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Gender differences in the price elasticity of demand for waterpipe and cigarette smoking in Lebanon, Jordan and Palestine: a volumetric choice experiment

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ABSTRACT

Objectives This study assessed the extent to which the elasticity of cigarette and waterpipe tobacco products differs between men and women. We also explored the levels of substitution and complementarity in tobacco products among men and women.

Setting The study examines tobacco elasticities in three Arab countries: Lebanon, Jordan and the West Bank of Palestine.

Participants We used data from nationally representative surveys of adults aged ≥18 years in Lebanon (n=1680), Jordan (n=1925) and Palestine (n=1679). The proportion of women was 50.0% of the sample in Lebanon and Palestine, and 44.6% in Jordan.

Primary and secondary outcome measures A zero-inflated Poisson regression model estimated own-price and cross-price elasticities for two variations of cigarettes and five variations of waterpipe tobacco products. Elasticities were measured based on eight scenarios of prices.

Results Demand for waterpipe tobacco products was elastic for both men and women. The cross-price elasticities in the three countries indicate the existence of substitution between cigarettes and waterpipe products and by different varieties within each of the two tobacco products. Gender differences varied across the three countries whereby higher cross-price elasticities were observed for women in Jordan and Palestine. For example, the price elasticity for discount waterpipe was −1.4 and −0.6 for women and men in Jordan, respectively.

Conclusions Results on the elasticity of demand for tobacco products and the existence of substitution between tobacco products reveal the higher responsiveness of men and women to changes in tobacco prices. This should be taken into consideration in tobacco control strategies particularly when reducing tobacco consumption via taxation policies.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ We used a robust, volumetric choice experiment from nationally representative surveys to assess own-price and cross-price elasticities of waterpipe tobacco—a topic that has received little attention in the literature.

⇒ The study provided a comprehensive evaluation of price elasticities of different tobacco products and by gender using identical methodologies that allow cross-country comparisons.

⇒ One limitation is that the data do not account for the effect of price differentials across the three neighbouring countries. Thus, the impact of smuggling on tobacco consumption remains uncertain.

⇒ Another limitation is related to the actual impact of price changes on tobacco consumption. Elasticities considered in this study measure the sensitivity of individuals to price changes adjusted for inflation but not for income.

INTRODUCTION

Empirical evidence suggests that men have higher rates of tobacco smoking compared with women.[1 2] In general, the prevalence of tobacco smoking among men is about 10-fold that of women in developing countries (32% vs 3.1%) as compared with less than two-fold in developed countries (30% vs 17%).[3] Tobacco control policies seeking to reduce tobacco prevalence include tax policies, consumer education, using health warning labels, restrictions on tobacco smoking in public spaces, banning tobacco advertising and promotion, and smoking cessation programmes.[4–6] Increasing tobacco prices by imposing higher tobacco excise taxes is among the most effective policy tools to reduce the prevalence of tobacco smoking.[7 8] To assess the effectiveness of tobacco tax policies, it is imperative to evaluate how individuals would change their responsiveness of tobacco consumption to changes in the

prices of each tobacco product and the possible trade-off between tobacco products. Higher tobacco prices may lead smokers to switch to lower-priced tobacco products. The bulk of available literature examining the price elasticity of demand for tobacco products has focused on cigarettes only. Studies that has focused on other tobacco products such as waterpipe are scarce.[9 10] A recent review on the price elasticity of demand for non-cigarette tobacco products revealed that there is a lack of corresponding research in the Arab region where most of the included studies has been conducted in high-income settings.[10]

The prevalence of non-cigarette tobacco smoking is increasing worldwide.[11] In the Arab region, waterpipe tobacco smoking—also referred to as narghile, arghile and shisha—is gaining popularity among both men and women.[12] Further, Arab women tend to smoke waterpipe tobacco more than cigarettes.[13 14] Recent estimates based on representative surveys show that the prevalence of waterpipe tobacco smoking among women in Lebanon is more than twice that of cigarettes (54.7% vs 27.5%).[15] Available evidence shows that tax policies might be unequal across socioeconomic groups as it imposes higher burden on the worse-off segment of the population.[16] Socioeconomic differences between men and women in the Arab region such as income differences may render women more vulnerable to changes in tobacco prices as compared with men. With women being endowed with lower financial resources, it is crucial to assess gender differences in terms of the degree of responsiveness in tobacco consumption in relation to changes in tobacco prices (taxes).

In the Arab region, taxation policies of waterpipe products as compared with cigarettes are absent. Moreover, in some countries tax rates on cigarettes are lower than the recommended rate of 75% of the retail price of tobacco products.[17] Based on a recent report of the WHO, the general tax structure of tobacco products in the region is composed of three different types of taxes: (1) import duty tax (%); (2) value added tax (%); and (3) excise tax (specific (USD) and ad valorem (%)).[17] In Jordan and Palestine, the overall tax rates on cigarettes exceed 75% (78.0% in Jordan vs 92.8% in Palestine), while in Lebanon, the overall tax rates on cigarettes is 9.9%.[17] As for waterpipe products, the overall tax rates are 21.2%, 30.4% and 79.0% in Lebanon, Jordan and Palestine, respectively.[18] These facts reveal that there is some room to increase taxation of different tobacco products in these countries as a tool to reduce the prevalence of smoking in the region.

The assessment of the price elasticity of demand for tobacco has been largely addressed using a variety of econometric models such as linear regression models, two-part models and the zero-inflated Poisson (ZIP) model.[9 10 19 20] However, the estimation of waterpipe tobacco elasticities and cross-price elasticities of tobacco products has received less attention in the literature.[15 21 22] Empirical evidence shows that results are rather mixed with some tobacco products being substitutes for cigarettes such as cigars and electronic cigarettes,[21] while others such as bidis are shown to be complementary to cigarettes.[23] Regarding differences across groups, there is a bulk of literature which assessed the elasticity of demand for tobacco products, mainly cigarettes, across age and socioeconomic groups in low-income countries.[7 20 24] To the best of our knowledge, there is only one study that quantified the elasticity in the Arab region (in Lebanon) across socioeconomic groups.[7] The results of this study show that demand for imported cigarettes is inelastic and that the corresponding own-price elasticities are higher for the poorest income quintile (−0.32) and lower for the richest quintile (−0.22).[7]

Studies investigating the price elasticities of demand for different tobacco products across gender groups are, however, limited.[25–27] Moreover, there were no previous attempts to assess gender differences in the price elasticities of waterpipe tobacco products. Existing empirical evidence concerning gender differences in the price elasticity of demand for tobacco, mainly cigarettes, is also mixed. For instance, using a two-part model, Tauras *et al*[27] showed that the price elasticity of young women in the SA was more than twofold the price elasticity of their men counterparts (−0.63 vs −0.25). However, Sweis and Chaloupka[26] (2014) demonstrated that Jordanian men had a higher price elasticity of cigarettes as compared with women (−0.81 vs −0.01).

A full analysis of the own-price and cross-price elasticities of different tobacco products that account for gender differences is lacking. The aims of this paper, which focuses on Lebanon, Jordan and the West Bank of Palestine, were thus twofold. First, we aimed to assess the extent to which the elasticity of cigarettes and waterpipe tobacco products differs between men and women. Second, we aimed to explore the substitution and complementarity in tobacco products among men and women.

METHODS
Data
We used data from nationally representative surveys that were conducted in Lebanon, Jordan and the West Bank of Palestine in June–August 2019. The full methodological details of these surveys are published elsewhere.[9 28] Briefly, eligible respondents included male and female adults (≥18 years old) residing in each country regardless of their nationality. The sample sizes were calculated to estimate the prevalence of current waterpipe smoking for both males and females in each country separately based on previously reported prevalence rates. A two-stage cluster sampling approach in which probability-proportional-to-size random selection methods was applied to choose clusters in each country. The first stage entailed selecting well-defined geopolitical areas (clusters) within the governorates in each country (8 governorates in Lebanon, 12 governorates in Jordan, 11 governorates in the West Bank). The second stage involved choosing a random sample of 30 households from each selected cluster using

systematic random sampling. From each selected household, one eligible male and one female residents were selected. To ensure the inclusion of each selected household in the sample, the household was visited three times. If the household is marked as 'Not at home', the next household was selected. In Lebanon and the West Bank, a balanced sample of men and women was selected, while in Jordan, the number of men was higher than women as additional households were selected based on their availability at home during the visits. All participants were provided with information about the study and were asked to provide consent to participate.

The surveys assessed the use of two main varieties of cigarettes (premium and discount cigarettes) and five varieties of waterpipe tobacco (premium, discount, home-delivered waterpipe tobacco, and premium and discount waterpipe tobacco café smoking). The questionnaire included a volumetric choice experiment (VCE) that modelled eight scenarios of different tobacco product with varying prices in each scenario. Respondents were asked to indicate the amount of tobacco (cigarettes and waterpipe) they were willing to consume under each scenario. Respondents could choose to consume any possible combination of tobacco products within each scenario. The VCE allows to calculate the cross-price elasticity between different tobacco products based on consumers' willingness to trade-off tobacco products under each scenario of prices. The surveys assessed non-flavoured waterpipe tobacco for Lebanon and Jordan and roll-your-cigarette smoking for the West Bank. For consistency, these two categories of tobacco have been excluded in the current analysis.

Statistical analysis

Akin to Chalak *et al*,[9] we used a ZIP regression model to calculate the own-rice and cross-price elasticities of demand for tobacco products for each country. The ZIP model is suitable for count data with excess zeros (non-smokers in our case). The ZIP model was estimated first for each gender group for each of the seven tobacco products. Then, the model was estimated for each gender for each tobacco product variety. Tobacco products were classified into three groups such that the within-group unit of measurement was homogeneous. These groups were (1) cigarettes, which included premium and discount cigarettes—measured in packs; (2) waterpipe tobacco (250 g), which included premium and discount waterpipe tobacco; and (3) waterpipe sessions, which included delivered waterpipe and discount and premium waterpipe café smoking sessions. For each group, the quantity was calculated as the sum of all quantities reported by each respondent at each set of prices. The price of each product variety was calculated using the Stone Index.[29] For each product variety, j, the Stone Index, P_j^S, is defined as

$$P_j^S = \prod_{m=1}^{M} (p_m)^{s_m}$$

where M is the total quantity within each product variety, p_m is the price of tobacco product $m = 1, \ldots, M$, and s_m is the expenditure weight of product m such that $\sum_{m=1}^{M} s_m = 1$. The Stone Index is a weighted geometric mean of the price of tobacco products. Some respondents reported zero quantities at certain price levels. So calculating s_m for each respondent at each scenario of prices yielded many null weighted prices. We therefore calculated s_m as the average weight of all respondents for all price scenarios for each tobacco product variety m.

Two binary variables were constructed for the regression analysis used to estimate the price elasticities of demand. The first equaled one if the individual smoked any type of cigarettes, while the second equaled one if the individual smoked any type of waterpipe tobacco. The former binary variable was used as an inflation variable in the ZIP models of cigarette products, while the latter binary variable was used in the ZIP models of waterpipe products. For all models, the set of independent variables of the first part model included the logarithmic forms of the prices of all tobacco product varieties and a categorical variable of four income groups. The inclusion of the prices of all tobacco products allowed for calculating the cross-price elasticities between all tobacco products. In general, the set of independent variables of the inflation part of the ZIP model included the relevant binary variable of tobacco smoking, age (categorical variable), marital status (binary variable which takes one if the individual is single), a region variable (country-specific), employment status (unemployed, full-time and part-time employee), education level (less than university and with university education), and a binary variable that equaled one if the individual was responsible for taking decisions in the household. For some tobacco product varieties across genders, only a subset of these independent variables was used due to the small sample size of smokers. All analyses were conducted using Stata V.14.2.

RESULTS

Sample characteristics

Table 1 summarises the three sample characteristics. The number of respondents were 1680 (50% female) in Lebanon, 1925 (44.6% female) in Jordan and 1679 (50% female) in the West Bank. In general, the distribution of men and women across the different age groups was balanced across all countries. Regarding the marital status, the share of single men and women was less than the quarter across countries. Turning to employment status, the unemployment rate was higher among women as compared with men across all countries (72.3% in Lebanon, 78.4% in Jordan and 89.8% in the West Bank). As for income groups, similar patterns were observed across all countries, with the population being concentrated in the second and third quartiles for both men and women. As shown in table 1, the highest share of smokers is observed in Lebanon for both gender groups (75.2% of men and 63.8% of women). Results indicate a higher

Table 1 Sample characteristics

	Lebanon (n=1680)		Jordan (n=1925)		West Bank (n=1679)	
	Women 840 (50.0%)	Men 840 (50.0%)	Women 858 (44.6%)	Men 1067 (55.4)	Women 840 (50.0%)	Men 839 (50.0%)
Age group, years						
<25	162 (19.3%)	134 (16.0%)	152 (17.7%)	188 (17.6%)	122 (14.5%)	177 (21.1%)
26–35	203 (24.2%)	174 (20.7%)	203 (23.7%)	237 (22.2%)	206 (24.5%)	205 (24.4%)
36–45	188 (22.3%)	187 (22.3%)	200 (23.3%)	256 (24.0%)	184 (21.9%)	160 (19.1%)
46–55	197 (23.5%)	170 (20.2%)	172 (20.0%)	198 (18.6%)	215 (25.6%)	148 (17.6%)
>56	90 (10.7%)	175 (20.8%)	131 (15.3%)	188 (17.6%)	113 (13.5%)	149 (17.8%)
Marital status						
Single	100 (11.9%)	147 (17.5%)	133 (15.5%)	278 (26.1%)	69 (8.2%)	185 (22.1%)
Otherwise	740 (88.1%)	639 (82.5%)	725 (84.5%)	789 (73.9%)	770 (91.8%)	653 (77.9%)
Employment status						
Unemployed	607 (72.3%)	187 (22.3%)	673 (78.4%)	372 (34.9%)	754 (89.8%)	189 (22.5%)
Full-time employed	174 (20.7%)	574 (68.3%)	137 (16.0%)	526 (49.3%)	57 (6.8%)	513 (61.1%)
Part-time employed	59 (7.0%)	79 (9.4%)	48 (5.6%)	169 (15.8%)	29 (3.4%)	137 (16.4%)
Education level						
Less than university	669 (79.6%)	664 (79.1%)	639 (74.5%)	805 (75.4%)	690 (82.1%)	718 (85.6%)
University education	171 (20.4%)	176 (20.9%)	219 (25.5%)	262 (24.6%)	150 (17.9%)	121 (14.4%)
Participation in decisions in the household						
Yes	706 (80.1%)	489 (58.2%)	692 (80.7%)	793 (74.3%)	616 (73.4%)	536 (64.0%)
No	134 (19.9%)	351 (41.8%)	166 (19.3%)	274 (25.7%)	223 (26.6%)	302 (36.0%)
Income group						
Lowest quartile	75 (9.1%)	62 (7.5%)	207 (24.9%)	227 (21.7%)	214 (26.6%)	174 (21.1%)
2nd quartile	321 (38.8%)	326 (39.5%)	320 (38.5%)	411 (39.4%)	355 (44.0%)	344 (41.9%)
3rd quartile	320 (38.7%)	323 (39.1%)	197 (23.7%)	262 (25.1%)	133 (16.5%)	163 (19.9%)
Highest quartile	111 (13.4%)	115 (13.9%)	107 (12.9%)	144 (13.8%)	104 (12.9%)	140 (17.1%)
Smoking cigarettes						
Yes	204 (24.3%)	415 (49.4%)	76 (8.9%)	496 (46.5%)	22 (2.6%)	249 (29.7%)
No	636 (75.7%)	425 (50.6%)	782 (91.1%)	571 (53.5%)	818 (97.4%)	590 (70.3%)
Smoking waterpipe						
Yes	389 (46.3%)	300 (35.7%)	60 (7.0%)	169 (15.8%)	43 (5.1%)	103 (12.3%)
No	451 (53.7%)	540 (64.3%)	798 (93.0%)	898 (84.2%)	797 (94.9%)	736 (87.7%)
Smoking any type of tobacco						
Yes	536 (63.8%)	632 (75.2%)	112 (13.1%)	575 (53.9%)	59 (7.0%)	302 (36.0%)
No	304 (36.2%)	208 (24.8%)	746 (86.9%)	492 (46.1%)	781 (93.0%)	537 (64.0%)

gender gap in terms of smoking in Jordan and Palestine as compared with Lebanon. For example, the prevalence of smoking in Palestine is 36.0% among men and about 7.0% among women. Women in Lebanon and Palestine tend to smoke waterpipe more than cigarettes, with a prevalence rate of waterpipe smoking of 46.3% and 5.1% and a prevalence rate of cigarettes smoking of 24.3% and 2.6% in Lebanon and Palestine, respectively.

Own-price elasticities

The price elasticities were first calculated by gender groups for each type of tobacco smoking for each country. Aggregate price elasticities have been documented

elsewhere.[9] Results, which are summarised in table 2, show that in Lebanon all elasticities of waterpipe products were greater than one, indicating an elastic demand for waterpipe products for both men and women, as compared with cigarettes. Particularly, elasticities were the highest for premium café sessions and premium waterpipe tobacco, which were relatively more expensive as compared with other varieties of waterpipe products. The price elasticity was higher for women for the following types of tobacco; discount cigarettes (−0.75 for women vs −0.58 for men), premium waterpipe (−2.02 for women vs −1.90 for men), delivered waterpipe (−1.89 or women vs

Table 2 Own-price and cross-price elasticities of tobacco products in three Arab countries*

	Premium cig† Women	Premium cig† Men	Discount cig Women	Discount cig Men	Premium WTP‡ Women	Premium WTP‡ Men	Discount WTP Women	Discount WTP Men	Delivered WTP Women	Delivered WTP Men	Premium café Women	Premium café Men	Discount café Women	Discount café Men
Lebanon														
Premium cig	**−0.919 (0.000)**	**−1.205 (0.000)**	0.230 (0.000)	0.146 (0.000)	−0.019 (0.718)	−0.019 (0.779)	−0.104 (0.063)	−0.034 (0.630)	0.142 (0.158)	0.206 (0.113)	0.028 (0.697)	0.001 (0.995)	0.010 (0.898)	0.047 (0.568)
Discount cig	−0.061 (0.606)	0.045 (0.467)	**−0.751 (0.000)**	**−0.582 (0.000)**	−0.210 (0.000)	−0.231 (0.001)	0.060 (0.358)	0.025 (0.752)	0.103 (0.349)	−0.013 (0.927)	−0.012 (0.870)	−0.04 (0.672)	0.008 (0.928)	−0.182 (0.042)
Premium WTP	0.078 (0.495)	−0.028 (0.639)	−0.019 (0.747)	−0.103 (0.009)	**−2.017 (0.000)**	**−1.901 (0.000)**	0.508 (0.000)	0.525 (0.000)	0.254 (0.012)	0.202 (0.137)	−0.104 (0.175)	0.029 (0.766)	0.114 (0.174)	−0.035 (0.692)
Discount WTP	0.339 (0.001)	0.014 (0.794)	0.017 (0.739)	−0.001 (0.972)	0.274 (0.000)	0.132 (0.035)	**−1.723 (0.000)**	**−1.741 (0.000)**	−0.030 (0.746)	0.024 (0.840)	0.026 (0.704)	0.016 (0.846)	0.179 (0.020)	−0.037 (0.641)
Delivered WTP	0.056 (0.591)	0.006 (0.909)	0.035 (0.501)	0.058 (0.101)	−0.244 (0.000)	−0.162 (0.010)	0.094 (0.084)	0.184 (0.006)	**−1.894 (0.000)**	**−1.847 (0.000)**	−0.029 (0.678)	−0.017 (0.845)	0.005 (0.944)	−0.121 (0.128)
Premium café	−0.110 (0.295)	0.048 (0.379)	−0.036 (0.482)	−0.041 (0.236)	0.100 (0.041)	0.097 (0.118)	−0.064 (0.246)	0.030 (0.654)	−0.343 (0.001)	−0.104 (0.421)	**−2.382 (0.000)**	**−2.230 (0.000)**	0.168 (0.029)	0.254 (0.002)
Discount café	0.331 (0.002)	0.024 (0.657)	0.007 (0.894)	−0.036 (0.306)	0.166 (0.001)	0.142 (0.025)	−0.230 (0.000)	−0.254 (0.000)	−0.068 (0.467)	0.061 (0.624)	0.347 (0.678)	−0.203 (0.019)	**−1.736 (0.000)**	**−1.655 (0.000)**
Jordan§														
Premium cig	**−1.121 (0.000)**	**−1.089 (0.000)**	0.055 (0.665)	0.253 (0.000)	−0.124 (0.533)	−0.286 (0.009)	−0.060 (0.768)	0.001 (0.994)		0.111 (0.827)	−0.467 (0.173)	−0.159 (0.339)		−0.084 (0.525)
Discount cig	−0.093 (0.653)	0.165 (0.008)	**−0.657 (0.000)**	**−0.707 (0.000)**	0.297 (0.177)	0.134 (0.261)	−0.540 (0.027)	−0.267 (0.089)		−0.079 (0.847)	0.137 (0.719)	−0.040 (0.825)		0.068 (0.638)
Premium WTP	0.199 (0.319)	−0.073 (0.224)	0.199 (0.140)	0.169 (0.001)	**−0.781 (0.000)**	**−0.540 (0.000)**	0.670 (0.004)	0.347 (0.028)		0.155 (0.715)	0.218 (0.524)	−0.245 (0.151)		0.110 (0.399)
Discount WTP	−0.412 (0.028)	0.085 (0.123)	−0.007 (0.956)	−0.067 (0.144)	0.055 (0.783)	0.015 (0.889)	**−1.376 (0.000)**	**−0.616 (0.000)**		0.422 (0.215)	−0.147 (0.670)	0.104 (0.506)		0.022 (0.852)
Delivered WTP	0.054 (0.771)	−0.005 (0.925)	0.030 (0.815)	−0.031 (0.505)	−0.042 (0.839)	0.012 (0.915)	0.022 (0.916)	0.173 (0.204)		**0.214 (0.466)**	−0.150 (0.657)	−0.227 (0.165)		0.047 (0.696)
Premium café	0.075 (0.686)	−0.002 (0.976)	0.006 (0.960)	0.011 (0.804)	−0.033 (0.875)	0.224 (0.042)	0.006 (0.977)	−0.185 (0.190)		−0.273 (0.436)	**−1.073 (0.002)**	**−0.586 (0.000)**		0.211 (0.099)
Discount café	−0.132 (0.482)	0.048 (0.384)	0.001 (0.997)	−0.092 (0.045)	−0.150 (0.463)	−0.099 (0.363)	−0.134 (0.527)	0.109 (0.435)		0.030 (0.935)	0.238 (0.490)	0.107 (0.520)		**−0.385 (0.005)**
The West Bank of Palestine														
Premium cig	**−2.259 (0.000)**	**−1.001 (0.000)**	−0.640 (0.000)		0.160 (0.491)	−0.031 (0.825)		0.429 (0.198)	−0.012 (0.979)	−0.425 (0.364)	−0.146 (0.523)	−0.354 (0.034)	−0.026 (0.905)	0.043 (0.735)
Discount cig	−0.593 (0.076)	−0.251 (0.002)	**−1.115 (0.000)**		−0.076 (0.772)	0.155 (0.301)		−0.384 (0.227)	−0.238 (0.617)	0.137 (0.755)	0.190 (0.427)	0.064 (0.704)	0.107 (0.656)	−0.031 (0.814)

Continued

Table 2 Continued

	Premium cig†		Discount cig		Premium WTP‡		Discount WTP		Delivered WTP		Premium café		Discount café	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Premium WTP	0.124 (0.681)	0.292 (0.000)		0.640 (0.000)	**0.184 (0.406)**	**0.201 (0.135)**		0.518 (0.086)	−0.155 (0.733)	0.684 (0.072)	−0.085 (0.721)	0.089 (0.580)	−0.190 (0.345)	0.239 (0.034)
Discount WTP	−0.004 (0.988)	−0.069 (0.299)		−0.116 (0.241)	−0.148 (0.563)	−0.340 (0.063)		**−0.524 (0.122)**	−0.288 (0.507)	−0.140 (0.841)	0.703 (0.005)	0.048 (0.786)	−0.195 (0.360)	0.211 (0.105)
Delivered WTP	−0.076 (0.817)	0.052 (0.498)		−0.078 (0.407)	0.131 (0.591)	0.084 (0.659)		−0.043 (0.898)	**−2.045 (0.000)**	**−0.608 (0.244)**	−0.012 (0.959)	0.612 (0.000)	0.463 (0.029)	0.251 (0.053)
Premium café	−0.104 (0.731)	−0.082 (0.259)		0.082 (0.397)	0.410 (0.112)	0.246 (0.186)		0.632 (0.084)	−0.023 (0.958)	1.726 (0.000)	**−1.625 (0.000)**	**−0.922 (0.000)**	−0.056 (0.803)	−0.172 (0.188)
Discount café	0.011 (0.972)	0.044 (0.525)		−0.216 (0.029)	−0.249 (0.321)	−0.122 (0.509)		−0.549 (0.106)	0.976 (0.040)	−0.655 (0.271)	−0.082 (0.721)	−0.447 (0.014)	**−0.386 (0.121)**	**−0.371 (0.009)**

*Reported figures indicate the own-price elasticity of each tobacco product, while the values in parentheses indicate the p value.
†Cig stands for cigarettes.
‡ WTP stands for waterpipe.
§The ZIP model did not converge for some tobacco products in the case of Jordan and the West Bank of Palestine.
ZIP, zero-inflated Poisson.

−1.85 for men), premium café (−2.38 for women vs −2.23 for men) and discount café (−1.74 for women vs −1.66 for men). However, using the CI approach based on the SE estimates (table 3), no statistical significant difference exists between men and women for these elasticities.

In Jordan, with the exception of discount cigarettes, women generally had higher elasticities as compared with men. For example, the price elasticity of discount waterpipe for women was about twofold the elasticity observed for men (−1.38 vs −0.62). Moreover, the price elasticity of premium cigarettes for women was slightly higher than the price elasticity for men (−1.12 vs −1.09). The highest elasticity was observed for discount waterpipe for women where a 10% increase in the price of discount waterpipe yielded a 13.8% decrease in its quantity consumed. Using the CI values, a significant difference between men and women exists for discount waterpipe only whereby the CIs for women and men were (−1.84 to −0.91) and (−0.91 to −0.32), respectively.

As for the West Bank, the price elasticity of premium cigarettes for women was −2.26 as compared with −1.00 for men. Palestinian women had the highest price elasticity of premium cigarettes as compared with Lebanon and Jordan. Furthermore, the price elasticities of home-delivered waterpipe and premium and discount café sessions were higher for women as compared with men. For example, the price elasticity of delivered waterpipe for women was slightly more than threefold the price elasticity of delivered waterpipe for men (-2.05 vs −0.61). The price elasticity of premium waterpipe was found to be positive for both men and women, although they were not statistically significant.

Table 4 summarises the price elasticities of tobacco product varieties by gender for each country. In Lebanon, all own-price elasticities were statistically different from zero, with higher elasticities being observed for women for cigarettes and waterpipe products. For example, a 10% average increase in cigarettes prices would result in a decrease in the quantity of cigarettes consumed by about 7.4% for women and 5.7% for men indicating an inelastic demand for cigarettes. Nonetheless, results show that demand for waterpipe was elastic. As for Jordan, the price elasticities of the three tobacco product varieties were higher for women. For example, a 10% average increase in waterpipe prices would result in a decrease in the quantity of waterpipe consumed by about 6.2% for women and only 3.7% for men. The demand for all tobacco product varieties was inelastic in Jordan. Different patterns were observed for the West Bank. The price elasticity of both cigarettes and waterpipe sessions were higher for women. However, the demand for cigarettes was elastic (−1.84 for women vs −1.03 for men), while the demand for waterpipe session was inelastic (−0.60 for women vs −0.33 for men).

Cross-price elasticities

Estimated cross-price elasticities of tobacco products are summarised in table 2 for the three countries. In

Table 3 The SEs of own-price and cross-price elasticities of tobacco products in three Arab countries

	Premium cig		Discount cig		Premium WTP		Discount WTP		Delivered WTP		Premium café		Discount café	
	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men
Lebanon														
Premium cig	**0.125**	**0.066**	0.055	0.039	0.053	0.066	0.056	0.070	0.214	0.154	0.101	0.130	0.072	0.091
Discount cig	0.119	0.062	**0.059**	**0.040**	0.053	0.067	0.065	0.081	0.266	0.160	0.110	0.141	0.075	0.095
Premium WTP	0.114	0.061	0.058	0.039	**0.066**	**0.082**	0.065	0.079	0.242	0.168	0.101	0.136	0.076	0.096
Discount WTP	0.105	0.054	0.051	0.035	0.050	0.063	**0.066**	**0.082**	0.277	0.157	0.093	0.121	0.069	0.083
Delivered WTP	0.105	0.055	0.051	0.035	0.050	0.063	0.054	0.067	**0.269**	**0.152**	0.119	0.148	0.070	0.088
Premium café	0.105	0.054	0.051	0.035	0.049	0.062	0.055	0.068	0.211	0.157	**0.100**	**0.129**	0.094	0.113
Discount café	0.106	0.054	0.051	0.035	0.051	0.064	0.055	0.068	0.211	0.172	0.094	0.124	**0.069**	**0.086**
Jordan														
Premium cig	**0.196**	**0.061**	0.127	0.048	0.199	0.110	0.204	0.138		0.316	0.343	0.510		0.166
Discount cig	0.207	0.062	**0.145**	**0.054**	0.220	0.119	0.244	0.157		0.332	0.382	0.410		0.182
Premium WTP	0.200	0.060	0.135	0.050	**0.216**	**0.122**	0.230	0.158		0.244	0.342	0.424		0.170
Discount WTP	0.187	0.055	0.126	0.046	0.201	0.107	**0.237**	**0.149**		0.275	0.346	0.340		0.156
Delivered WTP	0.186	0.055	0.127	0.046	0.208	0.107	0.208	0.136		**0.258**	0.338	0.293		0.164
Premium café	0.186	0.055	0.127	0.046	0.211	0.110	0.210	0.141		0.307	**0.353**	**0.350**		0.165
Discount café	0.187	0.055	0.128	0.046	0.204	0.109	0.212	0.140		0.273	0.344	0.364		**0.166**
The West Bank of Palestine														
Premium cig	**0.403**	**0.077**		0.099	0.231	0.141		0.334	0.456	0.468	0.229	0.167	0.220	0.126
Discount cig	0.334	0.080		**0.134**	0.263	0.150		0.318	0.476	0.438	0.239	0.169	0.241	0.133
Premium WTP	0.302	0.069		0.099	**0.221**	**0.135**		0.302	0.455	0.380	0.237	0.161	0.201	0.113
Discount WTP	0.295	0.067		0.099	0.257	0.183		**0.339**	0.434	0.700	0.247	0.177	0.213	0.130
Delivered WTP	0.330	0.076		0.094	0.243	0.191		0.340	**0.564**	**0.522**	0.231	0.157	0.212	0.130
Premium café	0.302	0.073		0.096	0.258	0.186		0.366	0.428	0.433	**0.266**	**0.165**	0.225	0.131
Discount café	0.309	0.069		0.099	0.250	0.185		0.339	0.476	0.595	0.230	0.183	**0.249**	**0.142**

Cig, cigarette; WTP, waterpipe.

Table 4 Own-price and cross-price elasticities of tobacco groups in three Arab countries

	Cigarettes		Waterpipe (250 g)		Waterpipe (sessions)	
	Women	Men	Women	Men	Women	Men
Lebanon						
Cigarettes	**−0.737** **(0.000)**	**−0.568** **(0.000)**	0.019 (0.694)	−0.014 (0.820)	0.106 (0.086)	−0.031 (0.677)
Waterpipe (250 g)	0.058 (0.381)	−0.042 (0.312)	**−1.215** **(0.000)**	**−1.198** **(0.000)**	0.120 (0.065)	0.072 (0.360)
Waterpipe (sessions)	0.033 (0.629)	0.011 (0.807)	−0.006 (0.919)	0.039 (0.583)	**−1.246** **(0.000)**	**−1.390** **(0.000)**
Jordan						
Cigarettes	**−0.708** **(0.000)**	**−0.565** **(0.000)**	−0.071 (0.702)	−0.126 (0.290)	−0.011 (0.975)	−0.027 (0.817)
Waterpipe (250 g)	0.065 (0.658)	0.056 (0.227)	**−0.620** **(0.001)**	**−0.371** **(0.003)**	0.344 (0.339)	0.075 (0.565)
Waterpipe (sessions)	−0.025 (0.864)	−0.022 (0.664)	−0.051 (0.785)	0.066 (0.602)	**−0.465** **(0.208)**	**−0.202** **(0.105)**
The West Bank of Palestine						
Cigarettes	**−1.844** **(0.000)**	**−1.029** **(0.000)**	0.508 (0.010)	0.133 (0.275)	0.011 (0.944)	−0.134 (0.140)
Waterpipe (250 g)	0.853 (0.002)	0.593 (0.000)	**0.124** **(0.506)**	**0.140** **(0.246)**	−0.090 (0.561)	0.289 (0.002)
Waterpipe (sessions)	−0.248 (0.365)	−0.031 (0.656)	−0.276 (0.215)	−0.051 (0.703)	**−0.603** **(0.002)**	**−0.326** **(0.003)**

Reported figures indicate the price elasticity of each tobacco product, while the values in parentheses indicate the p value.

Lebanon, the cross-price elasticities of premium cigarettes with respect to other tobacco products were not statistically significant except for discount waterpipe and discount café sessions for women. The cross-price elasticity of discount cigarettes with respect to premium cigarettes was positive and statistically significant for both men and women, indicating a substitution effect between the two types of cigarettes. The magnitude of the estimated cross-price elasticity of discount cigarettes with respect to premium cigarettes was higher for women (0.23) as compared with men (0.15). Such a result goes in line with the economic theory where a price increase in premium brands of a certain good leads consumers to switch to cheaper brands/products. As for premium waterpipe, results show that cross-price elasticities were statistically significant and positive with respect to discount waterpipe and discount café and negative with respect to discount cigarettes and home-delivered waterpipe for both women and men. This result indicates that there was some level of substitution between premium waterpipe and the discounted waterpipe products (discount waterpipe tobacco and discount cafe) and some level of complementarity within the premium waterpipe products (premium waterpipe tobacco with home-delivered waterpipe). Results also indicate that premium waterpipe and discount cigarettes exhibited some substitution, whereby a 10% increase in the price of discount cigarettes results in a 2.1% and 2.3% increase in the quantity consumed of premium waterpipe for women and men, respectively. Also of note, that most cross-price elasticities of premium waterpipe were slightly higher for women as compared with men. This result is also confirmed with the cross-price elasticity of discount waterpipe with respect to other waterpipe products whereby complementarity was observed between discount waterpipe and discount café while substitution effect was observed between discount waterpipe and premium and delivered waterpipe. However, the cross-price elasticities of discount waterpipe were slightly higher for women as compared with men. Furthermore, discount café sessions appear to be substitutes for premium café sessions with higher elasticities being observed for men (0.17 for women vs 0.25 for men).

As for Jordan, results show a substitution effect between premium and discount cigarettes for men only with, for example, a cross-price elasticity of discount cigarettes with respect to premium cigarettes equal to 0.25. As for waterpipe products, the cross-price elasticity of discount waterpipe with respect to premium waterpipe was statistically significant and positive for both men and women with the elasticity for women being twice that of men (0.67 vs 0.35). This may indicate that discount and premium waterpipe products were substitutes.

Lastly, results on the cross-price elasticities of tobacco products for the West Bank were mixed. Only a few of the cross-price elasticities were statistically significant for men and women. There was some level of substitution between waterpipe products for women. For example, the cross-price elasticity of home-delivered waterpipe with respect to discount café sessions was positive and close

to one for women (0.98). Furthermore, a 10% increase in the price of discount waterpipe product would reduce the quantity consumed of waterpipe in premium cafes by 7.03%. For men, on the other hand, unlike Lebanon and Jordan, results show complementarity between cigarettes products. For example, a 10% increase in the price of premium cigarettes would reduce the quantity consumed of discount cigarettes by 6.4%.

Once tobacco products were aggregated into groups, results indicate a substitution effect between cigarettes and waterpipe products for both men and women in the West Bank only, as shown in table 4. Moreover, the cross-price elasticity of cigarettes with respect to waterpipe was higher for women (0.9) as compared with men (0.6).

DISCUSSION

This study provides estimates of the responsiveness in tobacco consumption in relation to changes in the prices of different varieties of cigarettes and waterpipe tobacco products among women and men in Lebanon, Jordan and the West Bank. The study found that women are more responsive to changes in the prices of tobacco products particularly discount waterpipe in Jordan and premium cigarettes in the West Bank of Palestine. Given that women are generally worse-off as compared with men in these countries, such a result is in line with previous evidence where the poorest are found to be more sensitive to changes in tobacco prices.[7] Results for Jordan were different from those obtained by Sweis and Chaloupka[26] where the price elasticity of tobacco is found to be higher for men as mentioned in the Introduction section. Such a difference may be attributed to several reasons. First, previous estimates were calculated for cigarettes only without including any difference between cigarettes' products or waterpipe products. Second, previous estimates were based on actual consumption of cigarettes (number of packs smoked per week), while in our case, we applied a choice experiment that measure the amount consumed by each individual for each scenario of prices. Third, previous estimates were calculated based on the 2011 data were the prevalence of smoking among women was lower (5.1% in 2011 vs 13.1% in 2019).

The following highlights several interesting findings emerging from our analysis and their implications to policymakers. First, for some tobacco products, women were more sensitive to changes in tobacco prices, indicating that women smokers would reduce their tobacco consumption more than men smokers in response to similar increases in tobacco prices. Empirical evidence shows that the effects of policy interventions may vary by gender whereby women are more responsive to policy changes.[30–32] For example, using linear regression with states and years fixed effects, a study conducted in the USA show that a tobacco tax intervention appears to be beneficial for women, but not for men, in terms of reducing coronary heart disease mortality.[30] Such a result is of interest for policymakers for two main reasons. First,

as mentioned in the outset, the prevalence of waterpipe smoking is increasing in the Arab region particularly among women. Thus, an effective policy intervention may play a major role in reducing the prevalence of smoking among women. The second point is related to the specific health impact of tobacco use on pregnant women since smoking during pregnancy can increase the risk of abnormal pregnancy and delivery, birth defects, etc.[33] Reducing the prevalence of smoking among women would benefit both mothers and children by reducing the long-term health burden and the associated economic burden.

Second, the degree of responsiveness to changes in tobacco prices varied across the three countries. Different patterns of price elasticities were observed among the three countries once tobacco products were categorised into three groups: cigarettes, waterpipe tobacco (250 g) and waterpipe sessions. For example, the demand for cigarettes was elastic in Lebanon and inelastic in the West Bank, while the demand for waterpipe was inelastic in Lebanon and elastic in the West Bank. In Jordan, the demand both for cigarettes and for waterpipe appeared to be inelastic. Such differences might be related to the current prices of cigarettes and waterpipe products, as well as the overall socioeconomic status (eg, average income per capita). Moreover, these differences may be related to the fact that for nicotine-dependent smokers, a large increase in tobacco prices induces a smaller decrease in the quantity consumed of tobacco products. Such results reveal that tobacco smoking behaviour is rather country-specific, thus tobacco control policies should also be tailored in each country to reflect the sensitivity of tobacco products to price changes.

Third, the degree of responsiveness to changes in prices was higher for waterpipe products as compared with cigarettes. Such observation is mostly prominent for Lebanon where own-price elasticities of waterpipe products were greater than one for both men and women. This indicates an elastic demand for waterpipe products as compared with cigarettes. Such result is very important especially with the increasing popularity of waterpipe products in the region and the fact that waterpipe products are not taxed in the same manner as cigarettes.[34]

Fourth, results on the cross-price elasticities in the three countries indicated some substitution between cigarettes and waterpipe products, and within each product variety. However, gender differences varied across the three countries whereby higher cross-price elasticities were generally observed for women in Lebanon and Jordan. Whereas in the West Bank, results were mixed with some of the cross-price elasticities being higher for men. From a public health perspective, it is crucial to tax all tobacco products equally to avoid any substitution between and within cigarettes and waterpipe product varieties. For example, the positive cross-price elasticity between premium and discount cigarettes could lead to switching towards discount cigarettes, which may pose a higher risk of adverse health effects.[35 36]

In general, this paper adds to the literature that assesses the price elasticity of tobacco, particularly for waterpipe tobacco elasticities and cross-price elasticities of tobacco products. To the best of our knowledge, this is the first attempt that provides a comprehensive evaluation of price elasticities of different tobacco products and across gender groups in the region. As mentioned in the outset, previous estimates from Lebanon and Jordan were either aggregate estimates or were calculated for cigarettes only.[9 10 26] Available literature in other regions which provides estimation of aggregate elasticities of non-cigarette products generally exclude waterpipe products, while the other part of literature provide estimation across socioeconomic and age groups. Another key strength of the present article is the use of a harmonised methodology for three neighbouring countries in the region in terms of data collection and data analysis. Such approach allows for cross-country comparisons of the prevalence of smoking as well as the own-price and cross-price elasticities of different tobacco products. However, this is not without limitations. Our data do not account for the effect of price differentials across these three or other neighbouring countries. For example, the price of cigarette products is the highest in Palestine. As a result, Palestinians living in the West Bank may illegally purchase premium cigarettes with cheaper prices from Jordan. Such behaviour of smuggling may impact the effectiveness of tobacco policy interventions that seek to increase tobacco prices through taxation. Empirical evidence suggests that differences in tobacco prices across neighbouring countries may increase the consumption of tobacco in areas where the price of tobacco in neighbouring countries is lower.[37] With the presence of smuggling in the West Bank, the prevalence of tobacco smoking in the West Bank is expected to be different than that observed in the Gaza Strip. Indeed, available evidence shows that the prevalence rate of smoking is higher in the West Bank.[38] Unfortunately, this study focuses on the West Bank only, thus it is difficult to conduct a comparison between the two Palestinian regions. To sum up, price differentials across neighbouring countries suggest that prices of both cigarettes and waterpipe products shall be harmonised in the three countries to achieve effective decrease in the prevalence of smoking.

Another limitation is related to the independent variables included in the model that may affect the level of consumption of tobacco products. With the exception of prices, all variables were measured at the individual level. The income effect was captured in the ZIP model by controlling for both income differences and differences in the employment status of individuals. Other factors that might affect tobacco consumption and shall be available at the country or regional levels were not included in the surveys. An example of such variables is related to variations in the business cycle. Empirical evidence shows that gross domestic product (GDP) and unemployment rates across regions are highly correlated with tobacco consumption where higher GDP growth rates and lower unemployment rates tend to reduce tobacco consumption.[39 40]

Another limitation of the study is related to the actual impact of price changes on tobacco consumption. In our model, absolute prices were included in the analysis which allows to measure the price elasticities. Prices would affect tobacco consumption directly (substitution effect) and indirectly through reducing the purchasing power of individuals (income effect). However, if income increases, then the level of tobacco consumption will also increase. Accordingly, the prevalence and intensity of tobacco consumption might not be reduced if the tax increase was associated with income increase. To assess the effectiveness of tobacco tax policies, empirical evidence suggests to calculate the so-called affordability elasticity which captures the changes of tobacco consumption to changes in the price and income simultaneously rather than separating the two effects.[41] This is done by including the price-income ratio in the model instead of including both prices and income as two independent variables. Although we account for income effect in the current study, we could not calculate this ratio since income is available as a categorical variable.

Based on limitations raised above, future research could focus on the following three areas. First, the lack of data in this strand of literature calls for the collection of national comprehensive data for each country in the region. These data could include information about the source of purchase of tobacco products to account for the impact of illicit trade caused by price differentials across neighbouring countries. Accounting for this in the analysis of price elasticities is crucial to assess the effectiveness of tobacco taxation policies. Second, although income data are relatively unreliable in low-income countries where individuals tend to underreport the level of their income, future surveys could also include questions about the level of income or consumption expenditure as a proxy for income. This allows us to calculate the affordability elasticity of tobacco consumption and compare results with those obtained from considering price and income elasticities separately. Third, future research could also benefit from results obtained at the micro level to assess the associated health benefits as well as macro-level impact of tax interventions on government revenues.

CONCLUSION

The epidemic of waterpipe tobacco smoking is growing among women in low-income and middle-income countries.[12] Our analysis could inform efforts in increasing taxation on waterpipe tobacco products in similar contexts. Moreover, the prevalence of tobacco smoking is likely to increase among women in the region as social restrictions placed on women are reduced. These restrictions include religious restrictions and sociocultural acceptance of women smoking where people in the region believe that the practice of smoking reflect a 'negative image' of

women.[42 43] As shown in Lebanon, where smoking among women is more socially acceptable relative to other countries in the region, the prevalence of tobacco smoking among women is extremely high.[43 44] Therefore, gender-based analyses are important to consider the formulation of tobacco control policies. The differences in the own-price and cross-price elasticities between men and women for some tobacco products in Jordan and the West Bank of Palestine reveal the higher responsiveness of women to changes in tobacco prices as compared with men. This fact reflect the effectiveness of increasing tobacco taxes, hence reducing tobacco prevalence and the associated economic burden. Akin to previous evidence that demonstrates a substitution effect between cigarettes and other tobacco products, such as cigars and electronic cigarettes,[21] this paper shows that some waterpipe tobacco and cigarettes products act as substitutes. The fact that many tobacco products appear to be substitutes reflect the importance of taxing all tobacco products to avoid any potential substitution that may occur between and within tobacco products while increasing government revenues.[15 21 45]

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