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Original Article

Men's Smoking Trajectories and Health-Related Quality of Life in the Whole Family: Tehran Lipid and Glucose Study

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Abstract

Background: We aimed to investigate the latent smoking classes in men and their association with health-related quality of life (HRQoL) of themselves, their wives and offspring.

Methods: Using Tehran Lipid and Glucose Study (TLGS), 1781 men with marital stability and 8-18-year-old offspring were followed for 15 years (1999-2014). Latent class growth modeling (LCGM) was used to identify men's smoking patterns in 1139 men with at least three non-missing measurements of cigarettes per day (CPD); they had 1908 children (8-18 years at baseline). HRQoL and its physical and mental component summaries (PCS and MCS) was measured at the last follow-up using the SF-12v2 questionnaire. The associations of men's smoking classes with HRQoL of the family members were examined using generalized linear model.

Results: LCGM revealed four trajectories for men's smoking patterns; non/rare smokers, decreasing light, persistent moderate smokers, and persistent heavy smokers. Persistent smoking men, regardless of the amount of smoking (light or heavy), had lower scores in general health (ß= -7.80 for moderate and ß= -10.71 for heavy class) but not overall PCS. Al three trajectories of smoker men had poorer overall MCS than non/rare smokers. Living with persistent heavy smoker men was associated with decreased overall MCS in women (ß= -4.20), in particular role emotional (ß= -8.82) and mental health (ß= -9.42). No significant association was detected between fathers' smoking patterns and offspring HRQoL in young adulthood.

Conclusion: Our results show men's heavy and persistent smoking worsens their own and their spouses' HRQoL, mainly in mental health dimensions.

Keywords: Smoking trajectories; Latent class growth modeling; Family; Spouse; Iran

Introduction

Cigarette smoking, especially in developing countries, is considered a public health concern. In 2015, the worldwide estimated prevalence of tobacco smoking was over 1.1 billion, and four times higher in men than women (1). Surveys in Iran show that the rate of ever cigarette smoking in men is 26.1% and 17 times more than women (2) Almost 30% of women (2) and 34.5% of ado-

lescents (3) in Iran live in homes where others smoke.

Smoking is a well-known cause of many chronic diseases and has physical and psychological effects on the smoker. Health-related quality of life (HRQoL) as the subjective aspect of wellbeing, which proposes a holistic approach to health (4), could help provide an overview of this matter. The effect of smoking on HRQoL in smokers has been investigated before, mostly in cross-sectional studies, demonstrating impaired HRQoL in a dose-dependent manner (5-7). Considering the dynamics of smoking over time, its pattern of change appears to be important in affecting HRQoL. There are few longitudinal studies on this subject (8-12) that all agree on the poorer HRQL in smokers, yet their results are inconsistent concerning various smoking patterns and different dimensions of HRQoL. Given that the long-term studies are all from developed countries, there is a gap in the literature from the developing countries of the Eastern Mediterranean region.

Beyond personal effects, there are familial effects attributed to smoking, whose examination provides a better estimate of the health burdens of smoking. In Middle Eastern culture, smoking is more of a masculine stereotype, thus not stigmatized in men (13). The higher prevalence of smoking in men than women is evidence of this claim. Therefore, it is reasonable to hypothesize that these are men rather than women, who play as a role model in inducing smoking behaviors in families and determining smoking-related psychological outcomes and overall health status in other family members.

No long-term study has examined how living with a smoker could affect the HRQoL of other family members. Previous studies only investigated the association between second-hand smoke and HRQoL and showed significant dose-dependence in adults (14-16) and the younger population (17-19). Moreover, due to the lack of data in developing countries, this issue remains ambiguous and needs to be examined in more depth. With this background, as the most influential member of the Iranian family in this regard, we targeted men and examined their smoking behavior and its impact on the family. We used data from a unique family-based cohort study in the Middle East to fulfil two objectives, 1) determining the latent cigarette smoking classes in adult men, over 15 years of follow-up (1999-2014); and 2) investigating how these longitudinal patterns are associated with the HRQoL of themselves, their wives and offspring.

Methods

Study design and participants

Data for the current study is extracted from the Tehran Lipid and Glucose Study (TLGS). It is an ongoing population-based cohort focusing on non-communicable diseases and their determinants (20). TLGS study started with a baseline phase (1999-2001) and continued with five follow-up re-exams with 3-year intervals (1st follow-up: 2002-2004, 2nd follow-up: 2005-2007, 3rd follow-up: 2008-2010, 4th follow-up: 2011-2013, and 5th follow-up: 2014-2016). Three medical health centers of district No.13 of Tehran were selected, and 15,005 of their covered participants were recruited. For the present analysis, 1781 couples with marital stability and 8-18-year-old offspring were considered at baseline and followed for 15 years (1999-2014). To identify men's smoking patterns, the analytic sample for latent class growth modelling (LCGM) included 1139 men with at least three non-missing measurements of the daily number of cigarettes (642 men with more than three missing on smoking data were excluded). They had 1908 children (8-18 years at baseline).

Measurements

Fathers' smoking history

The daily number of cigarette smoking (CPD) was used to identify distinct smoking patterns in fathers and was collected using the TLGS self-administrated questionnaire. Those who smoked daily/occasionally were asked the following question: "how many cigarettes do you smoke each day now?"

Outcome variables

The outcome of the current study is HRQoL of the family members (fathers, mothers, and offspring). It was assessed using the reliable and valid Iranian translation of short-form 12-item health survey version 2 (SF-12v2) (21). It has 12 items and subjectively measures HRQoL into eight subscales, each with a score of 0 to 100. Four of the subscales, including physical functioning (PF), role physical (RP), bodily pain (BP), and general health (GH), make up the physical component summary (PCS). The other four subscales, including mental health (MH), role emotional (RE), vitality (VT), social functioning (SF), are the constructs of mental component summary (MCS). Four subscales of PF, RP, MH, and RE are measured with two items, while the other four are measured with one item.

Covariates

Trained interviewers collected each participant's socio-demographic data (age, education, employment, marital status) with standard questionnaires. Education is classified as illiterate/primary (0-6 years), secondary/diploma (6-12 years), and higher (>12 years). Participants are considered as employed/unemployed based on whether they have income or not. A positive history for each of diabetes mellitus (DM), chronic kidney disease (CKD), cardiovascular disease (CVD), or cancer was taken into account to assess disease history. Physical activity was assessed using the reliable and validated Iranian translation of the Modifiable Activity Questionnaire (MAQ) (22).

Statistical analysis

We used Latent Class Growth Analysis (LCGA) to identify changes in men's smoking. It is a semi-parametric technique used to identify distinct subgroups of individuals with similar patterns of change regarding a specific variable (23). The traj procedure in STATA was used to build group-based multi-trajectory models via a special application of finite mixture modelling (24). Model selection was made in two steps: first, the number of trajectory groups was determined based on a lower Bayesian Information Criterion (BIC) (25). Second, each latent class's various shapes were tested to identify the pattern of change over time (linear, quadratic, or cubic). In all analyses, a minimum size of 5% was considered for all classes. The models' goodness of fit was assessed under these conditions as suggested by Nagin (25): 1) the average posterior probability (APP) of group membership ≥70%, 2) the odds of correct classification (OCC) ≥5 for each group, and 3) proximity between the estimated probability of the trajectory group and the proportion assigned to the group. Subsequently, all participants' socio-demographic, behavioral, health characteristics and HRQoL were compared between men's smoking trajectories using one-way ANOVA and Chi-square tests.

We also analysed the associations of men's smoking trajectories with the HRQoL in themselves, their wives, and offspring, by generalized linear model with an identity link, and in four models: model 1) unadjusted; model 2) adjusted for age, education, employment; model 3) further adjusted for physical activity; model 4) BMI and history of chronic diseases were added. In assessing the association in offspring, sex and marital were also considered in all mentioned models. Statistical analyses were performed using STATA and IBM SPSS Statistics version 22. $P<0.05$ was considered statistically significant. Regarding HRQoL scoring, beyond statistical significance, a 5-point difference (in the 0 to 100 scale for each of the eight dimensions) was considered clinically significant. Meaning that, participants' groups whose scoring was 5 points or more apart from the reference group had clinically identifiable differences in their health status.

Results

Trajectories of cigarette smoking in men

Using LCGM, we tested different models for cigarette smoking in 1139 men; the four-group model provided the best fit to the data based on the goodness of fit criteria demonstrated in Table1-Appendix (All appendix tables are not published. Readers may contact the authors, if need-

ed) (BIC: -7032.23; APP: 0.97 to 0.99; OCC of the four classes= 380.31, 233.68, 406.29, and 582.31). The four groups, illustrated in Fig. 1, were labeled as non/rare smokers (68.6%), decreasing light smokers (12.8%), persistent moderate smokers (10.4%), and persistent heavy smokers (8.1%). Non/rare smokers were characterized as those who persistently smoked none or very few numbers of CPD. Decreasing light smokers smoked approximately 5 CPD at the baseline and reduced the amount to almost none from the third follow-up onward. Persistent moderate smokers reported smoking between 5 and 10 CPD, and with more fluctuation during the study, persistent heavy smokers smoked between 15 to 20 CPD. The mean number of CPD in each follow-up in the four groups of men's smoking is reported in Table 2-Appendix. The descriptive statistics based on men's trajectory classes are presented in Table 1 and Table 3 Appendix.

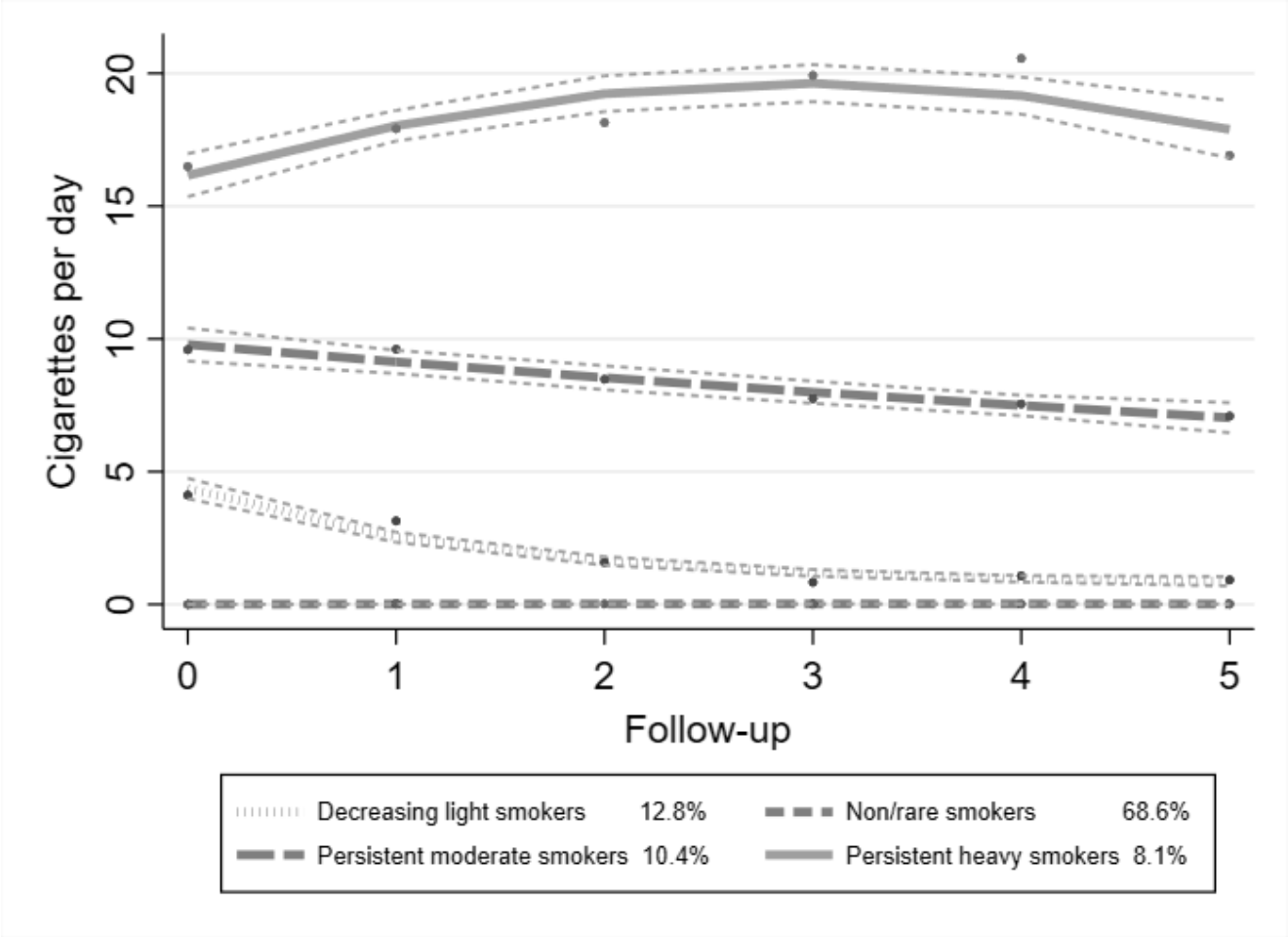

Fig. 1: Men's smoking trajectories

Table 1: Descriptive statistics of participants in follow-up 5, based on men's smoking trajectory classes

Variable	*Husbands*					*Wives*					*offspring*				
	Non/ rare smokers	De-creas-ing light	Per-sistent mod-erate	Persis-tent heavy	P-val-ue	Non/r are smok-ers	De-creas-ing light	Persis-tent mod-erate	Persis-tent heavy	P-val-ue	Non/ra re smokers	De-creasi ng light	Persis-tent moder-ate	Persis-tent heavy	*P*-value
Sex															0.10
Boy											299 (50.6)	44 (50.0)	32 (42.1)	24 (36.9)	
Girl											292 (49.4)	44 (50.0)	44 (57.9)	41 (63.1)	
Age	62.0±8.0	58.3±4.0	58.8±6.2	58.7±6.2	<0.01	55.6±6.8	54.4±6.6	53.4±6.9	55.5±7.3	0.008	30.3±3.2	30.6±3.3	29.7±3.3	29.9±3.1	0.28
Education					0.10					0.13					0.33
Primary	107 (37.7)	8 (20.5)	20 (44.4)	11 (47.8)		144 (47.7)	18 (37.5)	24 (43.6)	14 (46.7)		7 (1.2)	0 (0.0)	1 (1.3)	1 (1.5)	
Secondary	110 (38.7)	23 (59.0)	19 (42.2)	6 (26.1)		133 (43.8)	27 (56.3)	26 (47.3)	14 (46.7)		160 (27.1)	25 (28.4)	25 (32.9)	24 (36.9)	
Higher	67 (23.6)	8 (20.5)	6 (13.3)	6 (26.1)		27 (8.9)	3 (6.3)	5 (9.1)	2 (6.7)		434(71.7)	63 (71.6)	50 (65.8)	40 (61.5)	
Employment					0.02					0.35					0.13
Employed	146 (51.4)	27 (69.2)	26 (57.8)	14 (60.9)		14 (4.6)	3 (6.3)	2 (3.6)	1 (3.3)		372 (62.9)	58 (65.9)	43 (56.6)	37 (56.9)	
Un-employed	138 (48.6)	12 (30.8)	19 (42.2)	9 (39.1)		290 (95.4)	45 (93.8)	53 (96.4)	29 (96.7)		219 (37.1)	30 (34.1)	33 (43.4)	28 (43.1)	
Marital status															0.39
Single											230 (38.9)	34 (38.6)	35 (46.1)	26 (40.0)	
Married											361 (61.1)	54 (61.4)	41 (53.9)	39 (60.0)	
Physical activity	39.8±52.5	32.3±41.1	31.2±58.1	17.1±21.2	0.06	22.0±21.4	21.2±16.9	21.6±20.9	22.7±22.9	0.39	42.2±60.9	37.6±42.9	28.1±36.2	35.8±5.4	0.11
Disease History					0.44					0.44					0.29
Negative	262 (92.3)	38 (97.4)	43 (95.6)	22 (95.7)		281 (92.4)	45 (93.8)	54 (98.2)	29 (96.7)		552 (93.4)	85 (96.6)	73 (96.1)	62 (95.4)	
Positive	22 (7.7)	1 (2.6)	2 (4.4)	1 (4.3)		23 (7.6)	3 (6.3)	1 (1.8)	1 (3.3)		39 (6.6)	3 (3.4)	3 (3.9)	3 (4.6)	

Values are expressed as mean± SD for continuous variables and n (%) for categorical variables.

Men's smoking trajectories and HRQoL in the whole family

The personal, spousal, and offspring HRQoL is investigated in relation to men's smoking trajectories and the fully adjusted model is presented in Table 2. Compared to non/rare smoking men, men in the decreasing light smoking class had a significantly higher mean PCS score. Men in all smoking groups had lower mean MCS scores compared to non/rare smokers, with the lowest mean score in the persistent heavy smoker class (ß= -4.07; 95% CI: -7.34, 0.81, *P*=0.01). Wives' mean PCS score had no significant association with husbands' smoking patterns before and after adjustment for covariates. Regarding wives' MCS score, women with a persistent heavy smoking husband score 4.20 points poorer in MCS (ß= -4.20; 95% CI: -7.71, -0.68; *P*=0.02). No significant associations were found between the fathers' smoking trajectories and offspring's HRQoL in their young adulthood.

Table 2: Association of men's trajectory classes of smoking with the HRQoL of themselves and other family members.

	Men				***Wives***				***Offspring***			
	PCS		MCS		PCS		MCS		PCS		MCS	
	ß (95%CI)	P-value	ß (95%CI)	P-value	ß (95%CI)	P-value	ß (95%CI)	P-value	ß (95%CI)	P-value	ß (95%CI)	*P*-value
Non/rare smokers	Ref	-	Ref	-	Ref	-	Ref	-	Ref	-	Ref	-
Decreasing light	1.99(0.21,3.76)	0.02	-2.30(-4.63,0.01)	0.05	-0.57(-2.57,1.42)	0.57	0.57(-2.09,3.24)	0.67	0.30(-1.15,1.75)	0.68	0.31(-2.04,2.67)	0.79
Persistent moderate	0.08(-1.86,2.02)	0.93	-2.30(-4.86,0.24)	0.07	0.27(-1.86,2.41)	0.80	-2.07(-.4.92,0.78)	0.15	0.54(-1.00,2.09)	0.49	-1.68(-4.18,0.81)	0.18
Persistent heavy	0.31(-2.17,2.80)	0.80	-4.07(-7.34,0.81)	0.01	-0.72(-3.35,1.91)	0.59	-4.20(-7.71,-0.68)	0.02	1.20(-0.46,2.87)	0.15	0.15(-2.54,2.85)	0.90

Fully adjusted model. Adjusted for age, education, employment, physical activity, BMI and history of chronic diseases (DM, CKD, CHD, CVD, and cancer).

*In offspring, sex and marital status are added to Model 2.

HRQoL: Health-related quality of life, PCS: physical component summary, MCS: mental component summary

Table 4-Appendix reports detailed information on PCS and MCS components in the whole family in relation to men's smoking patterns. The full adjusted model is just presented in this table. Persistent moderate and heavy smoking men had lower mean score in the GH and RE subscales, which were statistically and clinically significant. Living with persistent heavy smoking men decreased mean scores of wives in MH and RE subscales.

Discussion

Using LCGM, four different trajectories emerged for men's smoking patterns over 15 years: non/rare smokers, decreasing light smokers, persistent moderate smokers, and persistent heavy smokers. Compared to non/rare smokers, persistent smoker men, regardless of the amount of smoking, had lower scores in general health but not overall PCS. They also had poorer overall MCS, in particular in the role emotional subscale. Moreover, living with persistent heavy smoker men decreased overall MCS in women, particularly role emotional and mental health. No significant association was detected between fathers' smoking patterns and offspring HRQoL in young adulthood.

Trajectories of cigarette smoking in men

In our sample, 68.6% of participants were non/rare smokers, and most smokers (12.8%) presented a pattern of decreasing light smoking. The other two groups of smokers (heavy and moderate) remained relatively stable over time. The non/rare smoking class had the highest average age (~62 years) among the smoking classes. The majority of participants in the persistent heavy smoker class had primary education (~48%) and the lowest amount of physical activity. These factors might be in concordance with their continuing smoking habits as clustering of health-related behaviors is suggested in the literature (26). In previous studies on the adult population, smoking presented patterns that generally align to those we saw in the current study; however, based on the number of data points, duration of the study, the definition of smoking, and the age range of participants, the number of trajectories and their shape may differ (27-31).

Trajectories of cigarette smoking and HRQoL in men

Regarding the effects of men's smoking trajectories on their personal HRQoL, physical health difference between constant and non/rare smok-

er men was only found on the subscale of GH; however, PCS showed no significant differences. On all mental subscales, constant heavy smoking men had poorer clinically identifiable health than non/rare smokers. Only in the RE subscale, the effect of smoking was statistically significant and present in moderate and heavy smoking classes in a dose-response manner. In the existing literature, smoking is negatively and dose-dependently associated with individual HRQoL (5-8, 32, 33), and the differences are more marked in mental dimensions of HRQoL (6, 8). However, some studies found smoking to be more related to the physical dimensions in the long-term (9, 10); they are mostly conducted in late adulthood and showed that it takes longer to affect a smoker's perceived physical health.

Men's smoking trajectories and HRQoL in wives and offspring

In the present study, the main effect of persistent heavy smoking in men was observed on their wives' MCS. All mental health subscales in wives in the persistent heavy smoker class had clinically identifiable changes compared to the non/rare smoker class. However, these changes were only statistically significant in RE and MH subscales. Although the present study did not show any changes in wives' PCS when their husbands are constant heavy smokers, the changes in PF and RP subscales reached a 5-point difference and implied clinical significance. On the other hand, compared to non/rare smoking class, living with husbands who nearly quit smoking during the study period did not reduce the women's HRQoL scores, finding that supports the beneficial effect of smoking cessation (34). Previous studies have shown a significant association between second-hand smoke and all domains of HRQoL (15, 16, 19) which is dose-dependent and stronger for home exposure (14). Women are more vulnerable to the smoking environment and evaluate their mental wellbeing worse than men (14). The pathway to psychological effects of second-hand smoking is not yet fully understood (35). Hormonal and neurotransmitter change due to nicotine in cigarette smoke are proposed as one of the causes of its mental health problems (16).

No significant association was detected between fathers' smoking patterns and offspring HRQoL in young adulthood in the current study. Existing evidence on the younger population shows more perceived health problems in children exposed to second-hand household smoke, especially more mental health problems in female adolescents (17-19). Such a relationship was not seen in our results; the reason could be that the age range of children was 8-18 years at the beginning of the study, and they may not have lived with their parents for a total of 15 years of the study. Due to such changes in environmental risk factors, we could not observe the potential long-term effects of paternal smoking on offspring's HRQoL, and the causal relationship could not be established. However, based on our results, fathers' smoking increased the offspring smoking amount in the long run, which could indirectly affect their children's HRQoL.

To the best of our knowledge, for the first time in the Eastern Mediterranean region and Iran, we used 15 years of detailed prospective data to assess trajectories of smoking in men, using LCGM. No previous studies have examined the spousal and intergenerational association of smoking and HRQoL. Our results further highlight the psychological effects of having a smoker in the family, compared to most previous studies that have examined its biochemical effects. We recognize limitations to the current study. First, although many potential confounders were added to the models, mental health status was not recorded thus was not adjusted. Second, self-reported data is always subject to recall bias; yet, using male subjective smoking data could be more accurate than second-hand smoking data reported by women in the conservative population of Iran, where women might underreport smoking-related information.

Conclusion

The current study established four distinct trajectories for men's smoking behavior over 15 years. Our results showed that the intensity and persistence in a man's smoking worsens the HRQoL of himself and his spouse, mainly in mental health dimensions. Smoking prevention efforts should consider the long-term smoking pattern; involve the whole family in behavior change interventions to improve outcomes.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The authors declare that there is no conflict of interests.

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