible volunteers identified from 24 community centres for older persons, which provide social and recreational day services for its members. The participants recruited from these centres were: (1) aged ≥60 years, (2) planning to stay in their current residence over the next year, (3) having no recent cardiovascular disease history, and (4) physically capable of participating.

At the baseline visit, all participants in the intervention arms received group-based face-to-face counselling and advice on how to increase energy expenditure via integration of physical activities into their daily routines, and basic strategies for starting (ie start slowly and to work the exercise into the daily routine). They received a contact telephone number for our staff in case they experienced any problems or required additional information regarding the implementation of their intervention. Subjects at those centres randomised to the buddy peer support system were given instructions on how to enlist support and walking partners, such as joining a walking group or with other participants from the same centre. Each participant was asked to reach the daily recommendations from the American College of Sports Medicine/Centers for Disease Control for moderate physical activity; at the start of the study the recommendations were 30 minutes, 3 to 5 times a week with a partner.[1] The participants receiving the pedometers were asked to increase the daily number of steps they took by at least 3500, which has been reported to correlate with the energy expenditure taken during 30 minutes of moderate physical activity.[15]

The subjects in the intervention groups received monthly telephone calls for the first 6 months of the 12-month intervention informing them of the details of the monthly meetings, where feedback from their physical activity diaries was provided and walking goals set for the subsequent month. Motivational meetings were also provided at which staff reinforced the earlier counselling and assisted participants in overcoming hurdles that might have arisen while implementing their targeted activity. The subjects in the control groups received no intervention and were not approached until the completion of the study.

For the main outcome of IPAQ, intraclass correlations (ICC) of between 0.05 and 0.10 were considered, with a median centre size of 17. A study of 400 evaluable participants would have more than 80% power to detect differences with effect sizes of 0.4 (if ICC=0.05) and 0.5 (if ICC=0.1) at the 5% significance level, and takes into account an expected drop out rate of 15%. These effect sizes corresponded to differences in IPAQ scores of 600 and 750 MET.min.wk^{-1} presuming an underlying standard deviation of 1500.

Results

Of the 412 volunteers identified, 399 (96.8%) agreed to participate. The consenting subjects were randomised to the buddy peer support group (12 centres with 10-23 participants per centre, n=193, 65.3% female; 92.2% completed the study) versus the control group (12 centres with 15-18 participants per centre, n=206, 67.0% female; 86.4% completed the study), as well as to the pedometry group (11 centres with 12-19 participants per centre, n=204, 63.2% female; 92.2% completed the study) versus the control group (13 centres with 10-23 participants per centre; n=195, 69.2% female; 86.4% completed the study). There were 43 subjects who did not complete the study owing to injury or sickness, travelling or moving away, loss of contact, or mostly refusal to continue (for no reason).

Data were analysed using the last-observation carried-forward and intention-to-treat methods. Compared to the controls, participants in the pedometry group significantly increased their levels of physical activity energy expenditure (as recorded by the IPAQ) by 1820 (95% CI, 1360-2290) MET.min.wk^{-1} (Table). Despite improvement in activity levels, aerobic fitness (as measured by predicted oxygen uptake) improved by 7% only (95% CI, -1 to 15%), after adjusting for body weight (P=0.10). No other improvements in cardiovascular risk factors or physical function were observed, with only a borderline significant reduction in the number of chair stands (P=0.05).

TABLE. Changes in physical activity (MET.min.wk^{-1}) for the pedometry and buddy interventions relative to controls (both P<0.001)

Intervention	Mean (95% CI) change in physical activity relative to controls (MET.min.wk^{-1})
Pedometry	1820 (1360-2290)
Buddy	1260 (780-17 460)

Compared to the controls, participants in the buddy group significantly increased their levels of physical activity energy expenditure by 1260 (95% CI, 780-17 460) MET.min.wk^{-1} (Table). The improvements in physical activity paralleled with positive changes in aerobic fitness after adjusting for body weight (12%; 95% CI, 4-21%). However, these significant changes only resulted in a small reduction in percentage body fat (-0.6%; 95% CI, -1.1 to -0.0%), with a significant reduction in the duration required to complete the 2.5-m get-up-and-go (-0.3 s; 95% CI, -0.05 to -0.0 s). The combination of motivational tools was no better than the individual interventions.

Discussion

In the older Hong Kong Chinese population, both the pedometry and buddy peer support interventions significantly increased the mean amount of physical activity. The latter intervention also improved aerobic fitness levels. Despite this, there were only limited improvements in the cardiovascular risk factors, with only the buddy group showing reduced body fat and time required to complete the 2.5-m get-up-and-go test. This is likely due to only a small proportion (7-8%) reaching the activity target, with about half showing a positive increase in activity levels. In part this may have been due to relatively high baseline activity levels to start with. Even the low and medium activity groups were achieving a mean of 7405 (95% CI, 6736-8140) steps.d^{-1} and the high activity group a mean of 9806 (95% CI, 8915-10 787) steps.d^{-1}. For persons aged >60 years, these levels of daily step counts appear high by international standards, where 6500 is considered common,[16] with 53% (the low/moderate fit) of our Hong Kong subjects averaging nearly 1000 more than this, and 48% in the high activity group achieving over 3000 more. However, these results were consistent with other studies,[17,18] and was likely due to the 'very high walkability' in the Hong Kong environment.[19]

Few studies have reported the impact of changes in physical activity as measured by the IPAQ on anthropometric measures and related vascular risk factors.[20] Such changes in exercise level measured by other instruments are associated with attenuation of age-related decline in many physical and psychological functions.[2,11,21,22] Meta-analyses evaluating the effects of physical activity or fitness on vascular disease involving 2.5 million person-years of observation have shown a clear inverse dose-response relationship between physical activity or fitness and vascular disease risk; active or fit subjects reduce their vascular disease risk by 30 to 50%, compared to corresponding sedentary or unfit persons.[2,10] This suggests that the increase in physical activity in both our pedometry and buddy groups as well as improved aerobic fitness in the buddy group may have a significant long-term beneficial impact on both all-cause and vascular disease mortality. However, given the lack of a significant improvement in the cardiovascular disease risk factors, larger studies, perhaps with additional risk factors or endpoints are necessary to confirm this assumption.

Recourse to pedometers and the buddy peer support system is a simple means of increasing physical activity in older subjects and targeting obesity and age-related complications. Further research is needed to find alternative or additional means to modify the behaviour of the approximately 50% of the subjects who did not increase their physical activity levels. The reproducibility and long-term maintenance of the improvements in these surrogate risk factors and their subsequent impact on vascular disease morbidity and mortality should also be assessed.

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Effect of motivational interviewing on the clinical and psychological outcomes and health-related quality of life of cardiac rehabilitation patients with poor motivation

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KEY MESSAGES

1. The low compliance rate and high dropout rate in traditional cardiac rehabilitation programme reflect the challenges to patients in maintaining a healthy lifestyle to prevent heart disease.
2. Motivational interviewing is effective in cardiac rehabilitation by increasing physical activity level of patients at 5 months, and reducing stress and dietary fat intake at 12 weeks.
3. Motivational interviewing did not significantly improve clinical and psychological outcomes of patients, but showed benefits in terms of the bodily pain subscale, general health subscale, and role emotional subscale of health-related quality-of-life outcomes.
4. Patients attending the cardiac rehabilitation programme demonstrated short-term (3-month) and long-term (12-month) improvements in clinical outcomes (exercise capacity, total cholesterol level, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, triglyceride), psychological (anxiety and depression) and quality of life (all subscales of the SF-36) outcomes.

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Introduction

Hypertension, smoking, obesity, and abnormal lipid concentrations are all modifiable risk factors for coronary heart disease. The modification can be achieved through cardiac rehabilitation (CR). The benefits of CR include improvements in functional abilities and reductions in symptoms, and reductions in cardiovascular mortality, morbidity, and coronary risk factors.[1] These benefits are dependent on programme participation and long-term adherence to exercise, and behavioural changes. The low compliance rate and high dropout rate in traditional CR reflect the challenges to patients in maintaining a healthy lifestyle.

Motivational interviewing (MI) is effective in promoting behavioural changes in patients with substance abuse and smoking.[2,3] It is effective in CR by increasing physical activity level of patients at 5 months,[4] and reducing stress and dietary fat intake at 12 weeks.[5]

Methods

This study was conducted from November 2007 to April 2010. It investigated the effects of MI on clinical and psychological outcomes, as well as health-related quality of life on poorly motivated cardiac patients receiving CR, using a randomised controlled trial. A total of 146 cardiac patients with low motivation attending a CR programme were randomised into a control or intervention group. Controls received usual CR care and the intervention group received usual care plus 10 sessions (each lasting 30 to 45 minutes) of MI (in weeks 1, 3, 5, and 7, and then once per month till 6 months, and then once at 9 and 12 months).

The MI interventions were delivered by trained research nurses. The interventions matched with the patient's stage of change. For participants in the action or maintenance stage, MI was used to strengthen the commitment to behavioural changes and for those who were in the precontemplation, contemplation, and preparation stage, MI focused on building motivation for change. Three initial MI sessions and one session per month for the following 4 months were supervised by the principal investigator together with co-investigators (the clinical psychologist, and the mental health nurse)

to ensure consistency and appropriateness. In order to blind the group allocation, data were collected by another research assistant.

Clinical outcomes included blood pressure, body mass index, total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, triglyceride, metabolic equivalent, tobacco use, drug compliance, readmission rate, and dropout rate. Psychological outcomes were depression and anxiety levels (measured by the Hospital Anxiety and Depression Scale), self-efficacy (measured by the General Self-efficacy Scale), and health-related quality of life (measured by the SF-36 Health Survey).

Data were collected at the beginning of the CR programme and months 3, 6, 9, and 12. Readmission

TABLE 1. Baseline characteristics among those who completed the study (n=116)*

Characteristic	All (n=116)	Control (n=64)	Intervention (n=52)	P value†
Age (years)	66.6 (9.9)	66.2 (11.0)	67.2 (8.5)	0.609
Body weight (kg)	64.3 (11.9)	64.1 (13.1)	64.4 (10.3)	0.895
Body height (cm)	158.5 (8.7)	158.1 (9.3)	158.9 (8.0)	0.594
Body mass index (kg/m^2)	25.6 (4.1)	25.7 (4.3)	25.5 (3.8)	0.804
Sex				0.178
Female	35 (30.2%)	16 (25.0%)	19 (36.5%)	
Male	81 (69.8%)	48 (75.0%)	33 (63.5%)	
Education level				0.549
No formal education	15 (13.2%)	9 (14.1%)	6 (12.0%)	
Primary	42 (36.8%)	20 (31.3%)	22 (44.0%)	
Secondary	38 (33.3%)	24 (37.5%)	14 (28.0%)	
College or above	19 (16.7%)	11 (17.2%)	8 (16.0%)	
Marital status				0.418
Single/divorced/widowed	24 (20.7%)	15 (23.4%)	9 (17.3%)	
Married	92 (79.3%)	49 (76.6%)	43 (82.7%)	
Monthly family income (HK$)				0.045
<10 000	44 (38.6%)	21 (33.9%)	23 (44.2%)	
10 000-20 000	30 (26.3%)	13 (21.0%)	17 (32.7%)	
>20 000	40 (35.1%)	28 (45.2%)	12 (23.1%)	
Working status				0.509
Currently working	23 (19.8%)	15 (23.4%)	8 (15.4%)	
Unemployed	4 (3.4%)	3 (4.7%)	1 (1.9%)	
Retired	71 (61.2%)	38 (59.4%)	33 (63.5%)	
Housewife	18 (15.5%)	8 (12.5%)	10 (19.2%)	
Hypertension				0.448
No	40 (34.5%)	24 (37.5%)	16 (30.8%)	
Yes	76 (65.5%)	40 (62.5%)	36 (69.2%)	
Diabetes				0.157
No	75 (64.7%)	45 (70.3%)	30 (57.7%)	
Yes	41 (35.3%)	19 (29.7%)	22 (42.3%)	
Hypolipidaemia				0.911
No	24 (20.7%)	13 (20.3%)	11 (21.2%)	
Yes	92 (79.3%)	51 (79.7%)	41 (78.8%)	
Current smoker				0.999
No	108 (93.1%)	60 (93.8%)	48 (92.3%)	
Yes	8 (6.9%)	4 (6.3%)	4 (7.7%)	

* Data are presented as median (interquartile range) or frequency (%)

† Categorical and continuous variables were compared using Pearson Chi-square test and T-test, respectively, whereas Fisher's exact test was used for working status and current smoker statistics

and dropout rates were collected at 12 months. Patient satisfaction evaluation and two focus-group interviews were conducted at 6 months.

Results

A total of 116 subjects (64 controls and 52 in intervention group; 81 males) completed the study. Their median age was 66.6 (interquartile range, 9.9) years. The two groups did not differ significantly in terms of demographics (Table 1), nor did those who did and did not complete the study.

The two groups did not differ significantly in terms of readmission during the 12-month period (P=0.637) and cessation of smoking (P=0.429). There were more dropouts in the intervention than control group (21 vs 9, P=0.014). The control and intervention groups differed significantly across time in terms of exercise capacity (measured by metabolic equivalent of task) [3.7 vs 4.1, P=0.04] and bodily pain subscale (81 vs 69.5, P=0.022) and vitality subscale (60.3 vs 53.8, P=0.031) of the SF-36. In both groups, metabolic equivalent of task values, total cholesterol, and low-density lipoprotein cholesterol levels improved significantly at 3, 6, 9, and 12 months. High-density lipoprotein cholesterol and triglyceride improved significantly only at 9 and 12 months. Similarly, all participants had significant improvements in anxiety, depression, and subscales in SF-36 across time.

The intervention group had significantly better results in the bodily pain subscale at 6, 9, and 12 months, the general health subscale at 3 months, and

TABLE 2. Generalised estimation equation models for comparison of the repeated measures outcome variables between the two groups

Variable	All (n=116)	Control (n=64)	Intervention (n=52)	P value
Bodily pain subscale score				
Group	-10.58	-19.65	-1.50	0.022
Month 3	6.84	0.86	12.83	0.025
Month 6	7.78	2.92	12.65	0.002
Month 9	8.13	3.30	12.96	0.001
Month 12	5.93	0.10	11.75	0.046
Group*Month 3	8.77	-0.92	18.47	0.076
Group*Month 6	10.25	1.18	19.33	0.027
Group*Month 9	9.62	0.48	18.75	0.039
Group*Month 12	11.66	2.03	21.30	0.018
General health subscale score				
Group	1.04	-5.40	7.49	0.751
Month 3	1.27	-2.62	5.17	0.522
Month 6	4.87	1.14	8.61	0.010
Month 9	4.85	1.08	8.63	0.012
Month 12	4.49	0.28	8.71	0.037
Group*Month 3	5.98	0.77	11.19	0.025
Group*Month 6	2.30	-3.52	8.11	0.438
Group*Month 9	3.03	-3.11	9.18	0.334
Group*Month 12	5.12	-1.17	11.41	0.111
Role emotional subscale score				
Group	-3.01	-12.71	6.69	0.543
Month 3	4.46	-0.76	9.68	0.094
Month 6	7.57	2.37	12.77	0.004
Month 9	6.45	-0.28	13.17	0.060
Month 12	4.94	-2.58	12.45	0.198
Group*Month 3	10.93	2.13	19.73	0.015
Group*Month 6	8.14	-1.18	17.45	0.087
Group*Month 9	13.68	3.61	23.75	0.008
Group*Month 12	15.29	4.76	25.83	0.004

the role emotional subscale at 3, 9, and 12 months (Table 2). The satisfaction level of the control and intervention groups did not differ significantly (7.8 vs 8.0, t=–0.244, P=0.812). The five categories identified in the focus group interviews evaluating the CR and MI were: (1) physical constraints after development of the cardiac problem, (2) awareness of the factors affecting health, (3) motivation to change in order to maintain health, (4) the need of psychological support, and (5) the effectiveness of the programme to patients.

Discussion

In this study, there were significant differences between the two groups in terms of metabolic equivalent of task (at all four time intervals), triglyceride (at 9 months), bodily pain subscale (at 6, 9, and 12 months) general health subscale (at 3 months), and role emotional subscale (at 3, 9, and 12 months). For metabolic equivalent of task, the control group had a significantly lower value at baseline. Although participants in both groups had improved exercise capacity, the improvement was significantly higher in the interventional group in terms of the triglyceride level, bodily pain subscale, general health subscale, and role emotional subscale. The effects of MI could only be reflected by improvement in certain subscales of health-related quality of life. No definite improvement in clinical outcomes was noted.

The dropout rate was higher in the intervention than control group (29% vs 12.3%). The non-significant differences in other outcomes might be due to the dilution effect from this high dropout rate. To determine sample size for future studies, the effect sizes of similar outcomes of two cardiac MI studies and the present study were compared (Table 3). In view of the small effect sizes, a larger sample size is needed to provide a clear difference between participants in each group of trial.

Regarding qualitative input, all participants appreciated the CR programme, and participants from the intervention group appreciated the importance of changes and motivation to keep a healthy lifestyle, but this was not reflected by statistical results. The focus group interviews identified physical fatigue and weakness as the major causes of not showing up for scheduled sessions. Four (25%) of the potential participants could not attend the interview sessions due to work commitments. This implied that work commitments and/or unable to take time off hindered participation in CR programmes as well as the MI sessions. As observed by the research nurses, many participants also wanted to go home to fulfil their family roles immediately after the CR programme, instead of staying behind for MI sessions. This might be another reason for dropouts.

In view of the cost of the MI, its burden on patients, and its insignificant resultant benefits, this intervention is not recommended. However, the short-term and long-term effects of the CR programme on clinical, psychological and health-

TABLE 3. Comparisons of effect sizes of three motivational interviewing studies on cardiac patients

Outcome variables	Effect size		
	The present study	Brodie et al (2008)	Hardcastle et al (2008)
Body mass index	0.17	0.13	-
Systolic blood pressure	0.02	0.10	-
Diastolic blood pressure	0.03	0.17	-
Cholesterol level	0.09	0.10	-
High-density lipoprotein	0.02	0.05	-
Low-density lipoprotein	0.03	0.08	-
Triglycerides	0.31	0.01	-
SF-36			
General health perceptions	0.10	-	0.48
Physical functioning	0.21	-	0.56
Role limitations due to emotional problems	0.17	-	0.73
Bodily pain	0.27	-	0.52
Mental health	0.10	-	0.48
Vitality	0.07	-	0.86
Role limitation due to physical functioning	0.11	-	1.47
Social functioning	0.11	-	0.81

related quality of life were favourable, and should be recommended for all cardiac patients in Hong Kong. Extending the hours for CR service and using a buddy system may help reduce the dropout rate.

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Effectiveness of Tai Chi in maintenance of cognitive and functional abilities in mild cognitive impairment: a randomised controlled trial

LCW Lam *, WM Chan, TCY Kwok, HFK Chiu

KEY MESSAGES

1. Regular physical exercise may offer benefits for cognitive function in older Chinese.
2. Tai Chi may be associated with a better preservation of global functioning after 1 year.
3. Physical exercise should be considered as part of a public health strategy to promote cognitive health in older adults.

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Introduction

With increasing longevity, dementia care has become a major public health concern. At present, there is no drug therapy proven to delay preclinical cognitive deterioration. As progression of dementia is also related to lifestyle and physical factors, non-pharmacological interventions may have a role in modifying disease progression.[1] In a review for the neuroprotective effects of physical exercises, attenuation of age-related gray matter loss, increased hippocampal volume, and functional connectivity of neural networks have been identified.[2]

Practicing Tai Chi has been demonstrated to result in better cognitive function and less decline with age.[3] We therefore compared the effectiveness of Tai Chi with stretching-and-toning exercise in the preservation of cognitive and functional decline in Chinese older persons at risk of cognitive decline.

Methods

This study was conducted from December 2007 to March 2010. It was approved by the Survey and Behavioural Research Ethics Committee of the Chinese University of Hong Kong, the Joint CUHK-NTEC Clinical Research Ethics Committee, and the Ethics Committee of the Department of Health. Written informed consent was obtained from all subjects before commencement of training.

Subjects over 65 years old were recruited from social and residential homes for the elderly. They were considered at risk of cognitive decline if they had mild cognitive impairment (measured by a clinical dementia rating [CDR] of 0.5) or amnestic mild cognitive impairment. Each participating centre was considered as one unit. All subjects in a given centre were randomised to the intervention or control group, so as to avoid biases due to communication between subjects within the centre. The intervention group received training on '24-style Tai Chi' by a certified Tai Chi master. The complex patterns of movements entail higher cognitive demands in addition to physical exercise. The control group was trained with stretching and relaxation exercises developed by physiotherapists and conducted by an occupational therapist. The assessors were blinded to the randomisation status.

Intervention was conducted in two phases. In the induction phase, the instruction course spanned from 4 to 6 weeks. Instructors conducted regular weekly sessions at the training centres until participants were familiar with the exercise. In the maintenance phase, subjects were given a video CD of the exercise programme. The frequency of the intervention was ≥30 minutes per day and ≥3 days per week. The centre in-charge logged the extent of exercise adherence. Practice could be either in a group at the centres or at home. The Tai Chi masters provided refresher lessons every month until the 12th month to boost adherence and ensure correct performance of posture sequence.

Comprehensive cognitive, functional, and neuropsychiatric assessments were conducted at baseline, 2, 6, and 12 months, using the following assessment tools: (1) CDR to evaluate global severity of cognitive impairment. A CDR of ≥1 is defined as clinical dementia. (2) The Alzheimer's Disease Assessment Scale – Cognitive subscale is a standard cognitive test for evaluating efficacy in intervention trials for Alzheimer's disease. To screen for additional cognitive domains that are also impaired in very mild dementia and mild cognitive impairment, digit span, delay recall, category verbal fluency tests, and mini-mental state examination were also used.

(3) The Disability Assessment for Dementia (DAD) was used to assess everyday functioning sensitive to early deterioration in persons with dementia. The Cornell Scale for Depression in Dementia (CSDD) was used to assess depressive symptoms in persons with dementia. (4) The Chinese Neuropsychiatric Inventory (NPI) was used to assess neuropsychiatric symptoms. (5) The Berg Balance Scale (BBS) was used to assess balance abilities in the elderly. The test consists of 14 tasks common in everyday life. Any interaction effect between balance and cognitive function was assessed.

The primary outcome measure was the rate of 'conversion' to clinical dementia (CDR of ≥1) after one year of intervention. The changes in cognitive scores from baseline were considered as the cognitive outcome indicator. Functioning changes (as measured by the DAD) between groups were compared. Secondary outcome measures were: (1) the change in CSDD score at 1 year, (2) the change in NPI score at 1 year (prevalence of motivational mood symptoms such as depression, apathy, anxiety), and (3) the change in BBS.

Intention-to-treat analysis was carried out for all subjects who completed the baseline assessment. The mean efficacy parameters (CDR, CDR sum of boxes, cognitive test battery, DAD, NPI, CSDD, and BBS scores) for both groups were computed for each visit. Multilevel generalised linear modelling was used to account for the correlations from within subjects and within centres. Baseline differences between groups were evaluated using a two-level model with subjects at level 1 and centres at level 2. Changes of efficacy indicators from baseline to each follow-up and intervention differences were tested with a three-level model with occasions (time points) at level 1, subjects at level 2, and centres at level 3. The CDR outcome was dichotomised into mild cognitive impairment or dementia and analysed using the multilevel logistic model (binomial distribution and logit link function).

Results

Of 548 participants in the 38 centres screened, 171 were randomised into the intervention and 218 in the control groups (Table 1). At 1 year, 92 (53.8%) and 169 (77.5%) of the subjects completed assessment, respectively. Participants in the intervention group had a mean of 1.5 years more education (p=0.007). There were no differences in CDR, cognitive function, subjective complaints, neuropsychiatric symptoms and BBS between groups.

At 1 year, 4 (4.3%) and 28 (16.6%) of the respective participants were rated as dementia (after controlling for education) [Table 2]. Multilevel logistic regression (controlled for baseline differences in education) revealed that the intervention group had a lower risk of developing dementia at 1 year (odds ratio [OR]=0.28, 95% confidence interval [CI]=0.05-0.92, P=0.064). The change of CDR sum of boxes scores showed that the intervention group on average had a 21% better preservation (lower scores)

TABLE 1. Baseline characteristics of participating centres and individuals

Characteristic	Intervention group (n=171)	Control group (n=218)	P value (comparison of centre means)
No. of centres	19	19	
Mean (median) group size	7.8 (8)	9.5 (9)	1.12
No. of hostel:social centres	4:15	6:13	χ^2=0.46
Mean±SD participant age (years)	77.2±6.3	78.3±6.6	0.23
No. of males:females	46:125	46:172	0.37
Mean±SD educational level (years)	4.1±4.3	2.6±3.2	0.007
Mean±SD mini-mental state examination score	24.7±3.0	24.3±2.9	0.73
Mean±SD Alzheimer's Disease Assessment Scale – Cognitive subscale	12.7±4.9	14.2±5.7	0.18
Mean±SD category verbal fluency	31.6±7.2	29.5±6.9	0.12
Mean±SD 10-minute delayed recall	3.9±2.3	3.4±2.4	0.17
Mean±SD digit span (backward)	2.4±1.1	2.2±1.1	0.24
Mean±SD visual span (backward)	2.3±1.1	2.3±0.9	0.98
Mean±SD Berg Balance Scale	52.3±3.1	52.1±3.1	0.55
Mean±SD neuropsychiatric inventory score	1.2±2.4	1.3±2.2	0.31
Mean±SD Cornell depression score	0.8±1.6	0.8±1.8	0.42
Mean±SD clinical dementia rating sum of boxes	1.02±0.8	1.08±0.8	0.52

TABLE 2. Baseline and 1-year follow-up comparison of cognitive and functional profiles in the intervention and control groups

Outcome	Intervention group (n=96)		Control group (n=169)		Group difference at 1 year
	Baseline	1 year	Baseline	1 year	
Mean±SD mini-mental state examination score	25.1±3.0	25.4±3.3	24.4±2.9	24.2±3.4	>0.05
Mean±SD Alzheimer's Disease Assessment Scale – Cognitive subscale	12.0±4.8	10.4±4.7	14.1±5.6	12.7±5.8	>0.05
Mean±SD category verbal fluency	31.5±6.8	34.6±7.5	29.7±6.8	32.6±7.9	>0.05
Mean±SD 10-minute delay recall	4.1±2.2	4.9±2.3	3.6±2.5	4.0±2.3	>0.05
Mean±SD digit span (backward)	2.3±1.1	2.4±1.2	2.2±1.1	2.4±1.1	>0.05
Mean±SD visual span (backward)	2.2±1.1	2.7±1.0	2.3±0.8	2.4±0.8	>0.05
Mean±SD Berg Balance Scale	52.4±3.3	53.4±2.3	52.2±3.1	52.3±3.4	0.053
Mean±SD Cornell depression score	0.81±1.8	0.12±0.5	0.87±1.9	0.16±0.6	>0.05
Mean±SD neuropsychiatric inventory score	1.0±2.2	1.7±3.2	1.3±2.3	1.6±3.1	>0.05
Mean±SD disability assessment for dementia	92.1±8.3	95.8±6.5	93.3±5.7	94.3±8.2	>0.05
Mean±SD clinical dementia rating sum of boxes	1.02±0.8	0.89±0.97	1.08±0.77	1.58±1.37	0.038
No. of patients with dementia	0	0	4	28	0.064

than controls (multilevel Poisson model, beta=0.79, 95% CI=0.63-0.99, P=0.038). Group differences in DAD scores across time were not significant.

There was no significant change in mini-mental state examination scores in both groups (multilevel linear model, beta=0.40, 95% CI= –0.62-1.42), P=0.44). At 1 year, there were improvements in digit backward and visual backward spans, delayed recall, category verbal fluency test, and Alzheimer's Disease Assessment Scale – Cognitive subscale scores, but differences between groups were not significant. Postural balance was measured by BBS. The intervention group had borderline better performance with time (multilevel Poisson model, P=0.053).

There were no significant changes in NPI scores across time, with a trend for lower CSDD scores from baseline to the third follow-up in both groups. The intervention group had 23% lower scores than the control group, but the difference was not significant (multilevel Poisson model, beta=0.98, 95% CI= 0.53-1.12, P=0.176).

Discussion

In the intervention group, lower overall CDR and sum of boxes scores across the study period suggested that Tai Chi may help preserve cognitive abilities. The effect sizes of exercise intervention are likely to be modest, so more sensitive outcome indicator than crude dementia conversion rates are required.

Both groups demonstrated improvements in cognitive test performance at 1 year. While practice effects may help enhance cognitive test scores with time, exercise intervention may have cognitive-stimulating effects resulting in better cognition. Physical activity was significantly protective against cognitive decline.[4] There was a need to explore factors that may modulate global functioning. The intervention group demonstrated a trend towards better functional preservation and postural balance. It was possible that the balance training in Tai Chi provided additional stimulation of the central nervous system. The integrated approach on motor coordination may offer benefits in overall functioning in addition to cognitive enhancement.

The results need to be interpreted in the context of the limitations of the study. An active control group of stretching and toning exercise was selected. The intervention group was better-educated and exhibited higher drop out rates. Interpretation of group differences in cognitive test scores should be considered after controlling for educational attainment. The high dropout rate in the intervention group reflected the need for adjuvant measures to boost adherence for high intensity programmes. The sample size was modest, which limited the power to detect subtle differences in cognitive function between groups. Also, the observation period was only 1 year. A longer follow-up may offer additional insights on the longer-term benefits of exercise.

Conclusions

In older adults at risk of cognitive decline, combined cognitive motor stimulation and balance training may help preserve global functioning. Further research is needed to substantiate the cognitive reserve hypothesis and its role in modifying clinical impairment in dementia.

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Stroke incidence and mortality trends in Hong Kong: implications for public health education efforts and health resource utilisation

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KEY MESSAGES

1. There has been a decline in age-standardised stroke incidence and case fatality between 1999 and 2007, the latter being less steep.
2. Health promotion efforts, improvement in socio-economic circumstances and hospital treatment may be contributing factors.
3. Although the incidence of stroke has declined, the continually ageing population, the static incidence of recurrent stroke, and the decline in case fatality will result in an increase in the absolute number of people with stroke, particularly among the elderly. Hence, declining incidence may not necessarily translate into a reduced demand for rehabilitation and long-term care services.
4. The higher incidence of stroke in men than women suggests that there is room for improvement in primary prevention in men.

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Introduction

Cerebrovascular disease is the second commonest cause of death and disease burden (measured as disability-adjusted life years) for persons aged 60+ years worldwide.[1] In Hong Kong, it is one of the three commonest causes of hospital admissions accounting for the largest number of hospital bed days, and is the commonest condition warranting long-term residential care. All these give rise to a considerable disease and disability burden.[2]

A review of stroke incidence and mortality trends with respect to age and gender may reflect the outcome of public health risk reduction initiatives: whether changes in incidence and mortality result in compression of morbidity or an increase in disease and disability burden, and whether the disease occurs in successively older age groups, particularly in older women. These data provide information for predicting health and social care resource required for cerebrovascular disease in future years.

Methods

This study was conducted from December 2008 to November 2009. The database of the Clinical Management System of all hospitals of the Hospital Authority was used. The ICD code 430-8 covering all strokes (ischaemic or haemorrhagic) was used. If the date of admission was within 30 days from last discharge, it was counted as one episode. Admissions after 30 days were considered a new episode. To distinguish a new stroke from recurrent or old stroke, the first year in which the diagnosis was made was considered as new (first episode) stroke. The same patient (number) admitted with a diagnostic coding of ICD 430-7 (new stroke) in subsequent years were classified as recurrent strokes, whereas those with ICD 438 (late effect of cerebrovascular disease) were classified as old strokes.

The total number of new and recurrent stroke patients occurring each year from 1999 to 2007 and their linkage to death certificates until 31 May 2008 were recorded. Age-specific stroke incidences were calculated for the age-groups of 35-44, 45-54, 55-64, 65-74, 75-84, and ≥85 years using the gender and age-specific stroke cases as the numerators and age-specific population sizes from the Hong Kong Census and Statistics Department as the denominators. This was done for the overall population and separately by gender and calendar year.

The death of stroke patients was ascertained by matching the hospitalisation records and the death records of patients (including deaths outside hospitals) using the unique Hong Kong identity card number. Dates of death were used to code the 30-day, 60-day, and 365-day case fatality. The 30-day (90-day/365-day) case fatality was the proportion of stroke patients who died within 30 days (90 days/365 days) after onset of symptoms from the first admission date of the episode. For 365-day case fatality, data was truncated on 1 June 2007 because there was censored information, as the cohort was

followed up until 31 May 2008.

Age-standardised rates were also calculated by gender and calendar year to facilitate comparisons controlling for age. We used the direct method with the mid-2006 Hong Kong population to standardise trends in incidences, whereas the total number of episodes (all new and recurrent strokes) from 1999 to 2007 was used to standardise trends in case fatality.

Poisson and negative binomial regression models were used to estimate relative risks (RR), 95% confidence intervals (CI) and P values for comparisons between genders and calendar year (grouped as 1999-2001, 2002-2004, and 2005-2007) while controlling for age. Evidence for heterogeneity of the effect of age-groups and years for different genders was determined by including their pair-wise product terms (ie gender x age and gender x year) in addition to the individual variables in a Poisson regression model. We also used negative binomial regression (a generalisation of Poisson regression) if there was evidence of over dispersion of data (variance of outcome greater than the mean). A significance level of 0.05 was used.

Results

Trends of stroke incidence

Between 1999 and 2007, 166 355 stoke episodes (118 414 new, 33 736 recurrent, and 14 205 old) were identified among patients aged ≥35 years.

The age- and sex-specific crude incidences and age-standardised incidences of strokes (new, recurrent, and old) are shown in Table 1. The incidences for both males and females rose sharply with each decade of age. Age-specific rates in males were higher than those in females, except for males aged ≥85 years in 2002, 2003, and 2005 having new strokes, and males aged 35-44 years in 1999 and 2002, aged 75-84 years in 1999 and 2000, and aged ≥85 in 1999 and 2005 having old strokes. The age-standardised incidences were also generally higher in men than women, and the incidences of new stroke steadily decreased from 1999 to 2007 in both genders with an exception in 2004 for men. The rate ranged from 526.4 per 100 000 persons amongst men in 1999 to 353.5 in 2007 and from 440.1 per 100 000 persons amongst women in 1999 to 279.4 in 2007. However, such a downward trend was not apparent for recurrent and old stroke incidences.

Trends in the 30-day, 90-day and 365-day case fatality of stroke patients

Crude and standardised case fatality within 30, 90, and 365 days are summarised in Table 2. The rates were larger among the patients aged ≥75 years in both sexes. Age-standardised case fatality of strokes in females were slightly higher than those in males. From 1999 to 2007, within a month of hospital admission, the age-standardised case fatality were ~11% in men and ~13% in women; at 90 days they were ~14% in men and ~16% in women; at 365 days they were ~21% in men and ~23% in women. A decline of case fatality for stroke was noted only from 1999 to 2001 but not thereafter.

Regression models of incidence and case fatality for stroke patients

The RRs of stroke incidences by time period and comparison between women and men after adjusting for age are summarised in Table 3. During the study period, the RRs decreased significantly by 21% for new strokes, whereas for recurrent strokes, the RRs increased by 34%. This contradiction might be due to misclassification of recurrent strokes as new strokes (particularly in 1999-2001). When new and recurrent strokes were combined, the incidences decreased significantly over the years but the size of the effect was diminished to 13%. The adjusted RRs for the incidence for women versus men were dependent on age-group (test for interaction, P<0.0001). Although women had a lower incidence than men, the female-to-male RR gradually increased with age (for new and recurrent strokes combined, in those aged 55-64 years, RR=0.57, 95% CI=0.53-0.62; for those aged ≥85 years, RR=0.93, 95% CI=0.86-1.01). Similar results were also obtained for new and recurrent strokes.

With respect to case fatality, using the time period 1999-2001 as reference, the adjusted RRs of the two consecutive time periods of 30-, 90-, and 365-day case fatalities were also reduced by 5% (data not shown). Similar to the findings for incidence, the sex effect depended on age-group. Women aged 35-44 years had significantly lower case fatality than men (RR=0.78, 95% CI=0.64-0.96). For those aged 45-74 years, there was no significant difference between the genders. For those aged ≥75 years, women had a 7% to 16% higher 30-day case fatality than men. There was no significant interaction between sex and year in terms of age-adjusted incidence and case fatality.

Discussion

The declining incidence of new stroke over the 9-year period is compatible with observations among Caucasian populations in the UK[3] and Europeans in New Zealand.[4] The declining trend may be due to the success of primary prevention achieving reduction in cardiovascular risk factors.

The incidence of recurrent stroke did not follow the pattern for new stroke. Instead, there was a slight increasing trend, suggesting that either there was room for improvement in secondary prevention (use of warfarin and antiplatelet drugs,

TABLE 1. Crude and age-standardised rates (based on the mid-2006 Hong Kong population) of new, recurrent, and old strokes in Hong Kong, 1999-2007 (rate per 100 000)

Age group (years)	No. of strokes in female/male/both			
	1999	2000	2001	2002
New stroke				
35-44	21.3/40.6/30.7	22.6/38.8/30.4	19.3/36.0/27.2	20.1/41.0/29.9
45-54	104.0/146.3/125.9	96.7/130.5/114.1	88.6/123.9/106.6	86.3/133.7/110.2
55-64	337.5/548.0/450.9	310.0/511.9/418.5	301.2/457.9/385.2	266.5/462.3/370.4
65-74	937.3/1260.0/1097.9	842.4/1130.5/986.3	786.8/1054.2/920.7	738.2/1042.4/890.6
75-84	1949.6/2318.0/2104.2	1707.0/2020.4/1839.7	1539.2/1977.5/1725.3	1484.9/1817.7/1626.9
85+	3083.6/3411.0/3178.2	2661.5/2950.9/2747.3	2402.3/2449.0/2416.9	2217.2/2136.8/2192.0
Total (crude)	408.2/459.7/433.8	363.2/415.3/388.9	335.6/393.0/363.7	319.7/391.7/354.6
Total (age-adjusted)	440.1/526.4/481.5	391.9/470.7/429.8	359.9/437.8/397.2	338.8/426.0/380.6
Recurrent stroke				
35-44	1.6/4.2/2.9	3.9/7.2/5.5	4.5/6.3/5.4	4.9/5.2/5.0
45-54	5.3/11.7/8.6	16.9/20.0/18.5	17.1/20.3/18.7	14.5/20.3/17.4
55-64	30.8/50.1/41.2	51.9/106.6/81.3	57.3/111.5/86.4	50.4/117.9/86.3
65-74	99.2/159.0/128.9	196.3/268.5/232.4	208.4/295.4/252.0	202.9/313.2/258.2
75-84	243.9/285.4/261.3	410.7/530.6/461.4	452.5/615.5/521.7	469.2/641.3/542.6
85+	314.8/369.9/330.7	596.9/674.8/620.0	641.9/821.4/698.1	714.0/783.0/735.6
Total (crude)	43.4/51.9/47.6	80.4/95.0/87.6	87.5/107.0/97.1	89.2/113.3/100.9
Total (age-adjusted)	46.6/59.1/52.5	86.4/108.1/96.7	93.5/120.2/106.2	94.6/124.4/108.8
Old stroke				
35-44	1.2/0.6/0.9	0.7/1.1/0.9	1.0/2.3/1.6	2.5/2.4/2.4
45-54	4.8/6.1/5.5	2.9/6.6/4.8	4.2/9.5/6.9	9.8/12.9/11.4
55-64	16.5/31.9/24.8	14.3/31.3/23.4	24.0/38.2/31.6	35.8/69.4/53.6
65-74	77.0/102.8/89.8	62.9/83.3/73.1	80.1/123.2/101.7	132.8/189.6/161.3
75-84	239.8/216.9/230.2	205.4/200.9/203.5	258.7/308.8/279.9	357.2/460.9/401.5
85+	507.0/369.9/467.3	356.6/472.4/390.9	465.1/505.1/477.6	509.7/684.0/564.3
Total (crude)	42.0/35.1/38.6	33.6/33.3/33.4	44.2/48.2/46.2	63.3/74.9/68.9
Total (age-adjusted)	47.0/41.2/44.4	37.2/39.4/38.3	48.5/54.8/51.5	67.5/83.1/74.8

control of hypertension and diabetes), or that secondary prevention is less effective than primary prevention. A history of stroke is a strong risk factor for subsequent stroke.

There was a small decrease in case fatality over this period, which was less steep than that in incidence. It has been documented that acute stroke units reduce mortality and also subsequent dependency.[5] At the beginning of the study period, stroke units had just been set up in hospitals, and all patients would undergo computed tomography of the brain within a very short period, followed by drug or surgical consultation where appropriate. This development may have contributed to the decline in case fatality.

In terms of the trend of disease burden, the steeper decline in incidence than case fatality suggests that disease burden may follow a decreasing trend. However, this is counteracted by a slight increase in recurrent stroke, so that there is unlikely to be any marked change in the total disease burden from stroke.

Theoretically, although decline in incidence contributes to reducing the number of new strokes, the ageing population, the static incidence of recurrent strokes, and the decline in case fatality can result in an increase in the absolute number of people with stroke, particularly among the elderly. The higher incidence and lower case fatality in men than women suggests that the absolute number of older men with stroke may increase, which has implications for long-term care, in that male gender is one of the independent risk factors for opting for long-term care in an institution. Although the demand for

No. of strokes in female/male/both				
2003	**2004**	**2005**	**2006**	**2007**
22.6/39.8/30.5	21.8/38.4/29.4	24.0/39.0/30.7	22.1/40.6/30.3	23.9/43.4/32.4
78.6/130.7/104.7	89.7/146.4/117.9	81.6/131.8/106.5	83.5/129.8/106.4	84.5/136.4/110.0
236.6/405.6/325.7	240.7/429.6/339.5	223.3/386.4/307.9	213.2/376.0/296.8	200.2/363.3/283.2
646.1/911.8/779.7	641.3/994.6/819.2	625.9/887.9/757.9	584.1/869.1/728.1	582.6/827.7/706.6
1325.5/1597.8/1442.2	1354.6/1686.2/1496.8	1318.7/1560.0/1423.1	1259.4/1514.6/1370.8	1210.4/1405.2/1296.5
2317.3/2108.6/2253.1	2134.0/2285.7/2181.0	2126.3/2089.5/2114.9	1828.0/2014.0/1886.4	1852.7/2078.2/1923.4
298.3/358.0/327.1	302.4/392.1/345.4	298.0/364.2/329.5	283.8/364.6/322.1	283.7/360.9/320.1
313.0/382.5/346.3	312.8/410.6/359.3	303.7/373.3/336.7	283.8/364.6/322.1	279.4/353.5/314.4
2.7/6.5/4.4	5.2/8.7/6.8	5.1/7.0/5.9	5.0/7.8/6.2	3.6/8.9/5.9
15.1/19.9/17.5	18.3/29.0/23.6	16.1/26.2/21.1	17.4/27.2/22.3	15.0/24.1/19.5
50.9/108.9/81.5	50.9/103.4/78.4	53.0/108.3/81.7	48.8/102.2/76.2	57.0/102.5/80.2
189.4/309.9/249.9	203.0/360.5/282.3	192.4/337.7/265.5	205.2/341.8/274.2	214.3/333.6/274.7
490.7/640.0/554.7	552.0/723.9/625.7	510.5/770.0/622.7	484.2/640.4/552.4	508.5/667.7/578.9
636.5/773.8/678.7	769.8/949.6/825.5	764.9/809.3/778.7	741.2/859.6/778.4	753.0/928.3/808.0
87.9/113.9/100.5	100.7/133.1/116.2	97.2/133.5/114.5	97.5/129.2/112.5	102.6/133.6/117.2
92.0/122.4/106.4	104.1/139.7/120.9	99.2/137.3/117.2	97.5/129.2/112.5	100.9/130.5/115.0
1.4/3.9/2.6	2.0/3.8/2.8	1.4/3.1/2.2	1.7/3.8/2.6	3.3/3.5/3.4
6.5/14.7/10.6	5.9/9.9/7.9	7.9/11.5/9.7	6.3/9.4/7.8	7.4/12.2/9.8
25.6/50.4/38.7	21.5/35.1/28.6	13.7/33.1/23.7	17.0/34.8/26.1	17.7/28.9/23.4
73.7/150.1/112.1	65.1/111.4/88.4	49.3/76.6/63.0	58.5/101.9/80.4	64.7/99.8/82.5
222.3/327.8/267.5	165.8/212.1/185.6	134.0/158.3/144.5	148.6/187.3/165.5	144.4/195.5/167.0
481.9/574.7/510.4	305.7/424.4/342.4	278.9/260.7/273.3	249.2/315.8/270.1	260.4/358.3/291.1
43.7/60.1/51.6	33.8/43.3/38.4	28.6/34.0/31.2	30.7/40.8/35.5	32.9/42.5/37.4
46.5/64.9/55.2	35.2/45.6/40.1	29.3/35.0/32.0	30.7/40.8/35.5	32.4/41.5/36.7

services can be projected approximately based on an estimate of the absolute numbers of people with stroke, collection of more primary data regarding stroke outcome in various age-groups is needed to provide more accurate estimates. Efforts in primary prevention appear effective; strategies could be devised specifically for men, whereas the effectiveness of secondary prevention efforts could be reviewed.

One of the limitations of this study was that the category 'old stroke' may have been underestimated, as it might not be the primary diagnosis for admission, and therefore omitted, particularly when there were multiple morbidities. For example it is difficult to explain the apparent sharp peak in incidence of old stroke in 2002. In addition, owing to the definition of recurrent stroke used for the extraction of data, some recurrent strokes may have been misclassified as new strokes if the strokes occurred before 1 January 1999, and thus the reported incidence for recurrent stroke in the first few years of the dataset was artificially low, whereas the reported incidence of new strokes in the first few years was artificially high. Misclassification of new and recurrent strokes may partly explain the decreasing trend in new strokes and the increasing trend in recurrent strokes. These were inherent limitations affecting the analyses of secondary datasets.

Conclusions

There was a decline in both age-standardised stroke incidence (new and recurrent combined) and case fatality between 1999 and 2007, the latter decline being less steep. This may be due to health promotion efforts and improvement in socio-

TABLE 2. Crude and age-standardised fatality for stroke within 30, 90, and 365 days of onset in Hong Kong during 1999-2007 (rate per 100)

Age group (years)	No. of stroke fatalities in female/male/both								
	1999	2000	2001	2002	2003	2004	2005	2006	2007
30-day fatality									
35-44	11.0/11.7/11.5	6.5/11.4/9.5	5.9/10.9/9.0	7.8/9.9/9.1	11.6/11.9/11.8	5.7/8.2/7.2	9.8/10.2/10.0	7.9/10.1/9.2	8.9/11.4/10.4
45-54	8.4/9.5/9.1	7.7/9.4/8.7	6.5/8.8/7.8	9.3/8.5/8.8	9.0/9.4/9.2	8.1/8.9/8.6	7.7/6.7/7.1	7.7/8.1/8.0	6.5/8.4/7.7
55-64	10.7/8.7/9.4	6.6/8.7/8.0	8.2/6.9/7.4	5.8/7.9/7.2	7.0/9.3/8.5	7.1/6.9/7.0	7.1/7.8/7.5	6.5/6.7/6.6	6.1/7.5/7.0
65-74	10.2/10.3/10.2	10.2/10.2/10.2	10.8/9.6/10.1	10.5/8.5/9.3	9.8/9.2/9.4	8.8/8.6/8.7	9.8/10.1/9.9	9.8/9.6/9.7	8.3/9.8/9.2
75-84	14.9/14.2/14.5	13.7/13.7/13.7	13.9/11.1/12.5	13.3/12.3/12.8	14.4/12.9/13.7	12.8/12.6/12.7	14.5/12.6/13.5	13.9/13.5/13.7	13.3/13.2/13.2
85+	22.7/19.4/21.7	23.6/19.1/22.1	17.6/16.4/17.2	19.1/17.8/18.7	24.4/20.3/23.1	19.4/17.0/18.6	20.5/16.6/19.3	19.6/18.2/19.2	21.0/18.1/20.0
Total (crude)	13.8/11.6/12.6	12.9/11.4/12.1	12.3/10.0/11.1	12.4/10.2/11.2	14.0/11.2/12.5	12.0/10.2/11.0	13.2/10.6/11.8	12.7/10.9/11.7	12.4/11.1/11.7
Total (age-adjusted)	14.1/11.8/12.9	13.3/11.6/12.4	12.5/10.1/11.2	12.4/10.3/11.3	13.8/11.2/12.5	11.9/10.1/10.9	13.0/10.6/11.7	12.6/10.8/11.6	12.1/10.9/11.5
90-day fatality									
35-44	11.0/12.8/12.1	8.1/12.0/10.5	5.9/12.4/9.9	7.8/11.6/10.1	12.7/12.6/12.7	6.7/8.2/7.6	10.7/10.2/10.4	7.9/10.1/9.2	10.5/12.5/11.7
45-54	9.9/11.1/10.6	8.7/10.2/9.6	7.5/9.5/8.7	9.9/10.0/10.0	10.2/10.5/10.4	9.1/10.1/9.7	8.6/7.4/7.9	8.4/8.8/8.6	7.5/9.2/8.5
55-64	12.0/10.4/11.0	8.1/10.1/9.5	9.1/8.1/8.5	7.3/9.0/8.4	8.4/10.5/9.8	8.5/8.7/8.6	8.0/9.0/8.6	7.8/8.5/8.2	7.2/8.8/8.2
65-74	12.6/12.9/12.8	12.5/12.7/12.6	13.2/12.0/12.5	12.9/11.0/11.8	11.6/11.6/11.6	10.8/11.4/11.2	12.0/12.6/12.3	11.3/11.7/11.6	10.8/12.1/11.6
75-84	19.5/18.6/19.1	17.8/17.7/17.8	17.9/15.1/16.5	17.2/16.9/17.1	19.1/17.5/18.3	16.5/16.9/16.7	18.1/16.9/17.5	17.2/17.3/17.2	16.8/17.6/17.2
85+	30.1/28.8/29.7	31.3/25.7/29.5	24.4/25.3/24.7	26.7/25.5/26.3	31.6/27.9/30.5	26.3/24.2/25.6	28.8/25.5/27.7	26.3/24.9/25.9	28.7/28.4/28.6
Total (crude)	17.5/14.9/16.1	16.5/14.2/15.3	15.7/13.0/14.3	16.0/13.3/14.5	17.8/14.3/15.9	15.4/13.3/14.3	16.9/13.7/15.2	15.8/13.6/14.6	16.1/14.4/15.2
Total (age-adjusted)	18.0/15.2/16.5	17.0/14.4/15.7	16.0/13.0/14.4	16.1/13.4/14.7	17.6/14.3/15.8	15.2/13.3/14.2	16.6/13.6/15.0	15.5/13.5/14.4	15.6/14.1/14.8
365-day fatality*									
35-44	12.3/15.9/14.6	10.3/14.0/12.6	7.6/14.6/11.9	10.0/12.6/11.6	14.9/13.0/13.7	6.7/8.5/7.8	12.2/12.1/12.2	9.5/12.0/11.0	10.7/13.6/12.4
45-54	11.9/13.7/13.0	10.9/12.3/11.7	8.7/11.4/10.3	11.5/11.8/11.7	11.8/12.5/12.2	10.9/11.6/11.3	10.0/9.8/9.9	9.5/11.2/10.5	9.6/12.1/11.1
55-64	14.7/13.8/14.1	11.2/13.4/12.7	12.1/11.8/11.9	8.9/13.0/11.7	11.4/13.7/12.9	10.3/11.8/11.3	10.9/12.1/11.7	10.5/12.0/11.5	11.3/12.8/12.3
65-74	17.5/18.9/18.3	17.8/18.9/18.4	17.4/17.8/17.6	17.8/17.3/17.5	16.1/17.8/17.1	14.7/17.2/16.3	16.0/17.9/17.1	15.4/17.7/16.8	15.5/17.5/16.7
75-84	27.5/30.9/29.1	25.9/28.3/27.0	25.9/24.2/25.1	25.4/26.9/26.1	26.7/27.6/27.1	23.9/26.8/25.3	25.8/26.1/26.0	24.5/26.3/25.4	25.6/28.5/27.0
85+	46.1/47.1/46.4	44.9/40.8/43.6	37.5/37.8/37.6	41.2/41.7/41.3	43.6/44.4/43.8	40.9/40.5/40.8	42.4/40.8/41.9	40.3/39.4/40.0	39.5/48.1/42.4
Total (crude)	24.8/22.4/23.5	23.6/21.2/22.3	22.3/19.4/20.8	23.1/20.3/21.6	24.5/21.2/22.7	22.2/20.1/21.0	23.9/20.3/21.9	22.6/20.4/21.4	23.5/22.4/22.9
Total (age-adjusted)	25.5/23.0/24.1	24.3/21.5/22.8	22.7/19.4/21.0	23.2/20.5/21.8	24.1/21.2/22.6	21.9/20.0/20.9	23.3/20.0/21.6	22.1/20.0/21.0	22.5/21.5/22.0

* Stroke episodes were up to 31 May 2007

TABLE 3. Adjusted period effects and sex effects for various age-groups on stroke incidence in Hong Kong (1999-2007) estimated by relative risk (RR)

Parameter	New stroke (negative binomial regression)		Recurrent stroke (Poisson regression)		Both (negative binomial regression)	
	RR (95% CI)	P value	RR (95% CI)	P value	RR (95% CI)	P value
Period						
1999-2001	1.00		1.00		1.00	
2002-2004	0.86 (0.81-0.90)	<0.001	1.30 (1.27-1.34)	<0.001	0.92 (0.89-0.96)	<0.001
2005-2007	0.79 (0.75-0.83)	<0.001	1.34 (1.30-1.37)	<0.001	0.87 (0.84-0.91)	<0.001
Age-group (years)	Women vs men		Women vs men		Women vs men	
35-44	0.55 (0.49-0.62)		0.59 (0.51-0.70)		0.56 (0.51-0.62)	
45-54	0.65 (0.59-0.72)		0.68 (0.62-0.75)		0.66 (0.61-0.71)	
55-64	0.59 (0.53-0.65)		0.50 (0.46-0.53)		0.57 (0.53-0.62)	
65-74	0.71 (0.64-0.78)		0.63 (0.60-0.65)		0.69 (0.64-0.74)	
75-84	0.83 (0.75-0.91)		0.75 (0.72-0.77)		0.81 (0.75-0.87)	
85+	0.96 (0.87-1.06)		0.85 (0.80-0.90)		0.93 (0.86-1.01)	

economic circumstances and hospital treatment. This may not necessarily translate into a reduction in demand for rehabilitation and long-term care services, because of population ageing. The higher incidence in men than women shows that there is room for improvement in primary prevention in men. Efforts in primary prevention appear effective; strategies could be devised specifically for men, whereas the effectiveness of secondary prevention efforts could be reviewed.

Acknowledgement

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Telephone-assisted pleasant-event scheduling to enhance well-being of caregivers of people with dementia: a randomised controlled trial

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KEY MESSAGES

1. This randomised controlled trial on 60 family caregivers of people with dementia examined the effectiveness of telephone-assisted pleasant-event scheduling (TAPES) for enhancing the well-being of caregivers in terms of reducing depressive symptoms and enhancing self-efficacy.
2. Analysis of covariance was used to compare the TAPES and treatment-as-usual (TAU) groups. The TAPES group had significantly lower levels of depressive symptoms than the TAU group.
3. It is suggested that TAPES has the potential of developing cost-effective, accessible, and sustainable intervention and support programmes for caregivers of people with dementia.

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Introduction

Social support enhances well-being and self-efficacy of caregivers of people with dementia. Nonetheless, many caregivers become socially isolated in the course of caregiving. Although psycho-education benefits caregivers, they may not have time to learn or leave their homes for this purpose.[1] Thus, it is important for caregivers to seek suppport and find time for themselves to enhance their well-being, without leaving their homes.

Psychological well-being is not only the absence of disorder but also the presence of subjective well-being. Positive psychology aims to cultivate individuals' positive feelings, behaviours, and cognition. Pleasant-event scheduling enhances the well-being of caregivers and works well with cognitive-behavioural treatment, particularly behavioural activation. Participants receiving behavioural activation are encouraged to engage in positive activities, recognise the consequences of their behaviours, and become active regardless of their feelings. Moreover, caregivers prefer telephone support over face-to-face contact, as it can meet the need for emotional support and education, without leaving their homes.

Pleasant-event scheduling increases the level of positive reinforcement in the daily routine. It involves a daily planner. The participant collaborates with the therapist to schedule various pleasant events at specific times in order to increase the level of reinforcement in the life of the caregiver and enhance positive mood.[2,3]

There are few systematic studies on telephone-assisted psycho-educational programmes for caregivers of people with dementia, despite the potential benefits of improving mental health and preventing distress. This pilot study evaluated the effectiveness of telephone-assisted pleasant-event scheduling (TAPES) on enhancing the psychological well-being of community-dwelling family caregivers. It validated a telephone-administered version of a pleasant-event module adapted from a validated face-to-face psycho-educational programme for Chinese caregivers.[1] It was hypothesised that TAPES resulted in significantly better well-being and mood level, compared with treatment-as-usual (TAU).

Methods

This study was conducted from December 2010 to August 2011. Written informed consent was obtained from each participant. Of 65 eligible caregivers of people with dementia recruited from the psychogeriatric team at United Christian Hospital, five refused to proceed with assessment and 60 were randomised to either the TAPES (n=30) or TAU (n=30) group according to the CONSORT for randomised trial of non-pharmacologic treatment. The primary full-time caregivers (for at least 6 months) were aged ≥25 years and consisted of spouses, daughters/sons, and daughter/son-in-laws of the patients. They were able to read and speak Chinese/Cantonese. Participants with any signs of severe intellectual deficits, suicidal ideation, or psychotic disorders were excluded.

The TAU group received standard care provided by the psychogeriatric team with regular psychiatric follow-up for the care recipients and support from social workers upon request. The TAPES group received interventions administered using the Pleasant Event Scale, Activity Planning, Event Tracking, and Daily Mood Record Forms, which were validated in in-home training and group settings.[1-3]

The TAPES had three components. First, the project rationale of behavioural activation was introduced, and the Pleasant Event Schedule (revised from California Older Person's Pleasant Events Schedule) was administered. The schedule consisted of pleasant activities in which engagement frequency and pleasure were rated. Activities included socialising, relaxation, contemplation, being effective, and doing. An information package was also distributed to advise on how to access social and psychological services in the community. Participants were then asked to decide on one or two activities that they would like to work on for the coming weeks. Second, six subsequent telephone calls of 20 minutes each (two calls per week during weeks 1 and 2 and then one call per week during weeks 3 and 4) were made. In the first phone call, participants were taught to schedule pleasant events according to the procedures of behavioural activation by working through the Pleasant Activity Planning Worksheet. To monitor individual progress, participants were asked to fill the Pleasant Event Tracking Form and the Daily Mood Record Form on a daily basis. Participants then mailed the completed progress charting forms back to the researcher. Third, concepts of adaptive coping were discussed from weeks 2 to 4: active coping, passive coping, and the goodness of fit between coping and situations, problem-solving coping (eg making preparations), emotion-regulation coping (eg distancing) and using situation-appropriate strategies (eg stepping back and taking a break when no immediate solution was available). The compliance of treatment was closely monitored. Participants had to complete the preceding component first before moving on the next component. The completion of the tasks was recorded on the intervention protocol. Regular weekly meetings were carried out by the intervention team to review the progress of caregivers.

The Centre for Epidemiologic Studies Depression Scale (CES-D) and Revised Scale for Caregiving Self-Efficacy (SE)[4] were administered via telephone by a blind researcher pre-intervention (1-3 days before the first intervention call), post-intervention (1-3 days after the last intervention call), and at follow-up (1 month after post-intervention).

Results

For caregivers, both the TAPES and TAU groups were comparable in terms of age, education level, gender, living arrangements, and duration of caregiving (Table 1). For care recipients, both the TAPES and TAU groups were comparable in terms of age, education level, gender, mini-mental state examination score, marital status, and number

TABLE 1. Demographics of caregivers

Demographic	Treatment (n=30)*	Control (n=30)*	*t* (x^2)	P value
Age (years)	58.1±12.4	55.1±11.3	0.962	0.340
Male	6 (21.4)	7 (22.6)	(0.000)	1.000
Female	22 (78.6)	24 (77.4)		
No. of siblings	4±3	3±2	2.343	0.023
No. of children	2±1	2±2	-1.499	0.139
Marital status			(1.367)	0.505
Single	6 (21.4)	4 (12.9)		
Married	22 (71.4)	25 (83.9)		
Live separately/divorced	2 (7.1)	1 (3.2)		
Education level			(8.805)	0.185
None	2 (7.1)	1 (3.2)		
Primary/kindergarten	6 (21.4)	12 (41.9)		
Junior secondary	6 (21.4)	2 (6.5)		
Senior secondary	8 (28.6)	10 (32.3)		
Form 6-7/vocational institutes	2 (0)	2 (6.5)		
College sub-degree	2 (7.1)	2 (6.5)		
College bachelor	4 (14.3)	1 (3.2)		

* Data are presented as mean±SD or No. (%)

TABLE 2. Demographics of care recipients

Demographic	Treatment (n=30)*	Control (n=30)*	*t* (x^2)	P value
Age (years)	80.1±6.11	79.9±8.6	0.107	0.915
Mini-mental state examination score	15.5±6.3	12.9±5.5	1.696	0.095
Relationship with caregivers			(3.735)	0.292
Spouse	12 (42.9)	11 (35.5)		
Children	15 (53.6)	14 (45.2)		
Children in laws	3 (3.6)	4 (12.9)		
Relatives	0 (0)	1 (6.5)		
Living arrangement			(3.924)	0.270
Living together	24 (85.7)	21 (67.7)		
Living at same district	2 (7.1)	3 (9.7)		
Living at different district	2 (7.1)	3 (12.9)		
Living at different region	2 (0)	3 (9.7)		
Duration of dementia (years)	3.4±2.0	3.3±2.2	0.245	0.807
Duration of caregiving (years)	3.2±2.4	3.3±2.3	-0.055	0.956
Hours of care per day	8.3±7.7	9.1±9.5	-0.328 (1.250)	0.744 (0.263)

* Data are presented as mean±SD or No. (%)

TABLE 3. Outcome measure scores

Outcome measure	Treatment (n=30)*		Control (n=30)*		ANCOVA F	P value
	Pre	Post	Pre	Post		
Centre for Epidemiologic Studies Depression Scale	16.11±10.89	12.64±11.10	12.06±8.90	14.97±8.69	4.225	0.045
Self-efficacy subscale for obtaining respite	56.92±29.34	61.59±26.41	67.27±26.72	74.41±25.96	1.731	0.194
Self-efficacy subscale for controlling upsetting thoughts about care giving	54.66±24.44	63.96±16.07	72.46±20.47	77.13±16.27	2.258	0.139

* Data are presented as mean±SD

of children (Table 2). There were baseline group differences in mood and self-efficacy measures: CES-D (t=1.39, P<0.05), SE for obtaining respite (t=1.02, P<0.05), SE for controlling upsetting thoughts about care giving (t=2.63, P<0.01). Analysis of covariance was used to compare the TAPES and TAU groups in terms CES-D and the self-efficacy scales. The scores on the pre-test were treated as a covariate to control for pre-existing differences between the groups (Table 3). The TAPES group had significantly lower levels of depressive symptoms than the TAU group. However, no significant changes in the self-efficacy levels were noted.

Discussion

Short-term telephone-assisted interventions using behavioural activation were successful in improving the mood of caregivers of people with dementia. These findings have implications for developing cost-effective, accessible, and sustainable intervention and support programmes for caregivers.

Many intervention programmes have been developed to support caregivers by reducing the negative aspects associated with caregiving. Few aimed to enhance the positive dimensions of their roles as caregivers. Qualitative analysis of an adapted leisure programme as a means of support for caregiver involvement revealed that the intervention had positive impacts on the caregivers, care recipients, and their family members.[5] In developing a satisfying lifestyle for both caregivers and care recipients, caregiver support was introduced by focusing on the positive aspects of caregiving rather than the burden.[5] The programme increased the caregiver's self-efficacy leading to improvements in the caregiving relationship and caregiver well-being.[5] The present study used behavioural activation to enhance the well-being of caregivers by initiating and engaging them in scheduling pleasant activities. In addition, telephone intervention could overcome barriers such as logistic problems, lack of time, unable to leave the patient alone, and caregiver health problems. Cognitive-behavioural intervention focuses on goal attainment for family caregivers of persons with dementia.[6] It aims to (1) improve the utilisation of community and professional services, (2) improve caregiver's coping and problem-solving skills, (3) modify dysfunctional thoughts, and (4) support caregivers in expressing and processing their emotions.[6] Most participants achieve these goals with good treatment compliance.[6] Intervention goals should be matched with outcome measures with appropriate sensitivity to match the type of intervention.[6] The present study aimed to improve caregiver mood through pleasant-event scheduling. The short period of intervention did not manage to teach specific skills in handling difficult situations. This may explain why no significant changes in the self-efficacy measures were noted, although significant improvement in mood was noted.

Caregiver mood is important. Depressive symptoms have a cumulative impact on health risk. Depression renders caregivers less likely to engage in pleasant events and more vulnerable to negative coping, which in turn, affects health behaviour patterns and choices. Path analysis revealed a significant effect of depressive symptoms as both self-efficacy for obtaining respite and self-efficacy for controlling upsetting thoughts.[7] The coping with caregiving programme successfully enhances self-efficacy and reduced depression.[7] The present study has demonstrated the effectiveness of pleasant-event scheduling to enhance the well-being of caregivers.

The present study had several limitations. The sample size was small and there was no long-term follow-up. Moreover, the depression score at baseline was significantly higher in the intervention group, so that the significantly improved scores could represent regression to the mean. Future studies should incorporate a more comprehensive programme with specific modules on teaching coping skills in terms of feasibility and effectiveness, and should entail longer-term follow-up.

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Perioperative outcome after nitrous oxide anaesthesia: an ENIGMA trial

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KEY MESSAGES

1. Nitrous oxide administration increased the rate of postoperative complications after major surgery, but was associated with lower rates of chronic postsurgical pain.
2. Anaesthesiologists should carefully consider the risk-benefit profile for each patient when opting to use nitrous oxide during anaesthesia.

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Nitrous oxide is among the oldest anaesthetics that are still available. Since 1844, billions of patients have received it during surgery. It is a weak anaesthetic but provides substantial analgesia. Nonetheless, its disadvantages include postoperative nausea and vomiting, limiting the inspired oxygen concentration that can be used, and expansion of air spaces (such as pneumothorax). It also leads to other biochemical changes, including inhibition of methionine synthase and interference with folate metabolism. Despite advances in anaesthesia, there is no study with adequate power to inform anaesthetists on the benefits and safety of nitrous oxide.

The Evaluation of Nitrous oxide In the Gas Mixture of Anaesthesia (ENIGMA) Trial compared perioperative outcomes in patients who did or did not receive nitrous oxide anaesthesia.[1] In 2050 adult patients undergoing major non-cardiac surgery that lasted for >2 hours, nitrous oxide anaesthesia was associated with an increased 30-day risk of severe vomiting, wound infection, fever, pneumonia, and atelectasis (Table).[1] The higher rate of complications markedly increased the financial burden associated with the use of nitrous oxide.[2]

In a post-hoc analysis of the ENIGMA trial, even after adjusting for known risk factors, nitrous oxide was associated with a higher rate of severe postoperative nausea and vomiting (adjusted odds ratio [OR], 2.04; 95% confidence intervals [CI], 1.37-2.32; P<0.0001).[3] In a randomised controlled trial of patients having major colorectal resections, nitrous oxide exposure was associated with increased DNA damage in circulating leukocytes and postoperative wound infections.[4]

A follow-up study of the ENIGMA patients showed that nitrous oxide was associated with an increased long-term risk of myocardial infarction (adjusted OR, 1.59; 95% CI, 1.01-2.51; P=0.04).[5] This may be related to the inactivation of methionine synthase after nitrous oxide exposure, resulting in increased plasma homocysteine concentrations,[6,7] and subsequent endothelial dysfunction that can be inferred from a decrease in flow-mediated dilation of the brachial artery.[8,9] The exact relationship between nitrous oxide administration and perioperative cardiac morbidity and mortality may be revealed by the ENIGMA-II Trial, in which 7112 patients at risk of coronary artery disease have been randomised to receive 70% nitrous oxide or nitrous oxide-free anaesthesia with 30% oxygen in air. The primary outcome is a composite of death and major cardiovascular events within 30 days of surgery.[10]

The ENIGMA Trial also identified certain benefits of nitrous oxide anaesthesia. In a long-term follow-up study, 10.9% of the patients reported pain that persisted from the index surgery. Among them, 84.8% had severe pain warranting chronic pain medications, surgical or psychological interventions. Interestingly, nitrous oxide provided long-term analgesia (Fig).[11] In patients receiving nitrous oxide,

TABLE. Postoperative complications after nitrous oxide anaesthesia in 2010 adult patients undergoing major non-cardiac surgery[1]

Postoperative complication	Adjusted OR (95% CI)	P value
Severe nausea or vomiting	2.52 (1.95-3.24)	<0.001
Wound infection	1.40 (1.02-1.91)	0.036
Fever	1.36 (1.11-1.66)	0.003
Pneumonia	1.95 (1.03-3.68)	0.040
Atelectasis	1.83 (1.33-2.50)	<0.001
Myocardial infarction	1.74 (0.67-4.51)	0.260
Thromboembolism	0.63 (0.28-1.40)	0.250
Blood transfusion	1.05 (0.82-1.33)	0.710
Death within 30 days	3.06 (0.82-11.4)	0.096

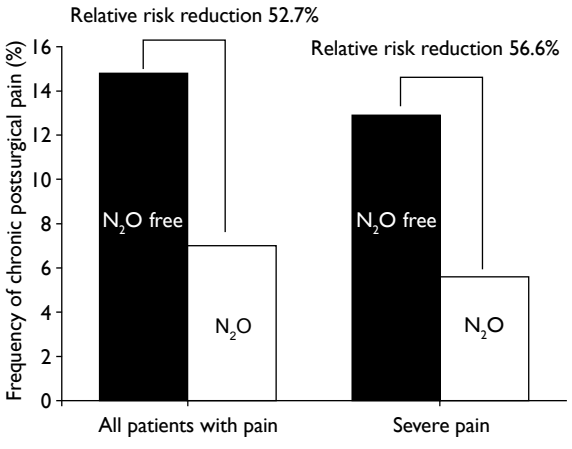

FIG. Nitrous oxide (N_2O) administration and the frequency of chronic postsurgical pain in all patients who reported pain and those with severe pain[11]

this risk was reduced by >50% (adjusted OR, 0.48; 95% CI, 0.33-0.93; P=0.04). Although these findings need to be confirmed with further clinical studies, preventive analgesia with nitrous oxide has also been demonstrated in several animal pain models.

The ENIGMA Trial highlighted the risk of infection with nitrous oxide, but also demonstrated its potential role for preventive analgesia. When deciding whether to use nitrous oxide during anaesthesia, anaesthesiologists should consider the risk-benefit profile. In healthy patients undergoing clean surgery, nitrous oxide may be a simple means of preventing chronic postsurgical pain. In elderly patients undergoing surgery with contaminated wounds, avoiding nitrous oxide may improve postoperative outcomes.

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Smoke-free policies on population health outcomes

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KEY MESSAGES

1. Poisson regression models were constructed to examine the change in trends and seasonal variations in deaths and hospital admissions before and after implementation of smoke-free law in 2007.
2. After implementation of smoke-free law, the predicted impact on hospital admissions and mortality from ischaemic heart disease was in line with findings from around the world.
3. The relatively low impact on ischaemic heart disease admissions in Hong Kong compared with other countries might be due to the fact that Hong Kong allowed exemptions from smoke-free policy until mid 2009.
4. Further analyses of future data are useful to refine the precise benefit to health.

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Introduction

Second-hand smoke (SHS) is a toxic mixture of carcinogens and other chemicals that may lead to cancers, chronic lung disease, heart disease,[1] and stroke.[2] Acute exposure to SHS can have immediate health effects, particularly in persons already compromised by chronic heart or lung diseases. In particular, risks of cardiovascular events may rise rapidly in response to relatively small exposures to SHS.[3] These effects might be identifiable in health care utilisation data.

On 27 October 2006, Hong Kong implemented a smoke-free law in indoor workplaces and public places to provide protection against SHS. On 1 January 2007, statutory no-smoking areas were extended to the indoor areas of all restaurant premises,

TABLE 1. Annual proportional change in hospital admission and mortality

Disease	Annual proportional changes in all ages (%) [95% CI]	
	Pre-intervention (1997-2006)	
	Hospital admission	Mortality
Outcome condition		
Ischaemic heart disease	2.94 (2.75 to 3.13)†	1.49 (1.12 to 1.86)†
Acute myocardial infarctions	1.64 (1.21 to 2.07)†	-1.20 (-1.70 to -0.70)†
Cerebrovascular	0.78 (0.58 to 0.97)†	-0.07 (-0.45 to 0.30)
Cardiovascular	0.84 (0.75 to 0.93)†	1.03 (0.80 to 1.26)†
Respiratory	-3.11 (-3.19 to -3.02)†	0.68 (0.40 to 0.95)†
Lung Cancer	-1.45 (-1.72 to -1.18)†	1.52 (1.14 to 1.90)†
All natural causes	-0.05 (-0.08 to -0.02)†	1.44 (1.32 to 1.57)†
Control condition		
Injury, poisoning and external causes	-4.66 (-4.76 to -4.55)†	-0.94 (-1.48 to -0.40)†
Cancer excluding lung cancer	1.01 (0.92 to 1.11)†	1.20 (0.96 to 1.45)†
Natural causes excluding cardiorespiratory	0.29 (0.26 to 0.32)†	1.94 (1.77 to 2.11)†
Other causes*	0.99 (0.94 to 1.04)†	1.61 (1.41 to 1.82)†

* Refer to ICD-9 (001-009, 140-161, 163-246, 280-294, 320-326, 520-629, 710-719)
† Significant at 5% level

indoor workplaces, public indoor places, and some public outdoor places. However, bars, bathhouses, nightclubs, clubs, massage establishments, and mahjong-tin kau premises were exempted until July 2009. The main aim of this legislation was to reduce exposure of workers to SHS. The likely impact of such legislation on health and health care costs was a concern.

We have calculated the cost of active and passive smoking in Hong Kong.[4] To estimate the immediate impact of smoke-free policies on health and costs, we need to monitor the changes in health-related variables over the early intervention period. The Hospital Authority Clinical Management System provides data on mortality and admissions to hospital. We used such data to examine the immediate impact of a reduction of exposure to SHS in the Hong Kong population following the workplace smoking ban. In examining the effect of change in health-related variables following a change in population exposure to airborne toxins, we used statistical methods that had been used to identify the impact of reductions in sulfur dioxide as a result of switching to lower sulfur fuel.[5] In that study, because the intervention took place in 1990, only mortality data were available. The current study was able to make use of health care utilisation data as well.

This study was carried out as soon as feasible in order to provide timely information on the impact of the legislation. It aimed to examine the health effects following the implementation of smoke-free workplaces in Hong Kong by (1) examining trends in deaths and admissions to hospital for conditions associated with passive smoking over the years prior to and immediately following implementation of the smoke-free policy on 1 January 2007, and (2) examining whether there was any discernable change in rates of deaths and admissions for these conditions that coincided with introduction of the policy after accounting for the underlying trends and impacts of other confounders.

Methods

This study was conducted from December 2006 to March 2009. The trends in deaths and admissions between the pre- (1997-2006) and post- (2007-2008) intervention periods were estimated and modelled, and changes between pre and post-intervention periods were calculated. Data on discharges from 31 acute hospitals collected by the Hospital Authority Clinical Management System were obtained for the following conditions: ischaemic heart disease (IHD) [ICD-9-CM 410-414], acute myocardial infarctions (AMI) [410], cerebrovascular disease (430-438), cardiovascular disease (390-459), respiratory disease (460-519), lung cancer (162), and all natural causes (001-799). Injury, poisoning and external causes (800-999, e800-e999), cancer excluding lung cancer (140-161, 163-239), natural causes excluding cardiovascular and respiratory disease (001-389, 520-799), and other causes (001-009,140-161, 163-246, 280-294, 320-326, 520-629, 710-719) were used as control conditions. The year 2003 was excluded in the model for admissions, as the admission trends changed during the outbreak of severe acute respiratory syndrome (SARS) in 2003. Information on deaths obtained from the Hong Kong Census

Annual proportional changes in all ages (%) [95% CI]		Relative change (%) [95% CI]	
Post-intervention (2007-2008)		From pre- to post-intervention	
Hospital admission	Mortality	Hospital admission	Mortality
-6.33 (-11.05 to -1.36)†	-0.63 (-4.61 to 3.50)	-9.00 (-13.59 to -4.17)†	-2.09 (-6.02 to 2.00)
1.81 (-9.46 to 14.49)	-2.76 (-8.64 to 3.50)	0.17 (-10.93 to 12.65)	-1.58 (-7.55 to 4.78)
-0.83 (-6.26 to 4.93)	1.71 (-2.70 to 6.33)	-1.59 (-6.99 to 4.12)	1.78 (-2.65 to 6.42)
-0.39 (-2.86 to 2.15)	1.38 (-1.22 to 4.05)	-1.22 (-3.68 to 1.30)	0.35 (-2.24 to 3.00)
-0.63 (-3.09 to 1.89)	1.27 (-1.73 to 4.36)	2.55 (0.01 to 5.16)†	0.59 (-2.40 to 3.67)
12.67 (4.28 to 21.74)†	-4.22 (-8.35 to 0.09)	14.33 (5.81 to 23.53)†	-5.65 (-9.73 to -1.39)†
2.25 (1.43 to 3.08)†	0.88 (-0.48 to 2.26)	2.30 (1.48 to 3.13)†	-0.55 (-1.90 to 0.81)
0.28 (-2.98 to 3.66)	-1.77 (-8.44 to 5.38)	5.18 (1.76 to 8.72)†	-0.84 (-7.58 to 6.41)
3.28 (0.66 to 5.97)†	1.04 (-1.72 to 3.87)	2.24 (-0.36 to 4.91)	-0.17 (-2.90 to 2.64)
3.17 (2.24 to 4.11)†	0.49 (-1.38 to 2.40)	2.87 (1.95 to 3.81)†	-1.42 (-3.27 to 0.46)
3.28 (1.96 to 4.62)†	1.22 (-1.07 to 3.57)	2.27 (0.96 to 3.59)†	-0.38 (-2.65 to 1.93)

TABLE 2. Seasonal variations in hospital admission and mortality

Disease	Seasonal variations in all ages (%) [95% CI]	
	Baseline (1997-2006)	
	Hospital admission	Mortality
Outcome condition		
Ischaemic heart disease	2.87 (2.21 to 3.52)†	21.12 (19.62 to 22.61)†
Acute myocardial infarctions	13.23 (11.71 to 14.75)†	19.05 (16.97 to 21.12)†
Cerebrovascular	4.21 (3.52 to 4.90)†	17.78 (16.25 to 19.31)†
Cardiovascular	5.49 (5.17 to 5.81)†	20.22 (19.30 to 21.15)†
Respiratory	12.62 (12.33 to 12.91)†	17.61 (16.48 to 18.74)†
Lung cancer	2.96 (2.02 to 3.91)†	2.43 (0.91 to 3.95)†
All natural causes	0.55 (0.45 to 0.65)†	11.65 (11.16 to 12.13)†
Control condition		
Injury, poisoning and external causes	3.26 (2.90 to 3.62)†	16.26 (14.03 to 18.48)†
Cancer excluding lung cancer	2.75 (2.42 to 3.08)†	1.06 (0.09 to 2.02)†
Natural causes excluding cardiorespiratory	2.21 (2.10 to 2.32)†	5.46 (4.80 to 6.13)†
Other causes*	1.04 (0.88 to 1.20)†	4.88 (4.06 to 5.70)†

* Refer to ICD-9 (001-009, 140-161, 163-246, 280-294, 320-326, 520-629, 710-719)
† Significant at 5% level

TABLE 3. Summary of relative changes from pre- to post-intervention in all ages in hospital admission and mortality

Disease	Relative changes in all ages (%) [95% CI]	
	Main model	
	Hospital admission	Mortality
Outcome conditions		
Ischaemic heart disease	-9.00 (-13.59 to -4.17)†	-2.09 (-6.02 to 2.00)
Acute myocardial infarctions	0.17 (-10.93 to 12.65)	-1.58 (-7.55 to 4.78)
Cerebrovascular	-1.59 (-6.99 to 4.12)	1.78 (-2.65 to 6.42)
Cardiovascular	-1.22 (-3.68 to 1.30)	0.35 (-2.24 to 3.00)
Respiratory	2.55 (0.01 to 5.16)†	0.59 (-2.40 to 3.67)
Lung Cancer	14.33 (5.81 to 23.53)†	-5.65 (-9.73 to -1.39)†
All natural causes	2.30 (1.48 to 3.13)†	-0.55 (-1.90 to 0.81)
Control conditions		
Injury, poisoning and external causes	5.18 (1.76 to 8.72)†	-0.84 (-7.58 to 6.41)
Cancer excluding lung cancer	2.24 (-0.36 to 4.91)	-0.17 (-2.90 to 2.64)
Natural causes excluding cardiovascular and respiratory	2.87 (1.95 to 3.81)†	-1.42 (-3.27 to 0.46)
Other causes*	2.27 (0.96 to 3.59)†	-0.38 (-2.65 to 1.93)

* Refer to ICD-9 (001-009, 140-161, 163-246, 280-294, 320-326, 520-629, 710-719)
† Significant at 5% level

Seasonal variations in all ages (%) [95% CI]			
Year 1 (2007)		Year 2 (2008)	
Hospital admission	Mortality	Hospital admission	Mortality
4.99 (3.15 to 6.83)†	9.45 (5.12 to 13.79)†	4.68 (2.88 to 6.47)†	20.86 (16.51 to 25.22)†
9.10 (4.75 to 13.45)†	8.94 (2.35 to 15.53)†	24.40 (20.10 to 28.70)†	21.61 (14.92 to 28.30)†
6.41 (4.41 to 8.41)†	13.18 (8.42 to 17.94)†	6.20 (4.23 to 8.16)†	15.19 (10.51 to 19.88)†
8.64 (7.72 to 9.56)†	12.80 (10.02 to 15.57)†	9.39 (8.51 to 10.26)†	15.59 (12.84 to 18.34)†
10.08 (9.19 to 10.97)†	13.62 (10.37 to 16.86)†	12.94 (12.07 to 13.81)†	20.01 (16.86 to 23.17)†
6.18 (3.48 to 8.88)†	3.17 (-1.45 to 7.79)	6.37 (3.84 to 8.91)†	1.97 (-2.76 to 6.69)
0.32 (0.04 to 0.61)†	8.65 (7.19 to 10.10)†	1.15 (0.88 to 1.43)†	10.70 (9.27 to 12.13)†
2.46 (1.31 to 3.62)†	11.19 (3.69 to 18.70)†	0.80 (-0.34 to 1.93)	11.38 (3.99 to 18.76)†
2.22 (1.32 to 3.12)†	1.77 (-1.18 to 4.72)	2.04 (1.17 to 2.91)†	2.75 (-0.17 to 5.66)
1.95 (1.64 to 2.27)†	4.90 (2.89 to 6.90)†	1.29 (0.99 to 1.60)†	4.84 (2.85 to 6.82)†
0.62 (0.17 to 1.08)†	4.80 (2.35 to 7.25)†	1.78 (1.34 to 2.21)†	4.91 (2.50 to 7.32)†

Relative changes in all ages (%) [95% CI]				
SARS	Air pollutants		Hospital beds and smoking prevalence	
Hospital admission	Hospital admission	Mortality	Hospital admission	Mortality
-5.56 (-10.39 to -0.46)†	-7.39 (-12.48 to -2.01)†	-2.13 (-6.35 to 2.27)	-9.65 (-14.22 to -4.84)†	-2.17 (-6.10 to 1.92)
7.22 (-4.84 to 20.82)	0.22 (-11.96 to 14.08)	-0.84 (-7.29 to 6.05)	-3.92 (-14.60 to 8.09)	-1.71 (-7.67 to 4.65)
-0.75 (-6.28 to 5.10)	-2.43 (-8.29 to 3.81)	2.16 (-2.62 to 7.17)	-2.41 (-7.78 to 3.27)	1.77 (-2.66 to 6.41)
0.64 (-1.90 to 3.25)	0.27 (-2.46 to 3.09)	0.72 (-2.07 to 3.58)	-1.78 (-4.23 to 0.73)	0.29 (-2.29 to 2.93)
2.39 (-0.19 to 5.03)	3.08 (0.27 to 5.96)†	0.45 (-2.76 to 3.77)	2.78 (0.22 to 5.40)†	0.29 (-2.70 to 3.36)
14.05 (5.42 to 23.38)†	17.52 (7.96 to 27.94)†	-4.98 (-9.39 to -0.35)†	14.68 (6.11 to 23.94)†	-5.63 (-9.71 to -1.37)†
3.18 (2.34 to 4.03)†	3.85 (2.94 to 4.77)†	-0.57 (-2.02 to 0.90)	1.78 (0.96 to 2.61)†	-0.61 (-1.96 to 0.75)
3.65 (0.23 to 7.19)†	7.45 (3.63 to 11.42)†	2.07 (-5.38 to 10.11)	5.29 (1.85 to 8.84)†	-0.97 (-7.71 to 6.26)
1.53 (-1.09 to 4.22)	5.53 (2.60 to 8.54)†	-0.44 (-3.37 to 2.58)	2.89 (0.27 to 5.59)†	-0.15 (-2.88 to 2.66)
3.79 (2.83 to 4.74)†	4.55 (3.52 to 5.59)†	-1.69 (-3.67 to 0.33)	2.24 (1.31 to 3.17)†	-1.41 (-3.25 to 0.47)
4.00 (2.64 to 5.37)†	3.42 (1.97 to 4.88)†	-0.67 (-3.10 to 1.82)	1.80 (0.49 to 3.13)†	-0.38 (-2.64 to 1.94)

and Statistics Department for the pre- and post-intervention periods were used to examine mortality for the conditions described above (ICD-10 codes were used in recent years and matched with equivalent ICD-9 codes).

Poisson regression models were used to examine trends in admissions and deaths from 1997 to 2008. Weekly admission and death counts were used as the dependent variables, adjusted with background variables of temperature, humidity, and cycle of seasonality as independent variables to capture the main seasonal variation each year. The regression model was initially fitted for periods of 10 years pre-intervention and 2 years post-intervention separately to estimate the average annual proportional change in admissions and deaths in the pre- and post-intervention periods.

For the relative change in trend between the pre and post-intervention periods, we created a dummy variable (which defined the pre-intervention period as 0 and the post period as 1) and added it as an independent variable in the Poisson models. The coefficient for the variable represented the relative change and the effect of the intervention could be shown in terms of average annual reductions in mortality and admissions.

A measure of proportional change (amplitude) in admissions and deaths was used to examine the seasonal variations to the overall mean in the pre- and post-intervention periods. We fitted a Poisson regression model with deaths or discharges against a pair of trigonometric functions (α sine, β cosine). The estimated coefficients were used to calculate the amplitude of the seasonal curve in terms of sine and cosine in which $\lambda = \sqrt{\alpha^2 + \beta^2}$, with 95% confidence intervals (CI). This amplitude (λ) represented the proportional changes in admissions and deaths in either warm or cool seasons from the relative mean. By comparing the parameters for the 10-year baseline period to the years after the intervention, we were able to evaluate the change in seasonal cycles for each condition that might be associated with the intervention.

We validated our models by examining changes in admission or deaths from conditions, which were less likely to be affected by the smoking ban, such as injury and poisoning, and compared these with the changes in the outcome conditions. For sensitivity analyses, we also adjusted admission trends in pre- and post-SARS periods and tested the background variables including air pollutant concentrations, number of hospital beds, and smoking prevalence in order to identify whether their impact on hospital admissions and deaths might change our conclusions.

Results

After the introduction of the smoke-free law, the annual proportional change in hospital admissions for IHD in all ages dropped by 9% (Table 1). The seasonal peak in hospital admissions for respiratory disease in all ages was reduced from 12.6% to 10.1% in the first year after intervention; however, there was a rebound to 12.9% in the second year (Table 2). For mortality in all ages, only those died from lung cancer immediate dropped by 5.7% after the intervention (Table 1). However, the seasonal peak for deaths from IHD declined from 21.1% to 9.5% and for all natural causes from 11.7% to 8.7% (Table 2). The seasonal peak for deaths from AMI also reduced in the first year but the change was not significant. In the second year, an increase in the seasonal peak for IHD and AMI deaths to the pre-intervention level was observed (Table 2).

Results from the sensitivity analysis[6] are consistent with the main model (Table 3). An alternative model of the post-SARS period for admission was also tested. The changes in admission from pre- to post-intervention were consistent with the main model but the proportional changes in IHD and two of the control conditions became insignificant. This alternative model may add uncertainty to the results and therefore was not considered for use as the final model.

Discussion

Many studies have reported a decrease in cardiovascular disease after the implementation of smoke-free laws. In the present study, the annual proportional changes in mortality were significant in two conditions: lung cancer (which decreased among all ages) and all natural causes (which increased in the age-group of 40 to 64 years). The reduction in lung cancer deaths is difficult to attribute to the intervention due to the long latency in development of lung cancer, except by the development of earlier detection and better treatments. Also the increase in death rates among the age-group of 40 to 64 years is likely to be due to an increase in numbers of this age-group with an ageing population. We examined the data in another way by investigating the seasonal variations in numbers of deaths and found a significant decrease in the peak for IHD, AMI, cardiovascular, and cerebrovascular disease deaths for the 65+ age-group. However, all of these causes of death returned to previous levels the following year, except for cerebrovascular disease (which increased but not significantly). This kind of rebound after a reduction in peak mortality levels has been seen after other interventions, and has been explained as a delay in some deaths that were expected but occurred in the following high mortality season.

Our results showed an impact on hospital admissions for IHD that the rate was significantly lower after the intervention for all ages and the 65+ age-group. In all age-groups, where we expected an

increase in admissions (as found for all causes), we actually had a decrease in admissions for IHD. For the seasonal variation in the number of admissions, there was a significant drop in admission due to respiratory diseases for all ages and the 65+ age-group. The drop might be related to a reduction in SHS exposure but it is difficult to confirm given the other patterns of admissions.

There were limitations in this study mainly related to data availability and complexity. In particular we only had 2 years of data after the intervention and there were a variety of seasonal trends and many factors affecting the data patterns. Therefore further data in later years are useful to confirm the trends identified here.

The disruption of the provision of hospital services due to SARS in 2003 should be taken into account in any analysis. It may have taken some time for admission trends to recover after 2003 and they may not mirror those before 2003. We have tried to adjust for this in our model and sensitivity analysis.

Finally, Hong Kong allowed exemptions to the smoke-free law and thus some of the population continued to be exposed to SHS till mid-2009. Further data in future years are useful to confirm whether the eventual imposition of smoke-free policies in all workplaces contributes to any further benefit in decreasing rates of IHD.

Conclusion

After the implementation of smoke-free policies in most workplaces in Hong Kong, the predicted impact on admissions to hospital and mortality from IHD was in line with findings from around the world. The drop of 9% in admissions for IHD in Hong Kong was on the low side compared with other countries. However, Hong Kong allowed exemptions from the smoke-free policy until mid-2009. Further analyses of future years' data may help to refine the precise benefit to health following amendments to the ordinance.

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Health of catering workers in Hong Kong: impact of the 2006 tobacco control legislation

AJ Hedley, SM McGhee *, R Fielding, JL Repace, CM Wong, SQ Lu, ALY Ho, HK Lai, LC Wong, J Chen

KEY MESSAGES

1. Second-hand tobacco smoke is a poison and a major cause of acute illness, chronic disease, and deaths in those exposed.
2. The 2006 Public Health Ordinance conferred enormous benefits in terms of health protection for catering workers. However, the legislation failed to secure the protection of all workers. The law is frequently violated by workers in supposedly non-smoking venues and the implementation of the ordinance did not take sufficient account of the need for clear advice to management on the mandatory nature of the legislation.
3. Non-smokers in exempted premises were continuously subjected to intensive tobacco smoke exposures. The 2.5 years exemption period predictably caused permanent harm to the health of many workers.
4. The delay in amending the Public Health (Smoking) Ordinance and failure to adhere to an evidence-based approach to tobacco control provides a lesson in the translation of public health evidence into policy and enforcement.

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Introduction

This study evaluated the exposures and health impacts of workplace second-hand smoke (SHS) on non-smoking catering workers after implementation of the 2006 Public Health (Smoking) (Amendment) Ordinance. Businesses that could claim their trade mainly entailed selling alcohol to customers aged over 18 years were exempted. This study provides objective evidence of the impact of this legislation on the health of workers in exempted and non-exempted premises.

Methods

This study was conducted from October 2007 to September 2008. We sampled 204 workers (from 99 premises) and 18 controls. Workers were interviewed using a standard schedule in which socioeconomic and demographic information was recorded together with job descriptions, characteristics of their workplace, health, and smoking history. In non-smokers we measured expired air carbon monoxide, lung function, and urinary cotinine concentrations. In the workplace the physical dimensions, sources of pollution, and indoor and outdoor concentrations of $PM_{2.5}$ (particulates matter <2.5 μm) were measured.

Results

The ordinance in 2006 led to a prohibition of smoking in most hospitality venues. The levels of tobacco chemicals from SHS exposures among non-smokers in these workplaces fell by up to 90%, as indicated by concentrations of the tobacco-specific biomarker cotinine in urine. In workers in Chinese restaurants, the median cotinine was 1.4 ng ml^{-1} compared with 9.3 ng ml^{-1} pre-legislation. In Cha Charn Ting workers, the observed level was 1.4 ng ml^{-1} compared with 23.6 ng ml^{-1} pre-legislation, a reduction of 94%. In venues exempted from the ordinance until June 2009, workers were exposed to high levels of fine particulates ($PM_{2.5}$) and tobacco chemicals from SHS. The urine cotinine levels in workers whose workplace permitted smoking were significantly higher than in workers who were protected by the ordinance. Only 2% of workers in exempted venues had cotinine levels of <1 ng ml^{-1} compared with 78% of low-risk controls and 33% of workers in non-smoking venues. None of the controls or non-smoking venue workers had cotinine levels of >25 ng ml^{-1} compared with 28% of those working in smoking venues (Fig 1).

Smoking outdoors generates dense aerosols of chemicals which contaminate those in the immediate vicinity. Workers in non-smoking restaurants with open doors had higher cotinine levels than those in closed-door venues due to customers smoking outside. The mean cotinine level in workers in restaurants with outdoor smoking areas, such as patios, was 4.1 ng ml^{-1}, which was 100% higher than in non-smoking venue workers.

Violations of the ordinance by customers who smoke were frequently reported (17%, 95% CI=12-24%). Co-worker smoking was reported in non-smoking restaurants (52.7%), venues with patios (61.5%) and bars (91%). Co-worker smoking in break periods was a substantial contribution to the health risks from SHS exposures of non-smoking staff as indicated by their urinary cotinine concentrations.

Workers in exempted venues were more likely to perceive poor air quality (odds ratio [OR]=9.3, 95% CI=4.2-20.9), higher risks from poor air (OR=3.7, 95% CI=1.6-8.6), and higher relative risk compared to other workers (OR=21.5, 95% CI=8.8-52.6). Compared to workers in non-smoking venues, workers in smoking venues were less reactive to SHS exposures and were less bothered by SHS (OR=0.2, 95% CI=0.1-0.5), took less protective action, such as discouraging nearby smoking to avoid smoke (OR=0.2, 95% CI=0.1-0.4).

Workers in non-smoking venues had lower median urine cotinine values if they (1) were bothered by smokers; (2) discouraged nearby smoking; (3) discouraged home smoking, and (4) had higher perceived susceptibility of non-smokers to lung cancer. However, there was considerable overlap of the distribution of cotinine levels between the three categories of avoidance behaviour (low, intermediate, high).

The indoor $PM_{2.5}$ levels across all catering venues correlated strongly with urinary cotinine levels in the workers (P<0.0001). Smoking was the most important determinant of indoor $PM_{2.5}$ in terms of variation explained (57%), followed by ventilation type (10%), and outdoor PM2.5 (7.0%). The number of burning cigarettes increased the indoor $PM_{2.5}$ exponentially (P<0.0001, Fig 2). Indoor mean $PM_{2.5}$ levels in non-smoking venues (geometric mean=60.3 μg m^{-3}) were not significantly different from ambient outdoor levels. Both were 500% above the World Health Organization annual Air Quality Guideline for $PM_{2.5}$ (10 μg m^{-3}). In smoking venues the mean $PM_{2.5}$ was 211.6 μg m^{-3} rising to 267.9 μg m^{-3} when smoking was directly observed which was 4.4 times as high as the mean level of 60 μg m^{-3} in non-smoking venues. Hong Kong is a highly polluted environment with poor air quality, but there was no difference in the outdoor ambient $PM_{2.5}$ levels between the locations of the smoking and non-smoking venues. Our findings on health impacts of SHS exposures cannot be explained in terms of outdoor ambient pollution.

Reports of respiratory symptoms were common among all catering workers. Non-smoking workers in smoking venues had the highest prevalence of throat discomfort, cough, phlegm, nasal symptoms and a higher prevalence overall of any reported symptoms. Working in exempted venues compared with non-exempted venues was strongly associated with reports of coughing (OR=3.6, 95% CI=1.1-12.0). This excess risk of 260% indicates that the respiratory system of these workers is constantly injured by their workplace environment. Those with a history of respiratory illness were particularly vulnerable (OR=3.1, 95% CI=1.1-8.4). The association between SHS exposures and symptoms is supported by the significant association between urine cotinine levels and cough (P<0.0049) and a cluster of upper respiratory symptoms including cough, phlegm, sore throat, and nasal blockage (P=0.023).

Lung function was assessed by spirometry

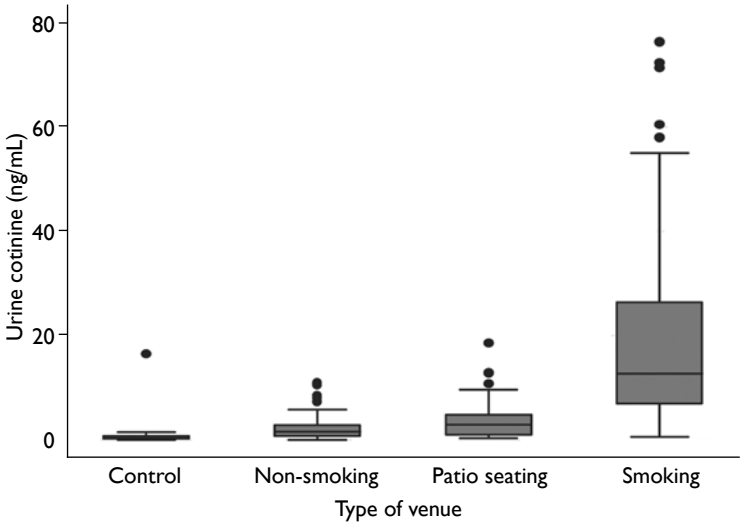

FIG 1. Urine cotinine in non-smoking workers

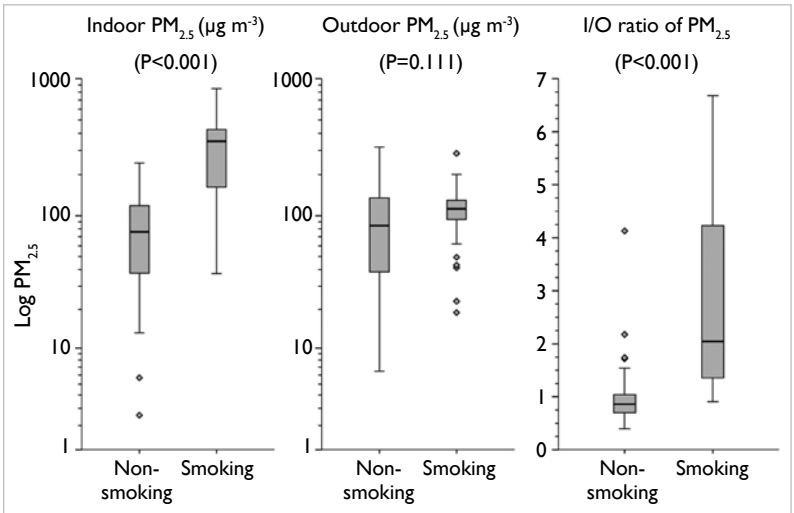

FIG 2. Indoor and outdoor $PM_{2.5}$ concentrations and indoor-outdoor (I/O) ratios at non-smoking (n=62) and smoking premises (n=27)*

* Boxes show the medians and interquartile ranges, and bars are 1.5 times the interquartile range. P values were obtained by ANOVA F-test (2-tailed)

using American Thoracic Society protocols. When compared with indoor $PM_{2.5}$ exposure ≤25 μg m^{-3}, the mean FEV_1 values in all non-smoking workers whose $PM_{2.5}$ exposures were 25-74 μg m^{-3}, 75-175 μg m^{-3}, and >175 μg m^{-3} were lower by 71 (95% CI=21-121), 78 (95% CI=24-132), and 98 (95% CI=14-182) ml, respectively. Similarly on this scale of $PM_{2.5}$ levels, mean FEF_{25-75} values were lower by 0.36 (95% CI=0.08-0.65), 0.50 (95% CI=0.19-0.81), and 0.56 (95% CI=0.23-0.90) L s^{-1}, respectively, whereas for FEV1/FVC, values were lower by 2.9% (95% CI=1.0-4.8), 3.2% (95% CI=1.3-5.1), and 4.3% (95% CI=1.3-7.3), respectively. When the analysis was applied to the subgroup of older workers much larger differences in lung function were observed with increasing levels of $PM_{2.5}$, reflecting their increased susceptibility to air pollutants (Fig 3).

Strong concentration-response relationships were observed between $PM_{2.5}$ and lung function values in all analyses. The tobacco-specific nature of these exposures is supported by the trend in lower lung function values with increasing urine cotinine levels, including FEV1 (P for trend=0.046) and FEF_{25-75} (P for trend=0.022).

After appropriate adjustment for age, sex and other relevant factors, workers in non-smoking venues had higher mean values for FEV_1 and FEF_{25-75} than those in smoking venues. The corresponding benefits were all relatively larger for the older workers indicating the benefit of relatively cleaner indoor air despite very high ambient outdoor pollution by international standards.

The excess mortality risk to Hong Kong catering workers from tobacco smoke can be assessed at two levels. First, by reference to the health based standards applied to air quality and ambient concentrations of particulates. The mean level of fine particulates in smoking venues (268 μg m^{-3}) is 2500% above the World Health Organization annual Air Quality Guideline for $PM_{2.5}$. It is estimated that per 10 μg m^{-3} excess short-term mortality risks are 0.21 to 1.3%, excess long-term all-cause mortality is 4% (95% CI=1-8%), and excess cardiopulmonary mortality is ≥6% (95% CI=2-10%). Second, we can estimate the risk of health outcomes, such as deaths from lung cancer and heart disease mortality from exposures to the total mixture of particulates and gases as indicated by the biomarker cotinine levels in body fluids (Fig 4).

If the catering workforce in Hong Kong totalled 217 985 distributed across non-smoking restaurants (190 970) patio-seating venues (21 219) and unrestricted smoking bars (5796), then the excess deaths attributable to SHS exposures, at the median levels would amount to 191, 83, and 162, respectively, accounting for 2% of all these workers or 2.7% of workers in smoking venues. In our sample of 204 workers, about 11 deaths were expected. The mortality risks for workers in the upper quantiles of the cotinine range are much higher (5-10%).

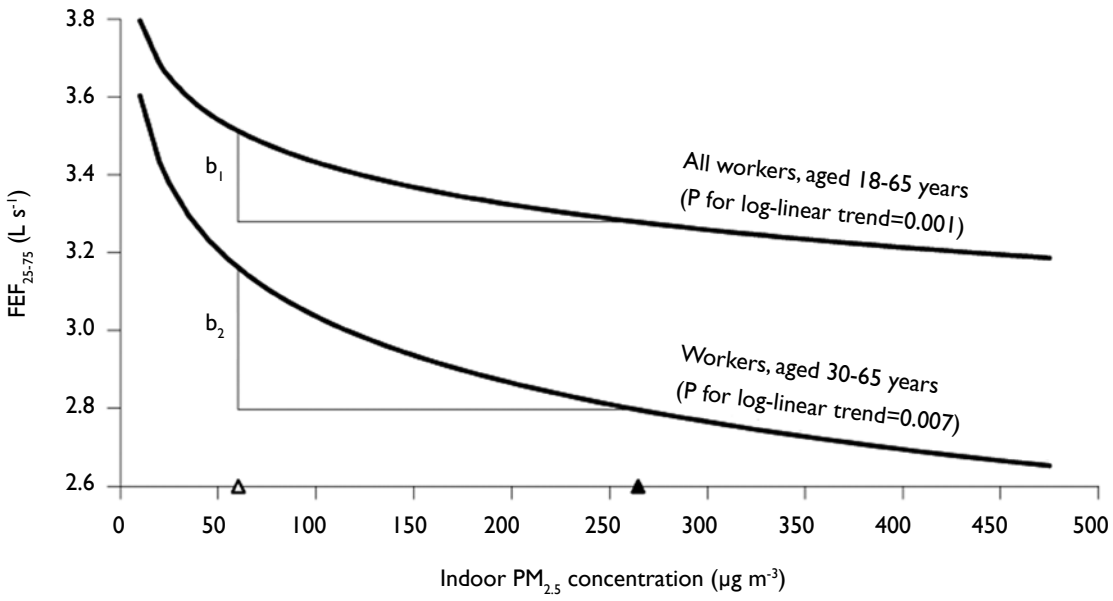

FIG 3. Estimated FEF_{25-75} per unit change of indoor $PM_{2.5}$ concentration among all non-smoking workers (n=186)*

* b_1=0.23, b_2=0.36, represent the differences in the estimated mean lung function corresponding to the mean indoor $PM_{2.5}$ concentrations, 60.3△ and 264.7▲ μg m^{-3}, in non-smoking and smoking premises respectively

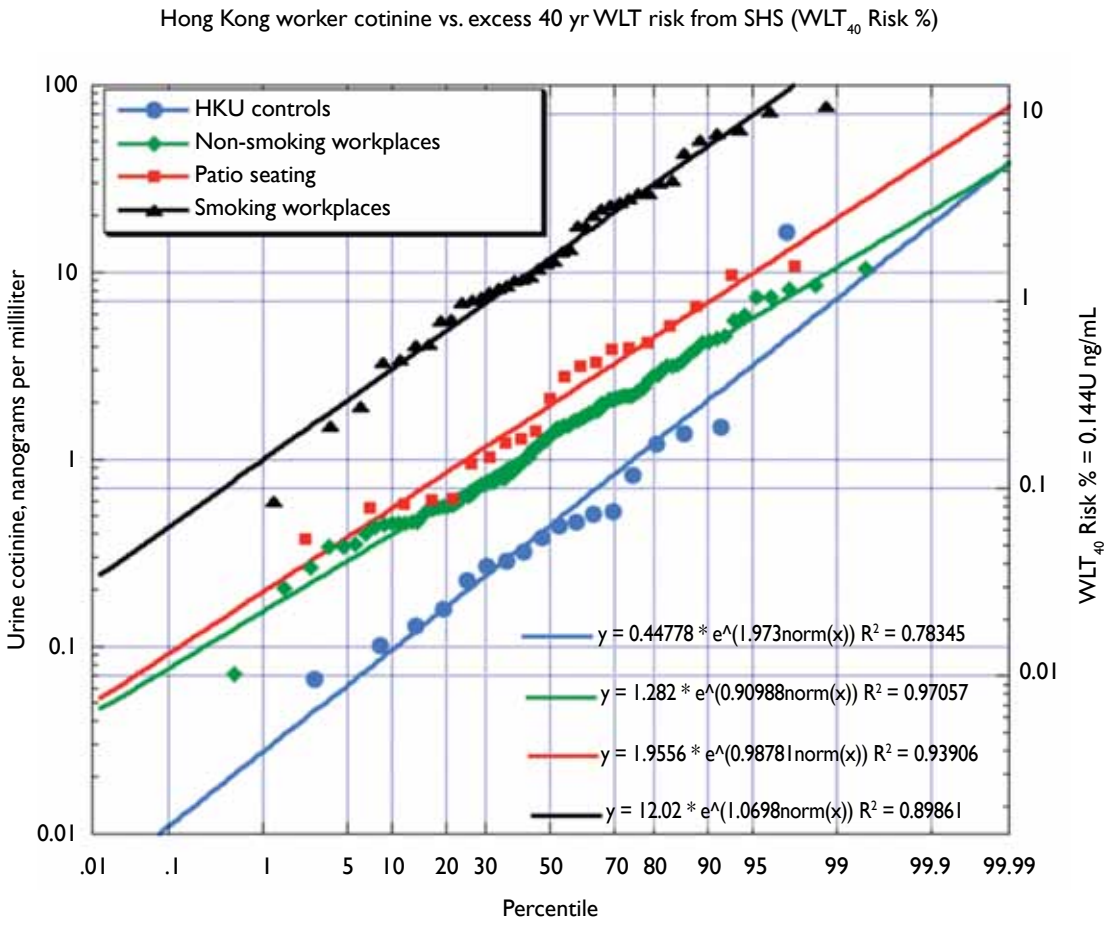

FIG 4. Log-probability plot of estimated working lifetime (WLT) risk for deaths from lung cancer and heart disease in Hong Kong workers versus urine cotinine by second-hand smoke (SHS) exposure group

Mortality risks represent the tip of a pyramid of bad health outcomes. Within the strata of this pyramid, many layers of increased health care needs and actions can be identified, from self-medication, recourse to traditional medicine and western practitioners, referral to specialist care, hospital admissions, and degraded quality of life from chronic illness.

Conclusions and implications

The 2006 Smoking (Public Health) Ordinance made an important contribution to the protection of many catering workers in their workplace. Levels of tobacco chemicals in smoke-free restaurants, indicated by fine particulates and urine cotinine levels, were reduced by up to 90% compared to the pre-ordinance period. However, exemptions from the Ordinance probably increased the intense SHS exposures in workers in exempted premises. These exposures, to chemicals known to cause cancers and diseases of the heart, blood vessels, lungs, and other organs are associated with higher risks of illness episodes, chronic disease, and deaths. The symptom patterns, degradation of lung function, and estimated excess mortality risks which we measured in bar workers indicate that permissive legislation in tobacco control is a causal factor for epidemics of cardiopulmonary disease. These bad health outcomes are a direct result of the exemptions in the 2006 public health legislation. Allowing exemptions was at variance with the established medical evidence of predictable harm. The failure of the public health system in this case study is a clear indication of the need for more reliable approaches to the translation of public health evidence into policy and practice.

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AUTHOR INDEX

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