# Long-term effectiveness of a community-based lifestyle intervention on smoking behaviors in adults: novel findings from Middle-East

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# Abstract

Introduction

we investigated the long-term effects of a community-based lifestyle intervention on cigarette smoking and intensity, hookah, and passive smoking in a Middle-Eastern population.

Methods

We used data of adult participans of the Tehran Lipid and Glucose Study (TLGS), (10368 individuals). After excluding those with missings and lost-to-follow-ups, 4915 individials underwent triennial follow-ups for 15.8 years and 1322 received intervention. The smoking status (cigarette, hookah, passive and cigarette intensity) were compared between control and intervention using the Generalized Estimating Equation (GEE).

Results

Intervention reduced the odds of cigarette smoking in men by 27% (OR = 0.73, 95% CI = 0.56–0.96; P = 0.03). Estimated mean cigarettes/day was 1.58 lower in men in intervention group. The intervention had short-term positive effects on mens' hookah smoking at 2nd follow up (coefficient = -0.54, 95% CI= -0.94,-0.14; $P = 0.008$). The effect was not significant at long-term ($P > 0.05$). women in intervention group were 38% less likely to smoke cigarette or hookah (OR = 0.62, 95% CI = 0.42–0.91; P = 0.016) and had 33% lower odds of secondhand-smoke exposure (OR = 0.67, 95% CI = 0.54–0.84; P = 0.001).

Conclusions

A community-based lifestyle intervention have long-term effects in reducing cigarette smoking and intensity in men, along with tobacco and passive smoking in women. It could affect mens' hookah smoking only in short-term.


# Introduction

Tobacco use is still a significant public health concern worldwide [1]. The WHO Framework Convention on Tobacco Control (FCTC) declined the global tobacco use. Despite being successful in relative control of cigarette smoking, developed countries have recently encountered an increase in the use of non-cigarette tobacco, including hookah [2]. Meanwhile, the developing countries of the Eastern Mediterranean region had the weakest results in managing the tobacco epidemic [2]. Iran ratified the WHO FCTC in 2005 and has made good progress in authorizing anti-tobacco legislations [3, 4]. Yet, cigarette smoking remained steady, and hookah consumption increased over two decades [3, 5, 6].

As the smoking behavior is formed in the context of society, its prevention strategies are most effective if carried out with a community-based approach instead of an individualistic or at-risk tactic [7, 8]. Ideally, community-based interventions use multiple components (e.g. education, policy, social marketing, and/or advocacy) and intervene in different settings simultaneously (family, schools, and community). Since the high-risk behaviors co-occurance increases the risk of cardiovascular diseases [9] community-wide programs have focused on multiple behaviors. These interventions have reduced the prevalence of smoking in short-term [10]. But there is no consensus on the long-term effects, especially in developing countries [11]. The Tehran Lipid and Glucose Study (TLGS) and Isfahan healthy heart program (IHHP) in Iran are among the few examples in the Middle East. Although successful in reducing smoking in men after one year, the IHHP could not maintain its effects beyond that time [12, 13]. The TLGS intervention resulted in 70% higher cessation rate after 3.6 years [14]. After nine years, no reduction in smoking prevalence was observed in non-diabetic participants [15].

Outside the government regulations, limited interventions have targeted hookah, most of which are integrated or inspired by existing anti-smoking strategies [16]. To control hookah use, interventions that involve different levels of society seem to be more effective. Their results are primarily studied in the short term leaving their long-term effects still under discussion. Although hookah use and society's attitudes toward it are rooted in the culture and beliefs of that community, there is still no consensus on whether specific interventions are needed to control hookah [16].

The gender inequality in smoking especially in Middle-Eastern culture, impose a heavier burden of secondhand smoke (SHS) on women than men. SHS risk in woman is mostly associated with the smoking habits of men whom she lives with in the family. Anti-smoking policies have been effective in reducing passive smoke in the workplace [17], but since homes are outside government-controlled territory, the effectiveness of these laws in reducing SHS in the home environment is still debated [18]. It has even been argued that these rules sometimes lead to a shift to smoking at home [19].

With all that said, using data of the Tehran Lipid and Glucose Study (TLGS) -a unique family-based cohort in the Middle East- we aimed to investigate the long-term effects of a community-based lifestyle intervention on the cigarette, hookah, and passive smoking in an urban population of Iranian adults.

## Methods

# Study design and participants

The TLGS is an ongoing population-based cohort conducted in district 13 of Tehran. The reason for choosing district 13 was the accessibility of the data of more than 90% of the families, and generalizability of the age and socio-economic status of its population to the whole Tehranies [20]. The TLGS consists of a cross-sectional baseline (1999–2001) investigating NCDs' prevalence and risk factors, and the subsequent triennial follow-ups (starting from 2002). Three health centers in District 13 were selected and 15,005 residents aged ≥ 3 years were recruited for the TLGS study. Starting from the first follow-up, a community-based intervention started with the main aim of tackling NCDs through lifestyle modification. It was performed in one health center and included residents in the area (5,630 participants from 15,005 all recruited residents); residents under the coverage of two other health centers were used as control.

The current study was restricted to adult participants at baseline (n = 10368), of whom 1523 individuals with unknown intervention/control membership and 3253 individuals moving between these areas during the study (transients) were excluded. Of the 4078 individuals residing in the control area, 95 and 233 were excluded due to missing data on smoking/hookah and covariates, respectively. The exclusion of 157 lost to follow-up cases left 3593 individuals in the control group. The exclusions in the intervention group were also due to missing data on smoking/hookah and covariates, and lost to follow-up (18, 92, 82 individuals, respectively). It remained us with 1322 individuals in the intervention group. The final sample was followed five times, for a median of 15.8 years (Fig. 1).

The study protocol was approved by the Ethical Committee of Research Institute for Endocrine Sciences and the National Research Council of the Islamic Republic of Iran. The TLGS is registered at Iran Registry for Clinical Trials, a WHO primary registry (http://irct.ir; IRCTID: IRCT138705301058N1). All methods were carried out in accordance with relevant guidelines and regulations. Written informed consent was obtained from all subjects.

# Measurements

Outcomes. Smoking behaviors including cigarette, hookah and passive smoking were the main outcomes of the current study, assessed with standard questionnaires. At each follow-up, participants were asked about their current cigarette and hookah smoking, then those who smoked cigarette daily or occasionally reported the number of cigarettes/day referred to as smoking intensity. Passive smoking was defined as the exposure to environmental tobacco smoke (whether at home or at work).

Covariates. Socio-demographic data and health status (history of hypertension and diabetes) were collected by trained interviewers using standard questionnaires. Physical activity (PA) level was assessed using a Lipid Research Clinic (LRC) questionnaire [21] in the first phase of the TLGS and was classified as high (at least three times a week), moderate (less than three times a week), and low (no PA in the past week).

**Intervention.** The TLGS lifestyle interventions which has been described previously [22] is designed based on the results of the baseline KAP study and inspired by the experiences of previous large and successful interventional studies i.e. North Karelia [23–25]. All participants in the intervention area received the intervention which was designed so as to cover three aspects of lifestyle

(smoking, physical activity and nutrition). A professional team provided the educational content and trained health volunteers (health liaisons) to recruit participants and distribute educational materials. The TLGS intervention had three components, in each of which, smoking was one aspect of focus that we explain here in detail:

### Family-based components

Families were invited to 2-hour group sessions with 20 attendees. The participation rate was 50%, three-quarters of which were women. Hazards of smoking were one of the subjects educated via face-to-face consultations, slide and video presentations. Smokers were invited to motivational classes and then referred to cessation clinics. Families received the quarterly journal “courier of health”, booklets or pamphlets two to four times a year. These written materials contained health topics including health hazards of smoking and smoking cessation techniques. Telephone surveys showed that all households received the educational materials, but half of them read and pay attention to the content.

### Community-based components

Key health massages were delivered in religious gatherings especially in Ramadan and international occasions such as World-No-Tobacco-Day and World-Diabetes-Day. Two to four annual conferences were held in the largest conference hall in the intervention area. Evaluations showed that the participation rate of families in at least one of the communities was 80% between each two follow-ups.

### School-based components

The school-based subprogram addressed the entire school population including parents. Smoking was ban in the entire school area and for all individuals. All smokers at schools were referred to motivational classes and cessation clinics. Parents participated in annual face-to-face classes and group discussions to get acquainted with school-based lifestyle modification subprogram. Related pamphlets/brochures were distributed to empower families in creating a tobacco-free environment at home. An annual two-day seminar followed by a 45-minute Q&A session was held in schools by physicians and dietitians targeting parents to enhance their knowledge and skills on the unhealthy behaviors and how to modify them at home.

# Statistical analysis

All analyses were split on sex. Continuous and categorical baseline characteristics were reported as mean ± SD and frequency (percent), respectively. Independent samples t-test and chi-square test were used to compare continuous and categorical variables between control and intervention groups respectively. The trends of smoking status during follow-up times were compared between control and intervention groups using the Generalized Estimating Equation (GEE) models. In the GEE models, smoking status was considered as binomial dependent variable (yes = 1, no = 0) and “logit” link function and “autoregressive” working correlation matrix were considered. Smoking status in men includes current cigarette smoking, passive cigarette smoking, cigarette intensity, and current hookah smoking status. In women, the aforementioned analyses were used to investigate current smoking (either cigarette or hookah) and passive smoking. The interaction term between intervention and follow-up time was checked and when it was not significance was excluded from the GEE models. Participants’ age, education, employment, marital status, physical activity, and diabetes and each smoking habit at baseline were adjusted in the GEE models. Statistical analyses were done using STATA software version 14, and $P < 0.05$ was considered as the significance level.

# Results

Sex-specific baseline characteristics of the participants in the intervention and control groups are shown in Table 1. Mean age, employment and diabetes prevalence in men, marital status and physical activity in women, and education in both genders differed significantly between intervention and control groups. The baseline prevalence of current and passive smoking and the number of cigarettes/day is also reported in Table 1. Subsequent changes in the smoking behaviors over follow-ups in the control, intervention, and total sample are illustrated in Fig. 2.

Table 1
Baseline Characteristics of men and women based on the control and intervention groups.

| | Men (2101) | | | Women (2814) | | |
|---|---|---|---|---|---|---|
| | Control n = 1551 | Intervention n = 550 | P-value | Control n = 2042 | Intervention n = 772 | P-value |
| **Age** | 43.66 ± 15.16 | 47.07 ± 15.98 | < 0.001 | 41.92 ± 13.76 | 42.91 ± 13.93 | 0.089 |
| **Education** | | | 0.002 | | | 0.001 |
| Higher | 275 (17.7) | 72 (13.1) | | 174 (8.5) | 55 (7.1) | |
| Secondary/diploma | 850 (54.8) | 289 (52.5) | | 1037 (50.8) | 342 (44.3) | |
| Illiterate/primary | 426 (27.5) | 189 (34.4) | | 831 (40.7) | 375 (48.6) | |
| **Employment** | | | 0.025 | | | 0.668 |
| Employed | 1123 (72.4) | 370 (67.3) | | 201 (9.8) | 71 (9.2) | |
| Un-employed | 428 (27.6) | 180 (32.7) | | 1841 (90.2) | 701 (90.8) | |
| **Marital status** | | | 0.190 | | | 0.020 |
| Single, widowed, divorced | 314 (20.2) | 97 (17.6) | | 408 (20) | 186 (24.1) | |
| Currently married | 1237 (79.8) | 453 (82.4) | | 1634 (80) | 586 (75.9) | |
| **Health status** | | | | | | |
| Hypertension | 343 (22.1) | 125 (22.7) | 0.766 | 475 (23.3) | 200 (25.9) | 0.151 |
| Diabetes | 144 (9.3) | 74 (13.5) | 0.007 | 244 (11.9) | 95 (12.3) | 0.795 |
| Obesity | 211 (13.6) | 90 (16.4) | 0.119 | 629 (30.8) | 235 (30.4) | 0.891 |
| **Physical Activity** | | | 0.645 | | | 0.007 |
| Low | 976 (62.9) | 340 (38.2) | | 1199 (58.7) | 496 (64.2) | |
| Moderate/High | 575 (37.1) | 210 (38.2) | | 843 (41.3) | 276 (35.8) | |
| **Cigarette Smoking** | | | | | | |
| Current smoking | 403 (26.0) | 113 (20.5) | 0.011 | 63 (3.1) | 9 (1.2) | 0.003 |
| Passive smoking | 509 (33.6) | 161 (29.9) | 0.134 | 466 (23.3) | 128 (16.9) | < 0.001 |
| Smoking intensity (Cigarette/day) | 9.85 ± 6.32 | 9.27 ± 6.35 | 0.406 | 5.88 ± 4.51 | 9.87 ± 5.94 | 0.027 |
| **Hookah smoking** | 36 (2.3) | 12 (2.2) | 1.000 | 21 (1.0) | 0 (0.0) | 0.002 |
| **Hookah/Cigarette smoking** | 422 (27.2) | 123 (22.4) | 0.027 | 80 (3.9) | 9 (1.2) | < 0.001 |

Values are Mean (SD) for continuous variables and n (%) for categorical variables.

The p-value is for comparison between intervention and control groups in each gender population.

Table 2 reports the estimated odds ratios (ORs) and 95% CIs from GEE models for evaluation of the association between intervention status and prevalence of smoking behaviors in men and women during follow-up times. In the GEE analysis, the interaction terms of intervention and follow-up time for cigarette smoking ($P_{interaction}$=0.17) and passive smoking ($P_{interaction}$=0.23) in men, and for cigarette/hookah smoking ($P_{interaction}$=0.97) and passive smoking ($P_{interaction}$=0.15) in women

were not significant and excluded from the final GEE models. The interaction terms were significant only for mens' hookah smoking, so included in the model ($P_{interaction}$<0.001).

Table 2
The GEE results of the association between smoking behaviors and intervention status during follow-up times in men and women.

| | Men | | | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Cigarette smoking | | Hookah smoking | | Passive smoking | | Cigarette/hookah smoking | | Passive smoking | |
| Predictors | OR (95% CI) | P-value | OR (95% CI) | P-value | OR (95% CI) | P-value | OR (95% CI) | P-value | OR (95% CI) | P-value |
| **Group** | | | | | | | | | | |
| Intervention | 0.73 (0.56–0.96) | 0.03 | 1.53 (1.09–2.15) | 0.013 | 1.05 (0.86–1.29) | 0.61 | 0.62 (0.42–0.91) | 0.016 | 0.67 (0.54–0.84) | 0.001 |
| **Time** | | | | | | | | | | |
| 1st Follow-up | Ref | | Ref | | Ref | | Ref | | Ref | |
| 2nd Follow-up | 0.82 (0.71–0.95) | 0.006 | 1.17 (0.95–1.45) | 0.140 | 0.82 (0.69–0.99) | 0.04 | 0.83 (0.66–1.06) | 0.16 | 0.78 (0.68–0.89) | < 0.001 |
| 3rd Follow-up | 0.70 (0.60–0.82) | < 0.001 | 1.15 (0.94–1.41) | 0.173 | 0.53 (0.43–0.64) | < 0.001 | 0.97 (0.77–1.23) | 0.87 | 0.56 (0.48–0.65) | < 0.001 |
| 4th Follow-up | 0.63 (0.53–0.76) | < 0.001 | 0.88 (0.70–1.11) | 0.269 | 0.50 (0.40–0.62) | < 0.001 | 1.00 (0.78–1.27) | 0.88 | 0.49 (0.41–0.57) | < 0.001 |
| 5th Follow-up | 0.56 (0.46–0.69) | < 0.001 | 0.77 (0.60–0.98) | 0.036 | 0.53 (0.43–0.66) | < 0.001 | 1.06 (0.81–1.38) | 0.69 | 0.31 (0.25–0.38) | < 0.001 |
| **Group*Time** | | | | | | | | | | |
| inter × 1st Follow-up | | | Ref | | | | | | | |
| inter × 2nd Follow-up | | | 0.38 (0.25–0.58) | < 0.001 | | | | | | |
| inter × 3rd Follow-up | | | 0.52 (0.34–0.79) | 0.002 | | | | | | |
| inter × 4th Follow-up | | | 0.63 (0.40–0.99) | 0.046 | | | | | | |
| inter × 5th Follow-up | | | 0.72 (0.45–1.15) | 0.164 | | | | | | |

*Data were presented as odds ratios of smoking behaviors and 95% confidence intervals for intervention and follow-up times.*

*Participants' age, education, employment, marital status, physical activity, diabetes and each smoking habit at baseline were adjusted in the GEE models.*

Current results showed that, the intervention significantly decreased the overall odds of cigarette smoking by 27% (OR = 0.73, 95% CI = 0.56–0.96; *P* = 0.03). In the total sample of men, the odds for the prevalence of cigarette smoking deacreased during follow-ups, from 0.82 at second follow-up to 0.56 at the last one (P < 0.05).

Our results showed significant positive effects of the intervention on being a hookah smoker at second follow-up (exp(coef) = 0.58, 95% CI= -0.94,-0.14; *P* = 0.008). The intervention effect was not significant at third (exp(coef) = 0.79, 95% CI = 0.55–1.14; *P* = 0.22), fourth (exp(coef) = 0.97, 95% CI = 0.66–1.42; *P* = 0.86), and fifth (exp(coef) = 1.09, 95% CI = 0.73–1.65; *P* = 0.64) follow-ups.

Based on our results, there was no significant association between intervention and prevalence of passive smoking during follow-ups in men (OR = 1.05, 95% CI = 0.86–1.29; *P* = 0.61); nevertheless, for the total sample of men, compared with first follow-up, the odds of passive smoking decreased, from 0.82 at second follow-up to 0.53 at the last one (*P* < 0.05).

In women, the intervention significantly decreased the odds of cigarette/hookah smoking and passive smoking in women, by 38% (OR = 0.62, 95%CI = 0.42–0.91; *P* = 0.016) and 33% (OR = 0.67, 95%CI = 0.54–0.84; *P* = 0.001), respectively. Nevertheless, for the total sample of women, compared to the first follow-up, the odds of passive smoking in women decreased over the follow-ups, from 0.78 at second follow-up to 0.31 at the last one (*P* < 0.001).

The GEE results for evaluation of the association between intervention status and the smoking intensity in men are reported in Table 3. As there was no interaction between intervention and time (*P* = 0.56), it was excluded from the model. The intervention significantly decreased the mean number of cigarette/day by 1.58 (coefficient = -1.58, 95%CI= -2.87,-0.30; *P* = 0.016).

Table 3
The GEE results of the association between smoking intensity and intervention status during follow-up times in men.

| **Men** | **Cigarette intensity** | |
|---|---|---|
| | ß (95% CI) | P-value |
| **Group** | | |
| Intervention | -1.58 (-2.87,-0.30) | 0.016 |
| **Time** | | |
| 1st Follow-up | Ref | |
| 2nd Follow-up | 0.03 (-0.63,0.68) | 0.94 |
| 3rd Follow-up | -0.33 (-1.06,0.41) | 0.38 |
| 4th Follow-up | 0.17 (-0.77,0.95) | 0.84 |
| 5th Follow-up | -0.09 (-1.05,0.87) | 0.86 |
| *ß presents mean difference of cigarette per day in intervention group compared to control group and in subsequent follow-ups compared to first follow-up.* | | |
| *Participants' age, education, employment, marital status, physical activity, diabetes and smoking intensity at baseline were adjusted in the GEE models.* | | |
| *The interaction terms of intervention and follow-up time for smoking intensity in men was not significant and excluded from the final GEE models (interaction P = 0.56).* | | |

# Discussion

The current study aimed to evaluate the long-term effectiveness of a multi-component community-based lifestyle intervention on tobacco behaviors in a large population of Iranian adults. The intervention reduced the risk of cigarette and hookah use as well as the intensity of cigarette smoking in men; although its effect on hookah was short-term and disappeared after the second follow-up. No change was observed in men's passive smoking between the intervention and control group. The intervention made

women less likely to smoke tobacco (cigarette or hookah) and reduced their exposure to secondhand smoke. None of the observed effects of the intervention on women was time-dependent.

The present study showed that the TLGS community-based lifestyle modification reduced the odds of cigarette smoking (by 27%) and decreased its mean intensity (by 1.58 cigarettes/day) in men. Women in the intervention group were less likely to smoke any tobacco (cigarette or hookah). The TLGS intervention maintained its effects in long-term. These results showed that implementing behavior change interventions in the context of the community and in the platform of existing national anti-tobacco policies have positive long-term results in tobacco control. Multi-component, multi-setting interventions have been previously suggested to curve the smoking epidemic [26]. Many community-based studies, with the ultimate goal of reducing the burden of cardiovascular disease, simultaneously targeted their behavioral risk factors, including tobacco smoking. North Karelia Project (Finland) and Minnesota Heart Health Program (USA) are among the very firsts with the former being the most successful one [23, 27]. Although successful in increasing awareness and changing attitudes toward smoking, many of these programs failed to reduce the smoking prevalence in general population [7]. But more recent reviews still emphasis on community strategies as an important part of health promotion activities especially those with multiple risk behavior approach. In their review, Ebrahim et al. [10], showed that such interventions reduced the prevalence of smoking in the community by 24%. In 2021, Bergum et al. [11] also showed that the numerical prevalence of smoking in the intervention group was lower than the control. However, none of these studies were longer than three years and no intervention effect was seen in the meta-analysis. Minian et al. [28] argued that health-improving interventions should invest in modifiable factors that increase participant's commitment to behavior change instead of individual epidemiological strategies.

The intervention reduced the prevalence of mens' hookah use, but only in short-term. After the 2nd follow-up, no significant difference was observed between the intervention and control in this regard. In women, due to the low prevalence, we reported the odds of hookah use pooled with cigarette smoking and the intervention reduced the likelihood of any tobacco use. Due to common determinants of cigarette and hookah use, programs designed for cigarette control can affect hookah use at the community level, but it seems that maintaining the effects in the long run requires designing hookah-specific contents and interventions [29]. Positive social norms, more acceptability, misperceptions about health risks and addictiveness of hookah, visual appeals, and added smell and flavor are among unique features that distinguish hookah from cigarette [29, 30]. The WHO FCTC is mostly based on available evidence on cigarette, indicating the lack of strong policy support for hookah control interventions. In recent years, international institutions are making more efforts to develop hookah-specific legislations. Researchers are also paying more attention to hookah control [16], however, quality interventions are still limited [31, 32]. Influential studies in this field, which are few in number, have often been conducted with emphasis on education and counseling on hookah cessation in small groups [16]. Like cigarette, behavioral interventions have been effective in raising awareness of the dangers of hookah at the community level [33, 34], and have led to behavior change in some cases [35, 36], but there is little evidence of their effectiveness in the long run.

The TLGS intervention reduced the risk of passive smoking in women by 33%, with no effect on mens' passive smoking. Due to the higher prevalence of smoking among Iranian men, women constitute a large share of the population at risk of SHS with the majority being the home-based SHS. The present study showed that implementing a behavioral community-based intervention in the existing legal framework can reduce passive smoking in women by targeting the home environment which is generally considered outside the realm of government regulations. Many countries have launched community-based interventions using educational media campaigns, advocacy, and public events mostly targeting vulnerable populations (pregnant women and children) [37–41]. At individual-level, increasing awareness, and changing attitudes and practice, can reduce SHS exposure especially in women and children. Interventions act through empowering individuals to create a smoke-free environment and avoid exposure, and also reducing the risk of smoking in the community (both prevalence and intensity) [42]. At community-level, mass media, knowledge campaigns and widespread messages are used to raise public awareness about the dangers of smoking and SHS which could gradually change social norms. All of these components rely on existing social structures such as smoke-free public environment that is mandated by law and enforced by the government [42].

This is one of the few multi-behavioral community trials in the Middle Eastern region whose long-term effectiveness on cigarette, hookah and passive smoking is being investigated. The current study with its large sample size and long-term follow-up of more than 12 years, contributes substantially to the weak body of literature available from this region. The study, however, has some limitations, one of which is the non-randomized design of the study. Collecting behavioral information including smoking and physical activity using questionnaire-based methods, may increase under reporting and recall bias. Moreover, as a part of TLGS, the current study was conducted in urban areas; therefore, the results may not be generalized to suburban and rural populations.

Our results provide evidence for the sex-specific effectiveness of a long-term multi-level healthy lifestyle intervention on smoking behaviors in a Middle-eastern population. It reduced cigarette smoking risk and its intensity in men, in long-run. We saw a short-term positive effect of intervention on mens' hookah use. In women, intervention reduced the likelihood of any tobacco smoking (cigarette or hookah) and exposure to SHS. These findings demonstrate the importance of community-based behavioral interventions to control tobacco. However, to be more effective in controlling hookah, such interventions seem to benefit from hookah-specific contents.

## Abbreviations

TLGS
Tehran Lipid and Glucose Study
GEE
Generalized Estimating Equation
OR
Odds Ratio
CI
Confidence interval

## Declarations


### Funding

There are no funding resources for this research.


### Declaration of interests

The authors declare that they have no conflict of interests.


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### Authors' contributions

HM-A, PA designed the study. LC carried out the statistical analysis. PA, HM-A, and LC contributed to interpretation of data. HM-A drafted the manuscript. PA and FA supervised and revised the manuscript. All authors read and approved the final manuscript.

### Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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# Figures

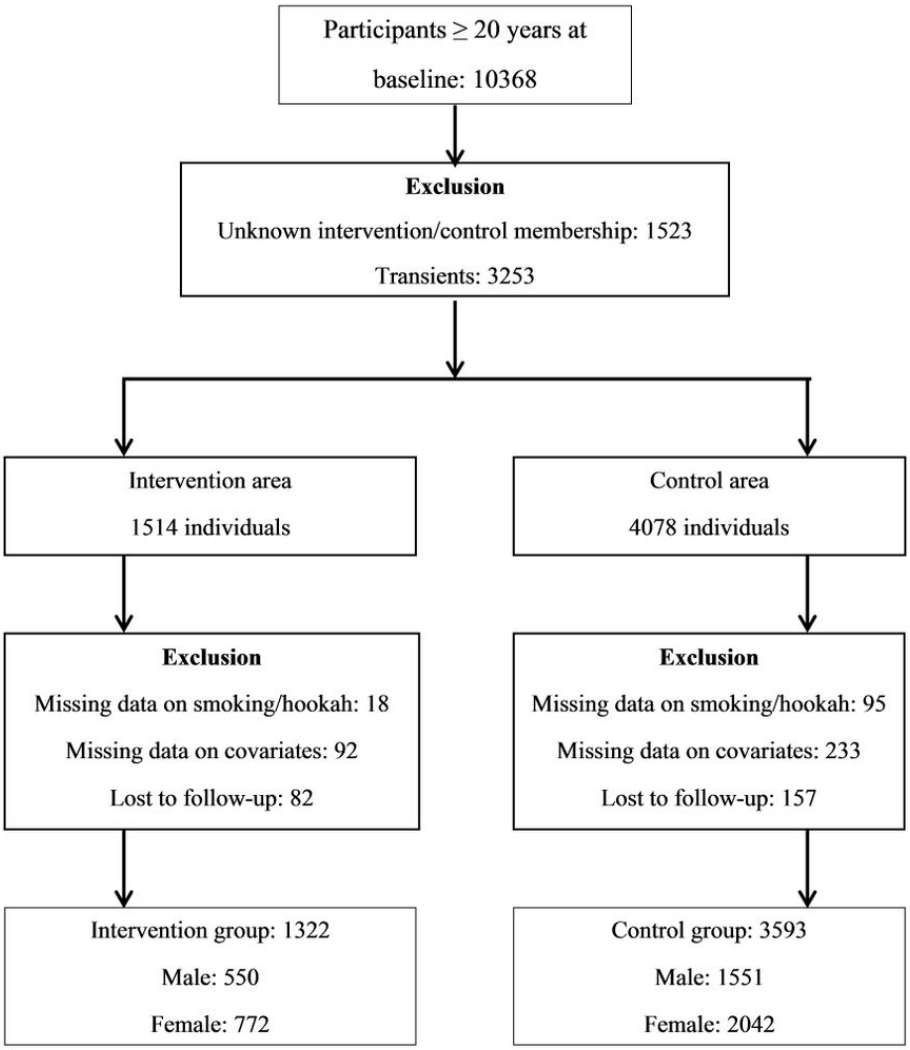
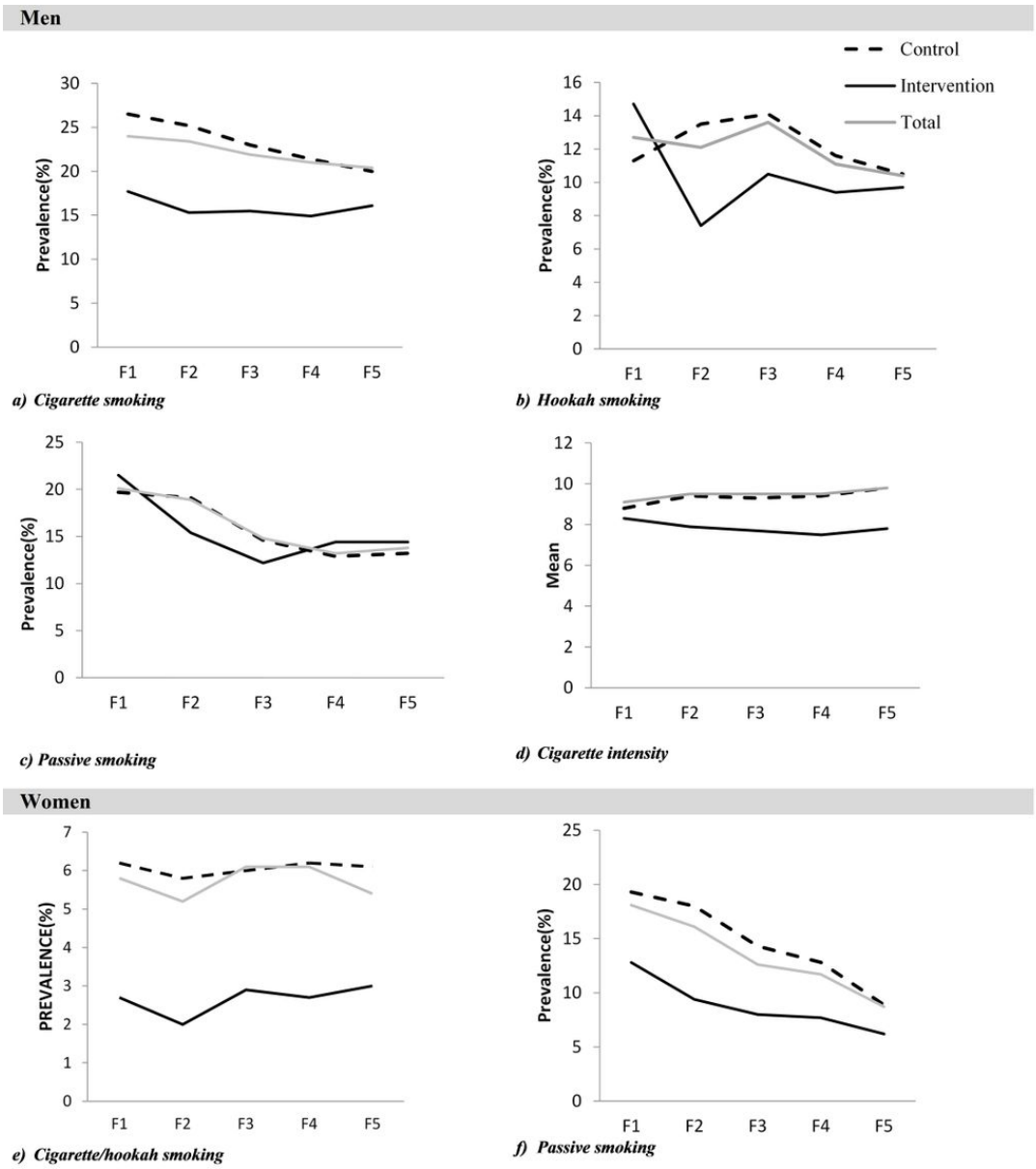



**Figure 1**

Sampling frame of the study.




## Figure 2

Prevalence of a) cigarette smoking, b) hookah smoking and c) passive smoking and d) mean cigarette/day in men, prevalence of e) cigarette/hookah smoking and , f) passive smoking in women, over follow ups: in total population and control and intervention groups.