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Economic research in waterpipe tobacco smoking: reflections on data, demand, taxes, equity and health modelling

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ABSTRACT

Economic evaluation of tobacco control policies is common in high-income settings and mainly focuses on cigarette smoking. Evidence suggests that increasing the excise tax of tobacco products is a consistently effective tool for reducing tobacco use and is an efficient mechanism for increasing government revenues. However, less research has been conducted in low/middle-income countries where other tobacco forms are common. This paper presents insights from our work on the economics of waterpipe tobacco smoking conducted in the Eastern Mediterranean Region where waterpipe smoking originated and is highly prevalent. The specific areas related to economics of waterpipe smoking considered herein are: price elasticity, taxation, government revenue, expenditure and healthcare costs. This paper aims to provide practical guidance for researchers investigating the economics of waterpipe tobacco with potential implications for other novel tobacco products. We present lessons learnt across five thematic areas: data, demand, taxes, equity and health modelling. We also highlight knowledge gaps to be addressed in future research. Research implications include designing comprehensive assessment tools that investigate heterogeneity in waterpipe smoking patterns; accounting for cross-price elasticity of demand with other tobacco products; exploring the change in waterpipe tobacco smoking in response to a tax increase and analysing the equity impact of waterpipe tobacco control interventions.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ There is limited research on the economics of waterpipe tobacco smoking.

WHAT THIS STUDY ADDS

⇒ This paper provides practical guidance for researchers investigating the economics of waterpipe tobacco with potential implications for other novel tobacco products, based on experience from work conducted in the Eastern Mediterranean Region.

⇒ Lessons learnt are presented across five thematic areas: data, demand, taxes, equity and health modelling.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Research implications include: designing comprehensive assessment tools that investigate heterogeneity in waterpipe smoking patterns; accounting for cross-price elasticity of demand with other tobacco products; exploring the change in waterpipe tobacco smoking in response to a tax increase and analysing the equity impact of waterpipe tobacco control interventions.

INTRODUCTION

Despite reductions in cigarette smoking in high-income countries, alternative forms of tobacco use are increasing worldwide, including waterpipe tobacco smoking, especially among youth.[1] Waterpipe tobacco smoking involves the passage of charcoal-heated air through a perforated aluminium foil separating the charcoal from the flavoured tobacco. The resulting smoke cools as it bubbles through the water before inhalation by the smoker.[2] Waterpipe tobacco smoking is a 'stationary' activity that takes more time compared with cigarette smoking and is typically a social activity often in waterpipe smoking establishments (eg, 'hookah cafés') where many users usually share a single waterpipe for extended periods.[3] Accordingly, waterpipe tobacco smoking is associated with unique features, including its novelty, its aromatic smell and bubbling sound among other sensory cues, its social dimension and limited accessibility.[2] Other factors that have contributed to the increased demand for waterpipe smoking involve the introduction of flavoured waterpipe tobacco, its reduced harm perception, proliferation of the waterpipe café concept, its promotion via the internet, as well as the lack of regulatory frameworks specific to the waterpipe.[4 5]

Evidence indicates deleterious health outcomes associated with waterpipe smoking including lung cancer, respiratory illnesses and cardiovascular diseases.[6] Given the rise in waterpipe smoking prevalence and its threat to public health, there has been a global interest in waterpipe tobacco control and a recognition of the need for specific regulations that consider the unique features of waterpipe tobacco smoking.[7 8] The WHO Framework Convention on Tobacco Control (FCTC) recommends that fiscal policies be implemented to reduce tobacco consumption[9]; however, there has been limited research on the economics of waterpipe smoking.

Caution should be exercised in applying economic approaches developed for cigarettes to waterpipe tobacco because each type of tobacco use has its idiosyncratic economic, social and contextual features. Against this backdrop, this paper aims to provide practical guidance for researchers investigating the economics of waterpipe tobacco by discussing lessons from our research in three Eastern Mediterranean countries, where waterpipe smoking rates are among the highest worldwide.[4] Guided by the World Bank's Economics of Tobacco Toolkit,[10] we discuss lessons learnt across five thematic areas: data, demand, taxes, equity and health modelling.

DATA

Economic research in tobacco control relies on the assessment of tobacco smoking prevalence. This requisite highlights the importance of having standardised assessments. Input data types range from aggregate measures to individual responses, and these measures vary based on the tobacco product and its use patterns. Given the unique features of waterpipe tobacco smoking, recommendations have been published around its appropriate assessment.[3 11] Despite these efforts, there is still limited surveillance of waterpipe tobacco smoking generally, and in the Eastern Mediterranean Region specifically. While waterpipe tobacco use is increasingly included on Global Adult Tobacco Surveys, concerns about its measurement validity have been raised[12] since its prevalence estimates appear strikingly low in waterpipe-endemic countries.[1] Thus, there is a timely need to collect more accurate waterpipe tobacco smoking prevalence data.

In our research, we conducted in-person nationally representative household surveys in Jordan, Lebanon, and Palestine between June and August 2019 using standardised questionnaires.[13] One strength of standardised questionnaires is that they allow for valid cross-country comparisons. Assessments included current waterpipe smoking, as well as details regarding the number of heads per session, amounts paid and venue (ie, commercial establishments—as cafés and restaurants, and home—whether prepared at home or ordered through delivery service). Survey results revealed high prevalence rates for current waterpipe smoking in all three countries (39.5% in Lebanon, 11.0% in Jordan and 12.9% in Palestine).[13] In waterpipe tobacco smoking research, assessing lifetime, past-year or past 30-day waterpipe tobacco smoking, while ignoring measures of quantity and frequency, may be insufficient. Specific measures (eg, number of sessions and number of heads per session) provide a more accurate estimation of the individual's toxicant exposure.[14] Besides, prices and patterns of waterpipe tobacco use are likely to vary by location (ie, home vs café),[15] which makes it critical to include questions about venue in waterpipe tobacco smoking surveys.

Despite following these practices in our work, we experienced additional data challenges. Our standardised assessment tools did not capture some of the variability in waterpipe tobacco use patterns pertaining to the duration of waterpipe tobacco smoking per session, and whether the sessions were shared by multiple smokers. Additionally, waterpipe tobacco use was self-reported and not biochemically verified, which may have resulted in under-reported prevalence. Current waterpipe tobacco smoking was reported by only a small proportion of women in two of the countries, which suggests a potential for social desirability bias resulting in unreliable estimates.[13]

Accordingly, future assessment tools should include questions that allow for capturing the heterogeneity in waterpipe smoking patterns. Additional assessments to consider include smoking patterns on specific days given that waterpipe smoking is more likely to occur on weekends than weekdays.[16 17] Another critical dimension to address is the seasonality of waterpipe smoking: being commonly practised in groups and in commercial establishments, its use may vary by season and is more common during summer months and holidays.[17 18] These suggested questions can be used to refine available standardised assessment tools for waterpipe smoking[11] and incorporated into global surveys for effective surveillance. In addition, verification of self-reported waterpipe smoking using reliable biomarkers is recommended whenever feasible to increase scientific rigour. Once such waterpipe tobacco smoking-specific data are available, they can be used to inform estimation of the economic impact of waterpipe smoking, including healthcare costs and productivity losses.

DEMAND

Understanding the determinants of demand is essential to ultimately reduce demand for tobacco products. This involves determining the characteristics of the specific product market by conducting market research and considering the relevant parameters needed for an econometric analysis. One central issue is how to estimate the price elasticity of demand for tobacco products (defined as the percentage change in consumption relative to a 1% price increase)[19] and how to use these estimates to predict the likely impact of changes in tax rates on consumption and government revenues. Over the past few decades, researchers have used various analytical techniques to estimate the price elasticity of demand for tobacco.[10 19]

In this regard, choice experiments are well suited for the evaluation of the effects of product attributes on consumer choice. The basic premise of a choice experiment is that a good or service can be described with a set of attributes, and respondents are presented with various choice sets from which they must choose among several alternatives. Researchers using this technique can assess respondents' stated preferences for product characteristics and the attributes they consider most important.[20] Although the choices are hypothetical and may not always reflect actual scenarios, findings from a choice experiment are important as they shed light on plausible trade-offs, informing decision-makers of policy configurations before their implementation.[21]

Our team investigated the demand for waterpipe tobacco smoking by estimating the own-price and cross-price elasticity of demand for both cigarettes and waterpipe tobacco products based on individual-level consumer data collected through volumetric choice experiments in Jordan, Lebanon and Palestine.[20] Through this experiment, we elicited respondents' stated purchases of eight cigarette and waterpipe tobacco product varieties by hypothetically varying prices. Respondents were asked to specify the quantity of cigarettes and waterpipe products they would purchase based on their corresponding prices and could choose one or more of each product or none at all. Waterpipe tobacco categories included premium and discount variations of store-bought waterpipe tobacco and waterpipe tobacco consumed in a café setting, as well as non-flavoured waterpipe tobacco and waterpipe home delivery. Results show modest cross-price elasticity between cigarettes and waterpipe tobacco across all countries, which provides policy-relevant information: a low rate of substitution between cigarettes and waterpipe tobacco supports the call for increasing taxes on each product.

The volumetric choice experiment, a recently developed derivative of the discrete choice experiment, has a major added value as it reveals the change in the quantity of a particular good in response to changes in attribute levels rather than whether that

good is chosen in response to such changes.[22] This aligns with real-world decisions that involve the purchase of multiple units of the same product. Despite the strengths of using volumetric choice experiment for tobacco demand analysis, one challenge lies in the interpretation of the results of the waterpipe demand analysis. Whereas a decrease in cigarette demand may be directly relatable to a positive health outcome, this is not necessarily the case with waterpipe smoking given the lack of corresponding evidence in the literature.

Additional studies are needed to understand the dynamics of individual behaviours in response to increasing waterpipe tobacco taxes. Some potential scenarios are: smoking fewer heads of waterpipe tobacco while extending the waterpipe smoking session per head; switching to other tobacco products; switching between home consumption and café consumption; and sharing the cost of the waterpipe at cafés. Further studies are required to better understand these behaviours and their economic and public health consequences. Another recommendation is to improve the accuracy and robustness of the predictions of volumetric choice experiments. This can be achieved by combining stated preference data with revealed preference data which reflect actual purchases in the market, collected from the same survey respondents. Combined models obviate the limitations of both methods (ie, hypothetical bias of stated preference and multicollinearity of revealed preference) and have been recently recommended in tobacco research.[23] Analysis of demand studies should also be replicated in additional countries to improve generalisability.

TAXES

Understanding the structure, design and administration of tobacco taxes is a critical thematic area within the economics of tobacco control. Price-based measures are among the core tobacco demand reduction tools recommended by the WHO FCTC.[24] Substantial evidence from countries across income levels suggests that tobacco taxation is the single-most, consistently effective tool for reducing tobacco use, while also serving as an efficient mechanism for increasing government revenues.[19] Evidence also indicates that raising taxes on tobacco products generates substantial healthcare cost-savings and can potentially result in additional gains by improving productivity at the workplace.[25] Higher prices exert their effect by causing current tobacco users to quit or reduce consumption and by preventing potential users from initiating use.[19] The size of these effects is often expressed as price elasticity of demand.[19] A comprehensive regulatory approach for effective waterpipe tobacco control must include price-based measures. One unique feature to consider in waterpipe taxation is the smoking venue (eg, home vs café/restaurant),[26] which underscores the importance of taxing the product itself rather than only the services at the venue. Another consideration is the significant gap in the price of a waterpipe smoking session in homes versus cafés/restaurants,[15] implying that taxes disproportionately affect café use relative to home use. The cost of waterpipe smoking at a commercial establishment is higher compared with home consumption, as it includes the price of the tobacco product itself as well as the hospitality service received at the establishment.

Tobacco excise taxes are an effective tool for generating fiscal revenues while improving public health outcomes by leading to tobacco demand reductions. Tobacco tax research can model the optimal tax rates and the appropriate type (specific vs ad valorem excise taxes) under current or hypothetical conditions while examining the pros and cons of various types of tobacco taxes from the perspectives of various stakeholders (eg, consumers, governments, tax administrators and producers). Besides, tobacco tax research is relevant for predicting the impact of changes in the relative prices of tobacco products on substitution among these products.[19] Knowing the unique contexts surrounding the design and administration of tobacco taxes in each jurisdiction, findings of tax modelling can potentially inform context-specific policies.

Research into price-based measures for tobacco control has focused on cigarettes. Nonetheless, a recent systematic review and meta-analysis examining the elasticity of demand for non-cigarette tobacco products supports the effectiveness of price increases in reducing consumption of non-cigarette tobacco products.[27] This review included only one study that reported price elasticity estimates for waterpipe tobacco, which was conducted in Lebanon.[28]

Since that systematic review was published, our team has developed a waterpipe tobacco-specific model that uses country-specific and market share-specific price data, consumption data, and price elasticity of demand to calculate the change in consumption, government revenue, and premature deaths averted following a change in the specific excise tax of waterpipe tobacco.[29] The model was applied to data from Jordan, Lebanon and Palestine, and estimates indicate that large increases in the specific excise tax can yield substantial government revenue and public health gains in all three countries.[29] These results support increasing taxation on waterpipe tobacco products and can inform relevant decision-makers. One policy recommendation is to raise taxes on all tobacco products simultaneously to discourage product substitution. However, we acknowledge that reducing waterpipe tobacco smoking, as is the case with other non-cigarette tobacco products, entails innovative tax policies. This model is one of the few that simulates any form of tobacco taxation in the Eastern Mediterranean Region generally and the first to simulate waterpipe tobacco taxation specifically. The strength of this model also corresponds with using high-quality surveillance data. However, the model has its limitations, including the fact that it does not incorporate cross-price elasticity of demand, given that waterpipe tobacco smokers may switch to other tobacco products when faced with rising prices. Besides, our experience highlights the need for researchers to collaborate with other stakeholders when building the models, including policymakers, tax administration staff and government officials, which will enhance their understanding of the tobacco tax structure and the role of tobacco taxes in tobacco control policy recommendations.

EQUITY

Central to the economic evaluation should be the analysis of the impact of tobacco tax increase and other tobacco control measures on the welfare of low-income populations and other vulnerable groups. As presented in the World Bank toolkit, the welfare of low-income populations is linked to tobacco in two main ways: either through the purchase and consumption of tobacco products or through involvement in the production, sale and distribution of tobacco products. This type of analysis requires access to detailed specific survey data, including income distribution and consumption patterns. Then, available analytical methods using country-specific data can be used to inform policy analysts on how to effectively address concerns about the poor, tobacco consumption and tobacco control policies.

Taxation as a tobacco control measure has been criticised for imposing a disproportionate burden on the poor through

regressive taxes.[19] However, many studies have provided evidence against this misconception, and this 'feared inequity' has been realised as one of the myths claimed by the tobacco industry.[30] A recent policy note from the World Bank argues that higher prices of cigarettes provide more health and financial gains to the poorest populations compared with the richest.[31]

The Global Tobacco Economics Consortium also provided supporting evidence on how higher tobacco excise taxes are strongly relevant to three inter-related targets of the United Nations sustainable development goals: lowering income poverty, reducing non-communicable diseases and expanding financial protection against illness.[32] Brown *et al* assessed the equity impact of various tobacco control measures on adult and youth smoking separately in two systematic reviews.[33 34] The reviews provided evidence of 'positive equity impact', whereby low socioeconomic groups were more responsive to price increases than high socioeconomic groups.[33 34] Other than reducing inequities in tobacco use, tobacco taxes can reduce health inequities by dedicating a portion of tax revenues to serve welfare programmes that directly benefit the poor. Spending on education, healthcare, tobacco cessation services and raising awareness of health consequences are potential strategies.[19] However, all relevant studies are again restricted to cigarettes, while only limited evidence exists on other tobacco products. The strength of the volumetric choice experiment is that it can readily address equity concerns. By tailoring compensated elasticity estimates to vulnerable subpopulations, the compensating variation estimates attendant to increased taxes or other fiscal tools can be derived and compared across population groups to inform the distributional effects of any policy scenario of interest.

To our knowledge, there is only one prior economic study with an equity lens that involves waterpipe tobacco. This study, by Salti *et al* in Lebanon,[35] estimated own-price elasticity for imported cigarettes, locally produced cigarettes and waterpipe tobacco to be negative, and showed a social gradient demand for each of these products, with higher socioeconomic status quintiles being less sensitive to price compared with the lower quintiles. The cross-price elasticity for most pairs of tobacco products suggests that the products are substitutes, except for the case of local cigarettes and waterpipe tobacco for the poorest quintile, which are consumed together.[35] Salti *et al* also examined the impact of increasing tobacco taxes on government revenues and household expenditures across socioeconomic status quintiles, while accounting for potential substitutions across tobacco products.[35] Analysis showed that a 50% increase in the tobacco excise taxes would increase the overall tax revenues by $405 million (with only 14% of the additional tax revenue being financed by the poorest quintile, vs 25% by the richest) and the overall expenditure on tobacco products by $370 million (with a share of the average household expenditure by adult equivalent equal to 4% for the poorest quintile vs around 1% for the richest).[35]

Economic studies of waterpipe smoking with a gender focus are also scarce. Evidence shows gender differences in waterpipe tobacco smoking, including initiation and smoking behaviour, tobacco flavours, motivation to quit and harm perception.[36–38] However, to our knowledge, there have been no published analyses of gender differences in price elasticity of waterpipe tobacco products. Such analysis allows for the exploration of responsiveness in tobacco consumption by gender in relation to changes in tobacco prices. Accordingly, our research team analysed gender differences in own-price and cross-price elasticity of demand for cigarettes and waterpipe tobacco in Eastern Mediterranean countries.[39] Findings revealed that women are more sensitive to changes in tobacco prices relative to men. This analysis not only contributes to the knowledge gap, but also informs contextual tax policies on waterpipe tobacco products. Results concerning gender differences in the own-price elasticity of waterpipe tobacco indicate that the increase in waterpipe taxes may be effective in reducing the prevalence of waterpipe smoking. Results also show that waterpipe and cigarettes act as substitutes, which reflects the importance of taxing all tobacco products to avoid any substitution between tobacco products.

Hence, it is fundamental for researchers to consider equity in the economic evaluation of waterpipe tobacco control interventions (both tax and non-tax strategies) to meet an urgent need for evidence that considers the nuances of waterpipe tobacco smoking. Such studies would guide the development of 'equity-positive' interventions. In brief, the application of equity frameworks for analysis of waterpipe tobacco smoking control policies and prevalence is instrumental.[40]

HEALTH MODELLING

Simulation modelling in public health is used for multiple purposes and has become an essential tool to inform and evaluate tobacco control policies. Various simulation models of smoking behaviours have been developed (eg, the SimSmoke model,[41] the health economic and economic consequences of smoking interactive (HECOS) model,[42] Tobacco Policy Model[43]) but none accounts for specificities of waterpipe tobacco. Specifically, the unique social dimension of waterpipe smoking, including the sharing behaviour, is a key consideration for health modelling, especially given the growing research on social networks and its influence on the spread of complex behaviours such as tobacco use.[44–46]

Agent-based modelling, a sophisticated computational modelling technique, has been explored for its potential usefulness in investigating complex behaviours. Moreover, it is thought that agent-based modelling may help to effectively anticipate the public health effects of potential changes in tobacco regulatory standards and policies to inform tobacco control policy.[47] Agent-based modelling has a unique feature of examining various 'what-if' scenarios in dynamic social and physical environments. Compared with other forms of tobacco use, waterpipe smoking is a uniquely complex behaviour that constitutes a social activity occurring among friends or persons associated with social networks. Accordingly, agent-based modelling may be especially useful for incorporating the influence of social networks on waterpipe smoking and capturing individuals' space-time activity along with the spatial distribution of waterpipe smoking venues.[48] Besides, the application of agent-based modelling in waterpipe tobacco smoking research serves as an illustrative exemplar for its application in other tobacco products. Future work should consider the application of agent-based modelling in waterpipe smoking research. Accordingly, it is critical to collect comprehensive prerequisite data related to individual-level factors that inform agent-based modelling. Eliciting individuals' preferences relating to waterpipe smoking, as through the use of discrete choice experiments and understanding waterpipe tobacco smoking patterns using longitudinal and waterpipe smoking-specific surveys are particularly needed for effective agent-based modelling.[48]

CONCLUSION

The unique context of waterpipe tobacco smoking contributes to considerable variability in its use patterns compared with cigarette smoking. This paper provides practical guidance with respect to specific tools for studying the economics

of waterpipe tobacco, with potential implications for other tobacco products. We discuss lessons learnt that can inform future econometric studies in waterpipe tobacco control, across multiple thematic areas, namely data, demand, taxes, equity and health modelling. We also highlight knowledge gaps which are mainly related to collecting high-quality surveillance data that take into consideration the specificities of waterpipe tobacco smoking. Research on the economics of waterpipe tobacco smoking, unlike cigarette smoking, is still in its infancy. Yet, we acknowledge that research discussed in this paper on the economics of waterpipe smoking (eg, research on price elasticity) coupled with available evidence can inform specific economic policy recommendations. However, caution should be exercised as some findings may not be generalisable to countries beyond the ones represented in this work. For other topics (eg, simulation modelling of health outcomes), the evidence base specific to waterpipe smoking is lacking. Hence, committed researchers are encouraged to adopt the research agenda identified earlier and continuously provide data needed to generate more supporting evidence.

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