Secondhand Smoke Exposure and Maternal Action to Protect Children from Secondhand Smoke: Pre- and Post-Smokefree Legislation in Hong Kong

Sophia Siu Chee Chan¹, Yee Tak Derek Cheung²*, Doris Yin Ping Leung³, Yim Wah Mak⁴, Gabriel M. Leung², Tai Hing Lam²

¹ School of Nursing, The University of Hong Kong, Hong Kong, China, ² School of Public Health, The University of Hong Kong, Hong Kong, China, ³ The Nethersole School of Nursing, The Chinese University of Hong Kong, Hong Kong, China, ⁴ School of Nursing, The Hong Kong Polytechnic University, Hong Kong, China

Abstract

**Background:** Smokefree legislation may protect children from secondhand smoke (SHS) in the home from smoking parent(s). We examined the effect of the 2007 smokefree legislation on children’s exposure to SHS in the home and maternal action to protect children from SHS exposure in Hong Kong.

**Methods:** Families with a smoking father and a non-smoking mother were recruited from public clinics before (2005–2006, n = 333) and after the legislation (2007–2008, n = 742) which led to a major extension of smokefree places in Hong Kong. Main outcomes included children’s SHS exposure in the home, nicotine level in mothers’ and children’s hair and home environment, mothers’ action to protect children from SHS, and their support to the fathers to quit.

**Results:** Fewer mothers post-legislation reported children’s SHS exposure in the home (87.2% versus 29.3%, p < 0.01), which was consistent with their hair nicotine levels (0.36ng/mg versus 0.04ng/mg, p < 0.01). More mothers post-legislation in the last month took their children away from cigarette smoke (6.3% versus 92.2%; p < 0.01) and advised fathers to quit over 3 times (8.3% versus 33.8%; p < 0.01). No significant change was found in the content of smoking cessation advice and the proportion of mothers who took specific action to support the fathers to quit.

**Conclusions:** SHS exposure in the home decreased and maternal action to protect children from SHS increased after the 2007 smokefree legislation. Maternal support to fathers to quit showed moderate improvement. Cessation services for smokers and specific interventions for smoking families should be expanded together with smokefree legislation.

Introduction

The prevalence of daily smoking in Hong Kong has declined from 23.3% in 1982 to 10.7% in 2012 [1]. Passive smoking killed 1324 people in 1998 in Hong Kong [2]. This figure was reported in advocacy campaigns to gain public support leading to the enactment of stronger smokefree legislation in October 2006, implemented from 1 January 2007. In the past two decades, smokefree legislation has been enacted or strengthened in some developed countries or regions to reduce secondhand smoke (SHS) exposure among non-smokers including children. By the end of 2007, 16 countries had passed national smokefree legislation covering all indoor workplaces and public sites [3]. Since 1 January 2007, Hong Kong extended the smokefree areas substantially, by banning smoking in all indoor workplaces, indoor areas of restaurants, shops, markets, public transport, residential care homes, indoor and outdoor areas of all educational institutions (including nurseries, kindergartens, schools and universities). Outdoor common areas such as public playgrounds, parks, beaches, barbecue sites, public swimming pools and all common areas of public housing estates (except a few outdoor smoking areas at remote corners) were also designated as smokefree areas.

Smokefree legislation is an effective intervention for smoking cessation. Previous studies found a reduction of smoking prevalence after the legislation in the United States, Canada, Italy and Scotland [4–6]. Smokefree legislation was associated with increased quit attempts in Scotland, England, and Ireland [7–10]. In Hong Kong, the 2007 smokefree legislation had a short-term effect in increasing the utilization of quitline services [11,12].

Other studies have examined the two contrasting hypotheses for the impact of smokefree legislation: displacement effect and social
diffusion of indoor smoking. Displacement effect means that the legislation reduces smoking in public, but simultaneously increases cigarette consumption in the homes and SHS exposure in other family members [15,14]. Social diffusion denotes that increasing restriction of smoking in public places would raise public awareness on SHS, resulting in more home smoking restriction [15]. The findings about these two hypothesized effects were inconsistent. Displacement effect of smoking was shown in Hong Kong and the US [13,16], but was not found in England [4,17,18], Wales [19,20], Scotland [20–22] and some European countries [23]. Some studies found that post-legislation reduction of SHS exposure was limited to non-smoking families or families with only the fathers being smokers [21,24]. Also, the SHS exposure in families with members smoking in the home showed no change between pre- and post-legislation [21,24,25].

Several studies above investigated the association between smokefree legislation and reduced SHS exposure in in-school adolescents and children aged above 4. Only one previous study specifically examined the impact of legislation on smoking behaviors of parents having children aged under 9 months [4]. Infants are vulnerable to respiratory illnesses from passive smoking as they have smaller and less developed lungs [26,27]. 165,000 children younger than 5 years in the world die every year from lower respiratory infection caused by SHS exposure [28]. The other hand, the implementation of smokefree legislation significantly reduced the hospital admissions for asthma in children [29,30]. In Hong Kong, the prevalence of daily smoking of Hong Kong males and females was 19.1% and 3.1%, respectively [1]. Paternal smoking is the major source of SHS in the home and the risk factor for respiratory or febrile illness in infants [31]. Hence, the present study targeted families with a smoking father, a non-smoking mother and a child aged 18 months or below.

Moreover, the association between smokefree legislation and maternal action to protect children from SHS in the home has not been examined. The maternal action includes bringing children away from smoking, asking smokers not to smoke near children, or giving cessation advice to smokers. Our previous study in Hong Kong found that spousal advice and support can help the smoking spouse to quit [32]. However, Chinese familial value follows Confucianism, which shapes family relationship in an expectation of respect for elders and males, in order to maintain a patriarchal and harmonious family [33]. A married woman in a Confucian, albeit highly westernized, society is less likely to challenge her husband's smoking habit [26,33].

The present study aimed to (1) examine the change of the paternal smoking behavior and quitting, (2) examine the change of the children’s SHS exposure in the home, (3) examine the change of the mothers’ action to protect their children from SHS and help the fathers to quit smoking, and (4) investigate whether the displacement or the diffusion hypothesis was supported after the extension of smokefree legislation.

Materials and Methods

Study design

We conducted an analysis based on the 3 cross-sectional survey data collected pre- and post-smokefree legislation. The pre-legislation data was drawn from two pilot randomized controlled trials (RCTs) in 2005 and 2006 [34–36]. The post-legislation data was drawn from a cross-sectional survey in 2007 and 2008. To maximize comparability, the recruitment strategy and eligibility criteria for the post-legislation survey were the same as the RCTs in 2005 and 2006. Both parents in the 2005 RCT and the post-legislation survey, and fathers in the 2006 RCT were invited to complete a standardized questionnaire. In addition, SHS exposure was assessed via nicotine level in mothers’ and children’s hair, and the level in their homes measured with nicotine monitors in the 34 families in the RCT in 2006 and 34 demographically matched families (by 7 criteria, see below) in the post-legislation survey.

Settings

Recruitment of all families was done in Maternal and Child Health Centres (MCHC) and Student Health Service Centres (SHSC) assigned by the Department of Health of the Hong Kong Government, as these centres had the largest number of clients for easier recruitment. MCHC provides free and integrated health services (e.g. vaccination and health check) for all newborn babies and all children up to the age of 3 who are Hong Kong residents. SHSC offers annual free health services to all students in primary and secondary schools including physical examination, individual health counselling and health education.

Comparison of the groups

The pre-legislation group consisted of 2005 and 2006 RCT participants. The 2005 data were from a baseline survey of a pilot RCT to test a nurse-delivered smoking hygiene intervention for non-smoking mothers to reduce SHS exposure in the household [36]. 219 families (including both fathers and mothers) were recruited from two MCHCs in the two districts of Lamtin and Yumatei from January to April 2005. All the children were aged 18 months or below.

The 2006 data were from a RCT to examine the impact of feedback on SHS exposure among non-smoking mothers and children in the home on the father’s smoking behavior [34,35]. Of the 120 screened families in two MCHCs in the two districts of Hunghom and Wan Chai and two SHSCs in two other districts of Lamtin and Sai Wan from May to October 2006, 114 (95%) consented to participate and only the fathers were required to complete the questionnaire on smoking behavior.

The post-legislation data were obtained by conducting a cross-sectional survey on the parents recruited from the four MCHCs and two SHSCs, which were the same as the 2 RCTs, plus the SHSC in one more district of Shatin, from June 2007 to August 2008. 1857 of the 12,011 (15.5%) screened families were eligible and invited to participate. 918 families (49.4%) consented and among them, 576 families (62.7%) with both parents, and 198 families (21.6%) with either one of the parents completed the survey. 144 families (15.7%) withdrew their consent. No participants in the survey reported participation in the 2005 and 2006 RCTs. In total, 742 mothers (80.8%) and 604 fathers (63.8%) completed the questionnaire.

Overall, 219 parents in the 2005 RCT, 114 fathers in the 2006 RCT, and 742 mothers and 604 fathers in the 2007–2008 survey were analyzed in the present study. For the comparison of fathers’ smoking and quitting between the pre- and post-legislation group, all father-reported data in the three surveys were used. For the comparison of children’s exposure to SHS and maternal action of protecting children from SHS exposure, only the mother-reported data from the MCHCs in 2005 RCT (n = 219) and 2007–2008 survey (n = 183, excluding those mothers with a child aged over 18 months) were included. Only 15 of the 144 children in the 2006 RCT were aged 6 years or below, so the data of 2006 RCT was excluded in the latter comparison. The comparison of nicotine level for children, mothers and the home environment was carried out with the data from the 2006 RCT and the post-legislation survey. The data is available upon request submitted to the corresponding author.
Eligibility

The inclusion criteria for the 2005 and 2006 RCTs were (1) the non-smoking mother accompanying her child to attend the selected MCHC/SHSC, (2) the child was under 12 years old, (3) the child’s father was a current smoker who smoked at least 1 cigarette per day in the past 30 days, (4) the mother, father, and child lived in the same household for at least 5 days in the past week, (5) both parents spoke Cantonese, and (6) both parents were Hong Kong residents. In order to obtain comparable samples in the post-legislation survey, the inclusion criteria were the same as the two RCTs. For the two RCTs and the survey, families with smoking fathers undergoing other smoking cessation programmes were excluded.

Procedures

For the two RCTs and the survey, parent(s) attending the selected MCHCs with their child on a selected date or students visiting the selected SHSCs with their parent(s) were invited to participate. Trained research assistants approached the families in the study sites and screened for their eligibility. After obtaining consent from both parents, the research staff administered a standardized and structured questionnaire for each participant at the study site. In case the father was absent at the study site, the research staff called him to obtain verbal consent and complete the survey via telephone within two days.

Variables in the self-administered questionnaire

The main outcomes were father-reported daily cigarette consumption, Fagerstrom Score of Nicotine Dependence [37], situations of smoking, quit attempt experience, stage of change in the Transtheoretical Model of Change [38], mother-reported children’s exposure to SHS, and mothers’ action to protect children from SHS. Details are shown in Table S1 in File S1.

Direct measurements of SHS exposure

SHS exposure was assessed by hair nicotine level of the mothers and children, and air nicotine level in the home. The procedures of collecting the test samples were parts of a multinational study of SHS exposure among women and children in 2006 [35]. Hair samples were collected in 34 families in the intervention group of the 2006 RCT and 34 demographically matched families in the post-legislation survey. Due to budget constraint in the 2006 RCT, only 34 of the 114 families could be included in the intervention group in which the nicotine level was measured. The cost of performing the nicotine measurement for all the participants in the post-legislation survey was high, and to ensure comparability across the study sites, we telephoned the father to obtain a verbal consent followed by written consent to the interview and the collection of saliva samples from the selected SHSCs with their parent(s) were invited to participate. Trained research assistants approached the families in the study sites and screened for their eligibility. After obtaining consent from both parents, the research staff administered a standardized and structured questionnaire for each participant at the study site. In case the father was absent at the study site, the research staff called him to obtain verbal consent and complete the survey via telephone within two days.

Variables in the self-administered questionnaire

The main outcomes were father-reported daily cigarette consumption, Fagerstrom Score of Nicotine Dependence [37], situations of smoking, quit attempt experience, stage of change in the Transtheoretical Model of Change [38], mother-reported children’s exposure to SHS, and mothers’ action to protect children from SHS. Details are shown in Table S1 in File S1.

Direct measurements of SHS exposure

SHS exposure was assessed by hair nicotine level of the mothers and children, and air nicotine level in the home. The procedures of collecting the test samples were parts of a multinational study of SHS exposure among women and children in 2006 [35]. Hair samples were collected in 34 families in the intervention group of the 2006 RCT and 34 demographically matched families in the post-legislation survey. Due to budget constraint in the 2006 RCT, only 34 of the 114 families could be included in the intervention group in which the nicotine level was measured. The cost of performing the nicotine measurement for all the participants in the post-legislation survey was high, and to ensure comparability across the study sites, we telephoned the father to obtain a verbal consent followed by written consent to the interview and the collection of saliva samples from the selected SHSCs with their parent(s) were invited to participate. Trained research assistants approached the families in the study sites and screened for their eligibility. After obtaining consent from both parents, the research staff administered a standardized and structured questionnaire for each participant at the study site. In case the father was absent at the study site, the research staff called him to obtain verbal consent and complete the survey via telephone within two days.

Variables in the self-administered questionnaire

The main outcomes were father-reported daily cigarette consumption, Fagerstrom Score of Nicotine Dependence [37], situations of smoking, quit attempt experience, stage of change in the Transtheoretical Model of Change [38], mother-reported children’s exposure to SHS, and mothers’ action to protect children from SHS. Details are shown in Table S1 in File S1.

Direct measurements of SHS exposure

SHS exposure was assessed by hair nicotine level of the mothers and children, and air nicotine level in the home. The procedures of collecting the test samples were parts of a multinational study of SHS exposure among women and children in 2006 [35]. Hair samples were collected in 34 families in the intervention group of the 2006 RCT and 34 demographically matched families in the post-legislation survey. Due to budget constraint in the 2006 RCT, only 34 of the 114 families could be included in the intervention group in which the nicotine level was measured. The cost of performing the nicotine measurement for all the participants in the post-legislation survey was high, and to ensure comparability across the study sites, we telephoned the father to obtain a verbal consent followed by written consent to the interview and the collection of saliva samples from the selected SHSCs with their parent(s) were invited to participate. Trained research assistants approached the families in the study sites and screened for their eligibility. After obtaining consent from both parents, the research staff administered a standardized and structured questionnaire for each participant at the study site. In case the father was absent at the study site, the research staff called him to obtain verbal consent and complete the survey via telephone within two days.

Variables in the self-administered questionnaire

The main outcomes were father-reported daily cigarette consumption, Fagerstrom Score of Nicotine Dependence [37], situations of smoking, quit attempt experience, stage of change in the Transtheoretical Model of Change [38], mother-reported children’s exposure to SHS, and mothers’ action to protect children from SHS. Details are shown in Table S1 in File S1.

Direct measurements of SHS exposure

SHS exposure was assessed by hair nicotine level of the mothers and children, and air nicotine level in the home. The procedures of collecting the test samples were parts of a multinational study of SHS exposure among women and children in 2006 [35]. Hair samples were collected in 34 families in the intervention group of the 2006 RCT and 34 demographically matched families in the post-legislation survey. Due to budget constraint in the 2006 RCT, only 34 of the 114 families could be included in the intervention group in which the nicotine level was measured. The cost of performing the nicotine measurement for all the participants in the post-legislation survey was high, and to ensure comparability across the study sites, we telephoned the father to obtain a verbal consent followed by written consent to the interview and the collection of saliva samples from the selected SHSCs with their parent(s) were invited to participate. Trained research assistants approached the families in the study sites and screened for their eligibility. After obtaining consent from both parents, the research staff administered a standardized and structured questionnaire for each participant at the study site. In case the father was absent at the study site, the research staff called him to obtain verbal consent and complete the survey via telephone within two days.

Variables in the self-administered questionnaire

The main outcomes were father-reported daily cigarette consumption, Fagerstrom Score of Nicotine Dependence [37], situations of smoking, quit attempt experience, stage of change in the Transtheoretical Model of Change [38], mother-reported children’s exposure to SHS, and mothers’ action to protect children from SHS. Details are shown in Table S1 in File S1.

Direct measurements of SHS exposure

SHS exposure was assessed by hair nicotine level of the mothers and children, and air nicotine level in the home. The procedures of collecting the test samples were parts of a multinational study of SHS exposure among women and children in 2006 [35]. Hair samples were collected in 34 families in the intervention group of the 2006 RCT and 34 demographically matched families in the post-legislation survey. Due to budget constraint in the 2006 RCT, only 34 of the 114 families could be included in the intervention group in which the nicotine level was measured. The cost of performing the nicotine measurement for all the participants in the post-legislation survey was high, and to ensure comparability across the study sites, we telephoned the father to obtain a verbal consent followed by written consent to the interview and the collection of saliva samples from the selected SHSCs with their parent(s) were invited to participate. Trained research assistants approached the families in the study sites and screened for their eligibility. After obtaining consent from both parents, the research staff administered a standardized and structured questionnaire for each participant at the study site. In case the father was absent at the study site, the research staff called him to obtain verbal consent and complete the survey via telephone within two days.

Variables in the self-administered questionnaire

The main outcomes were father-reported daily cigarette consumption, Fagerstrom Score of Nicotine Dependence [37], situations of smoking, quit attempt experience, stage of change in the Transtheoretical Model of Change [38], mother-reported children’s exposure to SHS, and mothers’ action to protect children from SHS. Details are shown in Table S1 in File S1.

Direct measurements of SHS exposure

SHS exposure was assessed by hair nicotine level of the mothers and children, and air nicotine level in the home. The procedures of collecting the test samples were parts of a multinational study of SHS exposure among women and children in 2006 [35]. Hair samples were collected in 34 families in the intervention group of the 2006 RCT and 34 demographically matched families in the post-legislation survey. Due to budget constraint in the 2006 RCT, only 34 of the 114 families could be included in the intervention group in which the nicotine level was measured. The cost of performing the nicotine measurement for all the participants in the post-legislation survey was high, and to ensure comparability across the study sites, we telephoned the father to obtain a verbal consent followed by written consent to the interview and the collection of saliva samples from the selected SHSCs with their parent(s) were invited to participate. Trained research assistants approached the families in the study sites and screened for their eligibility. After obtaining consent from both parents, the research staff administered a standardized and structured questionnaire for each participant at the study site. In case the father was absent at the study site, the research staff called him to obtain verbal consent and complete the survey via telephone within two days.
the home, was less frequently reported post-legislation; though the proportion reporting smoking when their children were not nearby increased significantly (post: 41%, pre: 22.4%, $p<0.01$). The differences in the smoking situations from the crude comparisons were further supported by the significant odds ratios after the adjustment of other covariates. The father’s Fagerstrom Score of Nicotine Dependence between pre- and post-legislation showed no significant difference when analyzed as ordinal categories (Adj. OR from ordinal regression model $= 0.88$, 95% CI $0.60$–$1.29$), but the post-legislation group had a significantly lower mean score than the pre-legislation group (post: 2.88, pre: 2.96, $p=0.04$).

There were no significant differences in reducing smoking and quit attempt between the pre- and post-legislation group, but the proportion at the action stage of quitting was higher post-legislation (post: 4.9%, pre: 0%, $p<0.01$).

Mother-reported children’s exposure to SHS and nicotine level in hair and home environment

Table 2 shows that the hair nicotine level in mothers and children post-legislation was lower based on the Mann-Whitney U test. The air nicotine level in the home was low and nearly undetectable pre- and post-legislation, which is consistent with the finding that the proportions of father’s smoking at home between pre- and post-legislation were similar (pre: 94.2%, post: 79.4%, $p=0.07$). Table 3 shows, as reported by mothers, more fathers post-legislation did not smoke at home (pre: 10.1%, post: 37.7%, $p<0.01$). 85.4% of fathers post-legislation did not smoke near the children, compared with 17.0% pre-legislation ($p<0.01$). 29.3% of children post-legislation were exposed to SHS in the home, compared with 87.2% pre-legislation ($p<0.01$). All the odds ratios in Table 3 were significantly smaller than 1, meaning that the odds

### Table 1. Father-reported smoking and quitting pre- and post-legislation.

|                        | Pre-legislation 2005–2006 (n = 333) | Post-legislation 2007–2008 (n = 604) | Adjusted odds ratios (95% CI)/Regression coefficient | p-value for the adjusted odds ratios |
|------------------------|-------------------------------------|--------------------------------------|-----------------------------------------------------|-------------------------------------|
| Mean daily cigarette consumption in the past week | | | 1.56(1.08, 2.24) | 0.01 |
| More than 30 cigarettes | 9(2.8) | 16(2.7) | | |
| 21–30 cigarettes | 20(6.2) | 47(8.0) | | |
| 11–20 cigarettes | 189(58.7) | 300(50.9) | | |
| 10 cigarettes or below | 103(32.0) | 226(38.4) | | |
| Mean daily cigarette consumption when smoked most heavily (SD) | 23.4(11.7) | 19.1 (13.9) | −4.87 | <0.01 |
| Fagerstrom Nicotine Dependence Test | 0.88(0.60, 1.29) | | 0.52 |
| Mild (Score 0–3) | 203(63.0) | 358(61.9) | | |
| Moderate (Score 4–5) | 82(25.5) | 143(24.7) | | |
| Severe (Score 6–10) | 37(11.5) | 77(13.3) | | |
| Mean score (SD) | 3.0(2.0) | 2.9(2.2) | −0.39 | 0.04 |
| Situations when smoked | | | | |
| At home | 211(65.5) | 228(38.5) | 0.180(0.12, 0.28) | <0.01 |
| At work | 233(72.4) | 356(60.2) | 0.350(0.23, 0.54) | <0.01 |
| When relaxing | 275(85.4) | 324(54.7) | 0.090(0.05, 0.17) | <0.01 |
| When felt bored/want to kill time | 275(85.4) | 312(52.7) | 0.070(0.03, 0.13) | <0.01 |
| Wanted to increase concentration | 60(18.6) | 159(26.9) | 1.95(1.20, 3.17) | 0.01 |
| Felt anxious | 253(78.6) | 182(30.7) | 0.060(0.04, 0.10) | <0.01 |
| In the absence of my children | 72(22.4) | 243(41.0) | 2.77(1.76, 4.34) | <0.01 |
| Smokers around | 273(84.8) | 265(44.8) | 0.050(0.03, 0.10) | <0.01 |
| After meal | 289(89.8) | 386(65.2) | 0.050(0.02, 0.11) | <0.01 |
| Drinking alcohol | 148(46.0) | 227(38.3) | 0.780(0.53, 1.13) | 0.11 |
| Quitting | | | | |
| Tried to reduce smoking | 246(76.4) | 471(78.0) | 0.940(0.61, 1.45) | 0.78 |
| Had previous quit attempt | 194(60.6) | 363(61.7) | 0.930(0.64, 1.36) | 0.72 |
| Stage of readiness to quit | | | | |
| Pre-contemplation | 304(94.4) | 509(86.9) | 3.74(1.93, 7.24) | <0.01 |
| Contemplation | 13(4.0) | 40(6.8) | | |
| Preparation | 5(1.6) | 8(1.4) | | |
| Action | 0(0.0) | 29(4.9) | | |

Remark: For all regression models, odds ratios and regression coefficients were adjusted by age (father, mother & child), father’s education level, years of father’s smoking, father’s perceived health status, child’s consultation to doctor in the past month, household income level and number of children at home. Missing data were excluded from analysis.

doi:10.1371/journal.pone.0105781.t001
of being in the worse outcome categories in the post-legislation group were smaller than the pre-legislation group. Fathers post-legislation were less likely to smoke near children or in the home, and children were less likely to be exposed to SHS in the home or near other smokers.

### Table 2. Nicotine level in mothers’ and children’s hair and home environment pre- and post-legislation.

| Nicotine level                        | Pre-legislation 2006 (n = 34) | Post-legislation 2007–2008 (n = 34) | p-value for Mann-Whitney U test |
|---------------------------------------|--------------------------------|-------------------------------------|---------------------------------|
| Child’s hair in ng/mg, Median (Range) | 0.36 (0.09–11.88)            | 0.04 (0.01–0.58)                    | <0.01                           |
| Mother’s hair in ng/mg, Median (Range)| 0.29 (0.09–1.16)             | 0.03 (0.01–9.74)                    | <0.01                           |
| Air at home µg/m³, Median (Range)     | 0.01 (0.004–0.27)            | 0.01 (0.001–0.73)                   | 0.58                            |

Remark: Missing data were excluded from analysis. doi:10.1371/journal.pone.0105781.t002

### Table 3. Mother-reported father’s smoking behavior at home and children’s exposure to SHS pre- and post-legislation.

| Pre-legislation 2005 (n = 219) | Post-legislation 2007–2008 (n = 183) | Adjusted odds ratios (95% CI) | p-value for the adjusted odds ratios |
|---------------------------------|---------------------------------------|--------------------------------|-------------------------------------|
| Father’s cigarette consumption within 10 feet of the child in the past week |                                      | 0.05(0.02, 0.09) | <0.01 |
| None                           | 37(17.0)                             | 152(85.4)                     |                                    |
| Less than 1 cigarette per day  | 75(34.4)                             | 10(5.6)                       |                                    |
| 1–4 cigarettes                 | 83(38.1)                             | 12(6.7)                       |                                    |
| 5–14 cigarettes                | 21(9.6)                              | 3(1.7)                        |                                    |
| More than 14 cigarettes        | 2(0.9)                               | 1(0.6)                        |                                    |
| Father’s daily cigarette consumption at home in the past week |                                      | 0.40(0.23, 0.70) | <0.01 |
| None                           | 22(10.1)                             | 58(37.7)                      |                                    |
| Less than 1 cigarette per day  | 31(14.2)                             | 3(1.9)                        |                                    |
| 1–4 cigarettes                 | 125(57.3)                            | 69(44.8)                      |                                    |
| 5–14 cigarettes                | 38(17.4)                             | 22(14.3)                      |                                    |
| More than 14 cigarettes        | 2(0.9)                               | 2(1.3)                        |                                    |
| Number of smokers (excluding father) smoked within 10 feet of the child in the past week |                                      | 0.05(0.02, 0.10) | <0.01 |
| 0                              | 67(30.6)                             | 165(91.7)                     |                                    |
| 1                              | 138(63.0)                            | 13(7.2)                       |                                    |
| 2                              | 12(5.5)                              | 2(1.1)                        |                                    |
| 3 or above                     | 2(0.9)                               | 0(0.0)                        |                                    |
| Child’s SHS exposure in the home |                                      | 0.08(0.04, 0.14) | <0.01 |
| No exposure                    | 28(12.8)                             | 128(70.7)                     |                                    |
| Occasional                     | 86(39.3)                             | 36(19.9)                      |                                    |
| 1 hour per day                 | 57(26.0)                             | 11(6.1)                       |                                    |
| 2–4 hours per day              | 45(20.5)                             | 3(1.7)                        |                                    |
| 5–7 hours per day              | 2(0.9)                               | 2(1.1)                        |                                    |
| 8–10 hours per day             | 1(0.5)                               | 1(0.6)                        |                                    |

Remark: Values are number (%). For all regression models, odds ratios were adjusted by age (father, mother & child), father’s education level, years of father smoking, father’s perceived health status, child’s consultation to doctor past month, household income level, and number of children at home. Missing data were excluded from analysis.

doi:10.1371/journal.pone.0105781.t003

### Mother’s action to protect children from SHS

Table 4 shows that in mothers whose children were exposed to SHS, the mothers post-legislation were more likely to take their children away from SHS than pre-legislation (pre: 6.3%, post: 92.2%, p<0.01), placed a ‘No-Smoking’ sign at home (pre: 0.5%, post: 17.6%, p = 0.01) and advised the fathers to avoid smoking near their children (pre: 69.1%, post: 86.3%, p = 0.03). Over 90%
of mothers pre- and post-legislation advised the fathers to reduce smoking, avoid smoking at home or avoid smoking near the children. The proportion of mothers who did not advise the fathers to quit in the past month was similar between pre- and post-legislation (pre: 34.2%, post: 35.9%), but more mothers post-legislation advised 3 times or more (pre: 8.3%, post: 33.1%, p < 0.01). There were no significant differences in the proportion of mothers who had action (pre: 23.1%, post: 26.7%, p = 0.62) and gave support to help fathers quit (pre: 28.2%, post: 31.9%,

Table 4. Mother’s action in protecting the child from SHS exposure, and mother’s advice and support in helping father to quit pre- and post-legislation.

| Protection of child from SHS exposure, among those whose children were exposed to secondhand smoke | Pre-legislation 2005 n(%) | Post-legislation 2007–2008 n(%) | Adjusted odds ratios (95% CI) | p-value for the adjusted odds ratios |
|---------------------------------|--------------------------|-------------------------------|-------------------------------|-------------------------------------|
| Took the child away from smoke | 12(6.3)                  | 47(92.2)                     | 325.29(40.21, 2631.69)        | <0.01                               |
| Opened the window               | 186(97.4)                | 44(86.3)                     | 0.05(0.006, 0.43)             | 0.01                                |
| Placed a 'No-Smoking' sign at home | 1(0.5)                | 9(17.6)                      | 21.01(2.13, 207.54)           | 0.01                                |
| Advised father to reduce smoking | 185(96.9)              | 47(92.2)                     | 0.70(0.06, 8.81)              | 0.78                                |
| Advised father to avoid smoking at home | 168(88.0)          | 45(88.2)                     | 2.21(0.59, 8.21)              | 0.24                                |
| Advised father to avoid smoking near the child | 132(69.1)          | 44(86.3)                     | 3.68(1.15, 11.75)             | 0.03                                |

| Number of mothers’ advice to the fathers to quit in past month, all mothers | Pre-legislation 2005 n(%) | Post-legislation 2007–2008 n(%) | Adjusted odds ratios (95% CI) | p-value for the adjusted odds ratios |
|---------------------------------------------------------------------------|--------------------------|-------------------------------|-------------------------------|-------------------------------------|
| Never | 75(34.2) | 65(35.9) | 1.22(0.56, 2.67) | 0.62 |
| Advised 1–3 times | 126(57.5) | 56(30.9) | 5.44(0.55, 53.53) | 0.15 |
| Advised 4–6 times | 14(6.4) | 20(11.0) | 0.97(0.27, 3.45) | 0.96 |
| Advised 7–9 times | 3(1.4) | 6(3.3) | 6.79(0.51, 91.17) | 0.15 |
| Advised more than 9 times | 1(0.5) | 34(18.8) | 3.68(1.15, 11.75) | 0.03 |

| Content of smoking cessation advice, among those mothers who advised fathers to quit | Pre-legislation 2005 n(%) | Post-legislation 2007–2008 n(%) | Adjusted odds ratios (95% CI) | p-value for the adjusted odds ratios |
|----------------------------------------------------------------------------------|--------------------------|-------------------------------|-------------------------------|-------------------------------------|
| Reminded him about the benefit to the child’s health | 55(38.5) | 63(54.3) | 1.64(0.82, 3.30) | 0.16 |
| Reminded him that smoking can lead to death | 37(25.9) | 37(31.9) | 1.31(0.62, 2.77) | 0.49 |
| Reminded him that quit smoking can save money | 41(28.7) | 32(27.6) | 0.73(0.34, 1.56) | 0.41 |

| Mothers’ action to help fathers quit, among those mothers who advised the fathers to quit | Pre-legislation 2005 n(%) | Post-legislation 2007–2008 n(%) | Adjusted odds ratios (95% CI) | p-value for the adjusted odds ratios |
|----------------------------------------------------------------------------------|--------------------------|-------------------------------|-------------------------------|-------------------------------------|
| Any action done | 33(23.1) | 31(26.7) | 1.22(0.56, 2.67) | 0.62 |
| Set a quit date for him | 1(0.7) | 5(4.3) | 5.44(0.55, 53.53) | 0.15 |
| Removed all the smoking-related utensils | 9(7.8) | 9(6.3) | 0.97(0.27, 3.45) | 0.96 |
| Placed a ‘no-smoking’ sign at home | 1(0.7) | 7(6.0) | 6.79(0.51, 91.17) | 0.15 |
| Requested others not to smoke near the father | 9(6.3) | 5(4.3) | 1.72(0.23, 12.83) | 0.60 |
| Gave father smoking cessation booklet | 19(13.3) | 8(6.9) | 0.36(0.12, 1.14) | 0.08 |
| Advised to seek professional help | 2(1.4) | 9(7.8) | 10.05(1.47, 68.60) | 0.02 |
| Discussed with father of needs in quitting | 1(0.7) | 10(8.6) | 1.64(0.82, 3.30) | 0.16 |

| Mothers’ support in helping fathers quit, among those who advised fathers to quit | Pre-legislation 2005 n(%) | Post-legislation 2007–2008 n(%) | Adjusted odds ratios (95% CI) | p-value for the adjusted odds ratios |
|----------------------------------------------------------------------------------|--------------------------|-------------------------------|-------------------------------|-------------------------------------|
| Any support given | 40(28.2) | 36(31.9) | 1.06(0.50, 2.24) | 0.88 |
| Complimented father when he did not smoke | 11(7.7) | 21(18.6) | 3.55(1.17, 10.76) | 0.02 |
| Congratulated him for decided to quit | 2(1.4) | 4(3.5) | 3.29(0.27, 39.47) | 0.35 |
| Helped father to think of substitutes for cigarettes | 30(21.1) | 7(6.2) | 0.35(0.12, 1.05) | 0.06 |
| Comforted father when he was feeling stressed or irritated | 9(6.3) | 6(5.3) | 0.64(0.14, 2.96) | 0.57 |
| Expressed confidence in father’s ability to quit/remain quitting | 5(3.5) | 2(1.8) | 0.10(0.01, 1.86) | 0.12 |
| Expressed pleasure at father’s effort to quit | 6(4.2) | 9(8.0) | 1.80(0.38, 8.49) | 0.45 |
| Helped father to use substitutes for cigarettes | 19(13.4) | 1(0.9) | 0.07(0.01, 0.59) | 0.02 |

Remark: Values are number (%). For all regression models, odds ratios and regression coefficients were adjusted by age (father, mother & child), father’s education level, years of father smoking, father’s perceived health status, child’s consultation to doctor past month, household income level and number of children at home. Missing data were excluded from analysis.

doi:10.1371/journal.pone.0105781.t004
Interpretation of findings

Summary of results

Based on the report from both fathers and mothers, smoking at home and SHS exposure among children in the home appeared to decrease after the legislation, where was consistent with the reduced hair nicotine level in both children and mothers. These findings are consistent with the hypothesis of social diffusion [15,23], such that the provision and promotion of smokefree legislation would increase the public approbation on reducing SHS exposure in the indoor environment and encourage more families to create a smokefree home. A study in Scotland supported that such legislation influenced parents to create a smokefree home through increasing their knowledge about the health hazards from SHS and desire to be seen as a caring and socially acceptable model [39]. The displacement hypothesis was not supported, and this is interesting as the present results were observed in a patriarchal society with most smokers being male. In Hong Kong, a large proportion of the population live in densely-populated apartments, and most environments nearby these apartments, especially in public housing estates, were designated as smokefree areas. However, the 2007 smokefree legislation with extensive prohibition of smoking in the outdoor areas was associated with subsequent reduction of fathers’ smoking at home and SHS exposure in their children. Nevertheless, our conclusion is not consistent with another Hong Kong study by Ho et al. (2010), which supported the displacement hypothesis. The inconsistency might be due to the different study design and the children’s age. Ho et al. (2010) included in-school adolescents (equivalent to US grades 2–4, aged 6 to 9), but the present study included much younger children aged 18 months or below. Mothers with younger children might be more concerned about the adverse effect of SHS and more influenced by the legislation, and hence took more action to protect their children from SHS than mothers with older children.

Our finding supported that more families post-legislation created a smokefree home, which might lead to the reduced SHS exposure in children in the home. This is consistent with another finding that the hair nicotine level in mothers’ and children’s hair post-legislation was lower than pre-legislation. Due to the warmer temperature and thicker walls in houses in Hong Kong [35], the air nicotine level in the home was nearly undetectable and thus we had limited biochemical evidence to support the change of smoking behavior at home. However, over 60% of the fathers post-legislation reported that they still smoked at home while their children were not there. Increasing studies showed that tobacco smoke can stick to indoor surfaces and release later as “third-hand smoke” [40,41]. Third-hand smoke can accumulate in smokers’ home and pose additional health hazards through dermal exposure and inhalation [42]. This means that children and others can still be exposed to the hazards of smoking even if the smokers do not smoke near them. In order to achieve zero exposure to SHS and third-hand smoke in the home, a smokefree home should be advocated.

Discussion

Policy implication

Publicity campaigns and policy implementation were shown to be effective in promoting smoking cessation and utilization of cessation service, especially in the context of the smokefree legislation [11,12]. However, the lack of comprehensive and persistent cessation campaigns and insufficient funding for cessation services with the implementation of smokefree legislation in Hong Kong were major limitations. According to the budget of Department of Health, the budget for law enforcement increased from US$0.9 million (US$1 = HK$7.8) in 2006 (pre-legislation) to US$3 million in 2007 (post-legislation) [43]. The budget for publicity work of Hong Kong Council for Smoking and Health (COSH) increased from US$0.4 million in 2005 (pre-legislation) to US$1.1 million in 2007 (post-legislation) [14,45]. Much more resources were allocated to publicity and enforcement of the smokefree legislation (e.g. manpower for patrol and prosecution work). However, smoking cessation services were extended in January 2009, which was two years after the implementation of the new legislation. Legislation can have stronger effect to increase quit attempts, if it is implemented together with early and massive social marketing campaigns for smoking cessation, specific interventions for families and available cessation services.

Limitations

The strength of this study was the specific focus on the smoking families with younger children. Also, both self-reported smoking
status at home and direct measurement of nicotine level were analyzed. MCHCs and SHSCs were selected as the recruitment sites because about 73% of the newborn babies, 95% of the primary school students and 80% of the secondary school students in Hong Kong received the free health services in MCHCs and SHSCs respectively [46,47]. However, due to the limited resources and permission from the Department of Health, only 4 of 32 MCHCs and 2 of 12 SHSCs were selected, which might reduce representativeness of the sample.

The present study had several limitations. Firstly, the RCTs in 2005 and 2006 were not specifically designed to evaluate the effect of the smokefree legislation. The demographic characteristics of the pre- and post-legislation samples showed some differences, which could lead to bias for comparison. To increase the comparability, the post-legislation survey had the same recruitment sites and eligibility criteria with the previous two RCTs. Also, the effect of legislation in the regression models was examined with the adjustment of the significant demographic variables. Secondly, the present study had a smaller sample size than most of the other population-based studies. Due to the limited number of recruitment sites, we pooled the subjects from MCHCs and SHSCs to maximize the sample size, but this might increase the heterogeneity of the subjects. Thirdly, Hong Kong has been commended for effective and evidence-based tobacco control [48]. It would be difficult to differentiate between the impact of smokefree legislation and other measures in the past, although there was no increase in tobacco tax and no substantial change of tobacco control measures during the study period. Future studies may consider comparing the impact of smokefree legislation with other places with a similar history of tobacco control. Lastly, this study was not a cohort study. Our findings were based on 3 cross-sectional surveys of smoking families and smokers at three time points, hence the causal inference on the differences in the outcomes is limited.

Conclusion

Our findings showed the additional benefits of the smokefree legislation in Hong Kong, which extended the prohibition of smoking to all indoor workplaces and many outdoor areas, in reducing SHS exposure in younger children in the home and increasing mothers’ action to protect their children from SHS. More effort in increasing cessation services and supporting mothers in helping the fathers to quit together with other strong tobacco control policies is needed.

Supporting Information

File S1 Supporting tables. Table S1, All outcomes in the analysis. Table S2, Socio-demographic characteristics of fathers and mothers pre- and post-legislation. Table S3, Socio-demographic characteristics of fathers, mothers and children between 2005 RCT and 2007 survey. (DOCX)

Acknowledgments

We are grateful to the staff of the Department of Health Maternal and Child Health Centres and Student Health Service Centres for their kind support in subject recruitment. We thank Mr Bernard Yeung and Miss Tracy Cheung who coordinated the project. Finally, we acknowledge the HKU student helpers for their dedication in assisting data collection.

Author Contributions

Conceived and designed the experiments: SSCC DYPL YWM GML. Performed the experiments: SSCC DYPL YWM. Analyzed the data: SSCC DYPL YWM GML. Contributed reagents/materials/analysis tools: SSCC YTD. Contributed to the writing of the manuscript: SSCC YTDG THL.

References

1. Census & Statistics Department [Hong Kong SAR government] (2013) Thematic Household Survey, Report No. 53: Pattern of Smoking. Hong Kong: Census & Statistics Department.
2. McGhee SM, Ho SY, Schooling M, Ho LM, Thomas GN, et al. (2005) Mortality associated with passive smoking in Hong Kong. BMJ 330: 287–289.
3. United Nations (2009) The Millennium Development Goals Report 2009. New York United nations.
4. Hawkins SS, Cole TJ, Law C (2011) Examining smoking behaviours among parents of children in the UK Millennium Cohort Study after the smoke-free legislation in Scotland. Tobacco Control 20: 112–118.
5. Bajoga U, Lewis S, McNell A, Szakowski L (2011) Does the introduction of comprehensive smokefree legislation lead to a decrease in population smoking prevalence? Addiction 106: 1346–1354.
6. Gorini G, Costantini AS, Pisi E (2007) Smoking prevalence in Italy after the smoking ban: Towards a comprehensive evaluation of tobacco control programs in Europe. Preventive Medicine 45: 123–124.
7. Hackshaw L, McEwen A, West R, Bauld L (2010) Quit attempts in response to smoke-free legislation in England. Tobacco Control 19: 160–164.
8. Fowkes FJ, Stewart MCW, Fowkes FGR, Amos A, Price JF (2008) Scottish smoke-free legislation and trends in smoking cessation. Addiction 103: 1888–1895.
9. Nagelhout GE, de Vries H, Boudreau C, Allwright S, McNell A, et al. (2012) Comparative impact of smoke-free legislation on smoking cessation in three European countries. The European Journal of Public Health 22: 4–9.
10. Mackay DF, Haw S, Pell JP (2011) Impact of Scottish smoke-free legislation on smoking quit attempts and prevalence. PLoS ONE 6: e26188.
11. Chan SSC, Wong DCM, Fong DYT, Leung AYM, Mak YW, et al. (2009) Short-term impact of new smoke-free legislation on the utilization of a quilton in Hong Kong. Nicotine & Tobacco Research 11: 356–361.
12. Tobacco Control Office Department of Health (2011) TCO 10th Anniversary Booklet. Hong Kong: Tobacco Control Office, Department of Health, The Government of the Hong Kong Special Administrative Region.
13. Ho SY, Wang MP, Lo WS, Mak KK, Lai HK, et al. (2010) Comprehensive smoke-free legislation and displacement of smoking into the homes of young children in Hong Kong. Tobacco Control 19: 129–133.
14. Addis J, Cornaglia F (2010) The effect of bans and taxes on passive smoking. American Economic Journal: Applied Economics 2: 1–32.
15. Mons U, Nagelhout GE, Allwright S, Guignard R, van den Putte B, et al. (2012) Impact of national smoke-free legislation on home smoking bans: findings from the International Tobacco Control Policy Evaluation Project Europe Surveys. Tobacco Control.
16. Addis J, Cornaglia F (2006) The Effect of Taxes and Bans on Passive Smoking [IA Discussion Paper No. 2191].
17. Jarvis MJ, Sims M, Gilmore A, Mindell J (2012) Impact of smoke-free legislation on children’s exposure to secondhand smoke: cotinine data from the Health Survey for England. Tobacco Control 21: 18–23.
18. Sims M, Bauld L, Gilmore A (2012) England’s legislation on smoking in indoor public places and workplaces: impact on the most exposed children. Addiction: 1–32.
19. Holliday J, Moore G, Moore L (2009) Changes in child exposure to secondhand smoke after implementation of smoke-free legislation in Wales: a repeated cross-sectional study. BMC Public Health 9: 430.
20. Moore GF, Currie D, Gilmore G, Holliday JC, Moore L (2012) Socioeconomic inequalities in childhood exposure to secondhand smoke before and after smoke-free legislation in three UK countries. Journal of Public Health.
21. Akhtar PC, Currie DB, Currie CE, Hao SJ (2007) Changes in child exposure to environmental tobacco smoke (CHETS) study after implementation of smoke-free legislation in Scotland: national cross-sectional survey. BMJ 335: 545.
22. Akhtar PC, Hao SJ, Levin KA, Currie DB, Zachary R, et al. (2010) Socioeconomic differences in second-hand smoke exposure among children in Scotland after introduction of the smoke-free legislation. Journal of Epidemiology and Community Health 64: 341–346.
23. Mons U, Nagelhout GE, Allwright S, Guignard R, van den Putte B, et al. (2013) Impact of national smoke-free legislation on home smoking bans: findings from the International Tobacco Control Policy Evaluation Project Europe Surveys. Tobacco Control 22: e2–e9.
24. Hao SJ, Gruer L (2007) Changes in exposure of adult non-smokers to secondhand smoke after implementation of smoke-free legislation in Scotland: national cross sectional survey. BMJ 335: 549.
25. Dove MS, Dockery DW, Connolly GN (2010) Smoke-Free Air Laws and Secondhand Smoke Exposure Among Nonsmoking Youth. Pediatrics 126: 80–87.
26. Cheraghi M, Salvi S (2009) Environmental tobacco smoke (ETS) and respiratory health in children. European Journal of Pediatrics 168: 982–985.
27. Strachan DP, Cook DG (1997) Health effects of passive smoking. 1. Parental smoking and lower respiratory illness in infancy and early childhood. Thorax 52: 905–914.
28. Oberg M, Jakkola MS, Woodward A, Peruga A, Prusa-Ustun A (2011) Worldwide burden of disease from exposure to second-hand smoke: a retrospective analysis of data from 192 countries. The Lancet 377: 139–146.
29. Mackay D, Haw S, Ayres JG, Fischer C, Pell JP (2010) Smoke-free Legislation and Hospitalizations for Childhood Asthma. New England Journal of Medicine 363: 1139–1145.
30. Millett C, Lee JT, Laverty AA, Glantz SA, Majeed A (2013) Hospital Admissions for Childhood Asthma After Smoke-Free Legislation in England. Pediatrics 131: e495–e501.
31. Leung GM, Ho LM, Lam TH (2004) Secondhand smoke exposure, smoking hygiene, and hospitalization in the first 18 months of life. Archives of Pediatrics & Adolescent Medicine 158: 687–693.
32. Chan SSC, Leung GM, Wong DCN, Lam TH (2008) Helping Chinese fathers quit smoking through educating their nonsmoking spouses: a randomized controlled trial. American Journal of Health Promotion 23: 31–34.
33. Mao A, Bristow K, Robinson J (2012) Caught in a dilemma: why do non-smoking women in China support the smoking behaviors of men in their families? Health Education Research.
34. Leung DYP, Chan SCS, Mak YW, Leung GM, Lam T (2010) Fathers’ smoking behaviors at home and near their children after a smoke-free legislation in Hong Kong: A two-group comparison. Circulation 122: e274.
35. Wipfli H, Avila-Tang E, Navas-Acien A, Kim S, Onicescu G, et al. (2008) Secondhand smoke exposure among women and children: evidence from 31 countries. American Journal of Public Health 98: 672–679.
36. Chan SCS, Leung YPD, Lam SL, Leung GM, et al. (2011) New anti-smoking legislation on second-hand smoke exposure of children in homes. Hong Kong Medical Journal 17: S38–42.
37. Heatherton T, Kouwlowski L, Frecker R, Fagerstrom K (1991) The Fagerstrom test for nicotine dependence: a revision of the Fagerstrom tolerance questionnaire. British Journal of Addiction 6: 1119–1127.
38. Prochaska JO, DiClemente CC (1994) The transtheoretical approach: Crossing traditional boundaries of therapy. Malabar, Fla.: Krieger.
39. Phillips R, Amos A, Ritchie D, Cunningham-Burley S, Martin C (2007) Smoking in the home after the smoke-free legislation in Scotland: qualitative study. BMJ 335: 553.
40. Becquemin MH, Berthelon JP, Bentayeb M, Attou M, Ledur D, et al. (2010) Third-hand smoking: indoor measurements of concentration and sizes of cigarette smoke particles after resuspension. Tobacco Control 19: 347–348.
41. Steinman M, Grundel LA, Pankow JF, Jacob P, Singer BC, et al. (2010) Formation of carcinogens indoors by surface-mediated reactions of nicotine with nitrous acid, leading to potential thirdhand smoke hazards. Proceedings of the National Academy of Sciences 107: 6576–6581.
42. Matt GE, Quintana PJE, Zakarian JM, Fortmann AL, Chatfield DA, et al. (2011) When smokers move out and non-smokers move in: residential thirdhand smoke pollution and exposure. Tobacco Control 20: e1.
43. Finance committee and Legislative Council of the Hong Kong Special Administrative Region (2007) Secretary for Food and Health: replies to initial written questions raised by finance committee members in examining the estimates of expenditure 2006-07, Session no.16. Hong Kong: Legislative Council.
44. Hong Kong Council on Smoking and Health (2006) Hong Kong Council on Smoking and Health: Annual report 2005-2006. Hong Kong: Hong Kong Council on Smoking and Health.
45. Hong Kong Council on Smoking and Health (2007) Hong Kong Council on Smoking and Health: Annual report 2006-2007. Hong Kong: Hong Kong Council on Smoking and Health.
46. Legislative Council of the Hong Kong Special Administrative Region (2014) LCQ18: Maternal and child health services. Available: http://www.info.gov.hk/gia/general/201401/22/P2014012206672.htm. Hong Kong. Reported on 22 January 2014.
47. Legislative Council of the Hong Kong Special Administrative Region (2009) Student Health Service. Hong Kong. Available: http://www.info.gov.hk/gia/general/200902/25/P2009022505161.htm. Reported on 25 February 2009.
48. Koplan JP, An WK, Lam RMY (2010) Hong Kong: a model of successful tobacco control in China. The Lancet 373: 1330–1331.