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# The allure of the waterpipe: a narrative review of factors affecting the epidemic rise in waterpipe smoking among young persons globally

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## ABSTRACT

**Objective** The objective of this narrative review is to highlight the determinants of the epidemic rise in waterpipe tobacco smoking (WTS) among youth globally. The Ecological Model of Health Promotion (EMHP) was the guiding framework for the review.

**Data sources** The following electronic databases were searched: Cochrane library, MEDLINE, EMBASE, PsycINFO, Web of Science and CINAHL Plus with Full Text. Search terms included waterpipe and its many variant terms.

**Study selection** Articles were included if they were published between 1990 and 2014, were in English, were available in full text and included the age group 10–29 years.

**Data extraction** Articles which analysed determinants of WTS at any of the levels of the EMHP were retained regardless of methodological rigour: 131 articles are included. Articles were coded in a standard template that abstracted methods as well as results.

**Data synthesis** The review found that methodologies used to assess determinants of WTS among youth were often conventional and lacked rigor: 3/4 of the studies were cross-sectional surveys and most enrolled non-representative samples. Within the framework, the review identified determinants of WTS at the intrapersonal, interpersonal, organisational, community and policy levels.

**Conclusions** The review suggests potential interventions to control WTS among youth, with emphasis on creative utilisation of social media, and tobacco control policies that include the specificities of WTS. The review further suggests the need for rigorous qualitative work to better contextualise determinants, and prospective observational and experimental studies that track and manipulate them to assess their viability as intervention targets.

## BACKGROUND

Waterpipe tobacco smoking (WTS) is increasing worldwide.<sup>1–2</sup> Once thought to be a form of tobacco use specific to the Eastern Mediterranean (EM) region, WTS has spread rapidly globally.<sup>3–4</sup> Despite the rise of WTS starting in all age groups in the 1990s,<sup>5</sup> WTS is predominantly a youth behaviour. Youth rates of WTS exceed adult rates in almost every study conducted, as clearly described in the first paper in this issue on the ‘Epidemiology of waterpipe smoking’.<sup>1–2</sup> Global statistics on ever and current WTS reveal alarming levels in high school and university students, often surpassing cigarette use.<sup>4–6–8</sup> WTS is not a safe

alternative to cigarettes. Research indicates toxicant yields and adverse health effects equal to or worse than those for cigarettes.<sup>9–22</sup> Recent comparisons of current e-cig versus WTS use among middle and high school students in the USA indicate equal rates for middle school students (1.1%), and slightly higher rates of the latter in high school students.<sup>23</sup>

Early research and interventions that investigated health risk behaviours highlighted individual genetic background, knowledge and attitudes; however, in the 1970s, researchers began to document the critical influence of the social and physical environments. A variety of ecological models have been suggested. For the purposes of this review, the Ecological Model of Health Promotion (EMHP)<sup>24</sup> was selected as a framework to guide the analysis. The EMHP posits that behaviour is influenced by factors at a variety of levels including intrapersonal, interpersonal, organisational/institutional, community and policy. Intrapersonal variables focus on an individual’s knowledge, attitudes and beliefs. Interpersonal variables focus on the influences of parents, peers, siblings, teachers, health providers and others in relatively close contact with the individual. The organisational level describes how the context and structures of formal and informal institutions such as schools, hospitals and workplaces can support or hinder behaviour change. At the community level, influences such as social networks, neighbourhoods and mass media buffer or facilitate the effect of larger forces on the individual. Finally, policy can influence behaviour change by changing the underlying attitudes, motivations and social norms. The EMHP was selected as it incorporates the majority of variables that research has linked to behaviour, including substance use in general<sup>25–26</sup> and tobacco use in particular.<sup>27–28</sup> Though determinants of tobacco use at each of these levels have been specifically identified for cigarettes, most of the WTS research has focused on intrapersonal or interpersonal determinants. The EMHP is relevant not only to research but also to practice and policy.

Although several narrative reviews of WTS have included sections on determinants of use, only one systematic review specific to motives, beliefs and attitudes around WTS has been published.<sup>29</sup> None of the reviews have focused specifically on youth. None explored determinants based on a conceptual framework. In addition, none have specifically reviewed the methodologies applied in the research. Exploring the literature from this perspective allows for the comprehensive identification of



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what is known and what gaps still exist in our understanding of a particular behaviour, and the methods applied to this understanding, and thus guides research where needed, as well as interventions in practice and policy where evidence is clear. This paper does not focus on demographic or socioeconomic factors as those are reviewed in the Maziak *et al*<sup>2</sup> paper in this issue.

## METHODS

For this narrative review, the following electronic databases were searched: Cochrane library, MEDLINE, EMBASE, PsycINFO, Web of Science and CINAHL Plus with Full Text. Search terms included waterpipe and its many variant terms—hubble bubble, shisha, hooka, goza, arghile and narghile. The search was limited to papers published in English, between 1 January 1990 and 15 August 2014. We took 1990 as our lower limit based on the Rastam *et al*<sup>5</sup> analysis of the rise in WTS among all age cohorts in the 1990s. Given that this epidemic is particularly concentrated among young people, we included only articles that included the age range 10–29 years. The articles abstracted were compared with those already available in a database of articles on tobacco use kept by the Public Health in the Arab World website as well as with the articles included in the earlier systematic review<sup>29</sup>—additional articles were included when missing.

The title and abstract of each selected article were read, and the article was retained if it discussed determinants of WTS, which included knowledge, beliefs, attitudes, motives, perceptions, as well as social, media-related and policy related factors. Since research on WTS determinants has increased only in the past decade, and since the objective of this review was to document any findings at each of the levels of the EMHP, we included articles regardless of methodological rigour. The total number of articles included in this review is 144, including both quantitative and qualitative methods.

Articles were divided by country. Coauthors coded the articles in a template that abstracted methods as well as results. Of the 144 articles, 131 were data-based studies (not editorials, news analyses or reviews) and only these were included in the assessment of methods. Once data abstraction was complete, the articles (and their summaries in the template) were redistributed for narrative review to coauthors by the level of the EMHP.

## RESULTS

### Review of the methodologies used in the research around WTS determinants

A total of 131 data-based studies were identified. These included 22 qualitative, 107 quantitative and 2 mixed method (quantitative plus qualitative) studies. Qualitative methodologies included key informant interviews, focus groups, behavioural observation, and analysis of text-based and visual-based materials (eg, websites, advertisements, twitter posts and policy documents). Of the 109 quantitative and mixed methods studies, the vast majority, 106 (97.2%), used surveys; of these, 100 (94.3%) were cross-sectional, and 6 utilised prospective designs. The quantitative studies also included one that used a lab-based experimental design, and another that assessed waterpipe use and topography characteristics using behavioural observation.

In terms of sampling methodology, 9 of the 131 studies sampled archival materials (text or visual documents) and 123 used human subjects (one was a mixed methods study that sampled both individuals and archival data). Of the 123 studies that sampled individuals, 73 sampled either randomly or assessed entire populations, whereas 50 used convenience

sampling. Among these 123 studies, a majority of sampling frames were educational institutions (n=75), 19 were community-based samples including healthcare clinics, 15 used multiple frames (typically combinations of educational institutions, cafes, worksites and healthcare institutions), 8 were cafes/restaurants where waterpipe users congregate and 5 were national samples.

Among the 123 studies that used human subjects, 47 (35.9%) were not representative of specific populations. The other 76 used random sampling or assessed entire populations to obtain representative samples from nations (n=4), city, state or region (n=10), school system or single educational institution (n=53), waterpipe customers in a retail establishment (eg, café; n=4), and other populations (eg, pregnant women in healthcare settings; n=5; table 1).

### Review of factors affecting the rise in WTS: applying the EMHP for analysis

The vast majority of the 131 data-based studies globally focused on either the intrapersonal or interpersonal levels (table 2) and were conducted in the Arab region or the USA. When analysed by 5-year intervals, it is clear that as knowledge evolved and progressed, more attention was placed on understanding factors at the more distal levels such as organisational, community and

**Table 1** Methodological characteristics of data-based studies included in review (N=131)

	n (%)
<b>Method</b>	
Quantitative	107 (81.7)
Qualitative	22 (16.1)
Mixed methods (quantitative and qualitative)	2 (1.5)
<b>Design</b>	
Analysis of text or visual materials	9 (6.9)
Key informants	2 (1.5)
Focus groups	6 (4.6)
Other qualitative design	5 (3.8)
Cross-sectional survey	100 (76.3)
Prospective survey	6 (4.6)
Experimental design	1 (0.8)
Other quantitative design	1 (0.8)
<b>Sampling methodology*</b>	
Convenience sample assessed	50 (38.2)
Entire population or a random sample assessed	73 (55.7)
Archival data assessed	9 (6.9)
<b>Sampling frame</b>	
Educational institution	75 (57.3)
Café/restaurant	8 (6.1)
Local community, including health clinics	19 (14.5)
National	5 (3.8)
Multiple frames	15 (11.5)
Archival data	9 (6.9)
<b>Representativeness of human samples (n=111)</b>	
Not representative	47 (35.9)
Representative of the population of a city, state or region	10 (7.6)
Representative of the population of a nation	4 (3.1)
Representative of a school system or educational institution	53 (40.5)
Representative of waterpipe customers in a retail establishment	4 (3.1)
Representative of other populations	5 (3.8)

\*Numbers total >131 due to some studies having multiple samples and/or frames.

**Table 2** Data-based studies by level of the Ecological Model of Health Promotion and world region\*

Ecological model level	Arab region	Americas	Europe	Africa	Asia	Global
Intrapersonal	N=23	N=48	N=5		N=6	N=1
Interpersonal	N=38	N=35	N=1	N=2	N=10	N=1
Institutional/organisational	N=4	N=4				N=1
Community	N=4	N=5			N=1	
Policy	N=3	N=7	N=2			

\*The total N is greater than 131 as several articles include more than one level. The level of each of the data-based articles is listed in the reference list. References<sup>30–67</sup> were coded as part of the methodological analysis but not referenced directly in the text.

policy levels (table 3). Policy-level studies have only recently begun to be conducted, despite a clear understanding (from decades of work related to the cigarette epidemic) of the need for comprehensive policy to impact tobacco control.

#### Intrapersonal factors

There are a number of intrapersonal factors affecting the epidemic rise in WTS among youth globally. These include reasons for smoking, attitudes towards WTS, perceptions about health hazards, perceptions of addictive properties and ability to quit.

#### Reasons for smoking

The most common reasons that youth provide for smoking a waterpipe are for entertainment, relaxation, to fill up free time (boredom/loneliness/absence of alternative recreation), out of curiosity, to socialise and to experiment with something new.<sup>68–86</sup> They also use it as a mechanism for emancipation and an expression of manhood.<sup>78 87 88</sup> The waterpipe is also perceived to provide a positive somatic experience that engages almost all the senses, including taste,<sup>16 69 70 85 89</sup> smell,<sup>70 85 89</sup> sight, sound and touch.<sup>13 78 83 90 91</sup> The combination of fruit flavour and smooth smoke was perceived to provide a ‘relaxing appeal’.<sup>92</sup>

‘Culture’ is often given as a reason for WTS use among EM young people living both inside and outside the EM region.<sup>93</sup> For those living abroad, they claim it as one way to hang onto one’s heritage, as well as to meet and socialise with others of the same ethnicity.<sup>9 83</sup>

#### Attitudes towards WTS

Youth have favourable perceptions towards WTS, and describe it as entertaining, attractive, romantic, fun, highly popular, socially acceptable, fashionable, exotic, intimate and an ‘affordable relaxing novelty’.<sup>7 68 73 81 83 84 92 94–98</sup> These attitudes are

**Table 3** Data-based studies by level of the Ecological Model of Health Promotion and year\*

Ecological model level	2000–2004**	2005–2009	2010–2014
Intrapersonal	N=6	N=25	N=47
Interpersonal	N=6	N=21	N=66
Institutional/organisational		N=2	N=8
Community	N=3	N=3	N=10
Policy			N=12

\*The total N is greater than 131 as several articles include more than one level. The level of each of the data-based articles is listed in the reference list. References<sup>30–67</sup> were coded as part of the methodological analysis but not referenced directly in the text.

\*\*Although this review abstracted articles starting in 1990, no articles exploring WTS determinants were found prior to the year 2000.

associated with WTS use as well as intention to initiate use among non-users.<sup>99 100</sup> In one study, thinking that successful and cool people smoke waterpipe—sometimes called imitation—increased the odds of being a current WTS.<sup>69 101</sup> More notably, the youth view the waterpipe apparatus itself as attractive.<sup>70</sup> Youth also perceive that WTS results in a number of positive affective and cognitive effects, including relieving anxiety and stress,<sup>102–104</sup> anger and depression;<sup>71</sup> forgetting problems,<sup>87</sup> and improving concentration and self-efficacy. On the other hand, self-efficacy and self-esteem—both attitudinal—were found to be protective against WTS.<sup>99</sup>

Young people often compare the waterpipe to cigarettes. The waterpipe is perceived to be a more ‘attractive’ tobacco product that is more appealing than cigarettes, is novel, has secondhand smoke that is less bothersome, is more available and accessible, and is a cheaper alternative to an expensive night out at bars.<sup>75 78 92 105</sup> Some view the waterpipe as a replacement or exit strategy from cigarettes.<sup>69 92</sup>

#### Perceptions about health hazards

A survey of US undergraduate students found that the majority believed there were health hazards associated with waterpipe use.<sup>82</sup> As to the perceived health hazards of WTS relative to cigarettes, results of published surveys are inconclusive.<sup>29</sup> Most studies conducted in EM countries,<sup>69 73 74 94 106–109</sup> and a few in Western<sup>76 91 110–115</sup> and other<sup>116–118</sup> countries, found that youth believe that WTS is less harmful than cigarette smoking. However, a substantive number of other studies found the opposite.<sup>16 85 95 97 119–124</sup> Identified reasons for the perceptions of lower harms with WTS include water filtration, little or no nicotine, fewer chemicals, social acceptability, fruit flavours (and their aromatic smell) that are perceived to indicate a healthy product or safe detoxified smoke, and the lack of media campaigns about WTS implying that they must be safer.<sup>72 74 75 89 102 106 111 125 126</sup>

#### Perception of addictive properties and ability to quit

Typically, youth report a low or no chance of becoming addicted to WTS.<sup>72 75 102 110 126</sup> Similarly, those who use a waterpipe typically report a high degree of confidence that they can quit at any time.<sup>75 82 102 112 126</sup> One study in Syria reported that the majority of WTS believed quitting smoking is difficult.<sup>123</sup> When speaking about addiction, youth point to the frequency of smoking, as well as smoking alone as indicators.<sup>102</sup>

#### Interpersonal influences

The social aspect is perhaps the ‘sine qua non’ of WTS—binding users to the experience and providing ‘kinship’ or ‘brotherhood’ and encouraging use.<sup>72 77 92 95 127–129</sup> Family and friends<sup>69</sup> play an important role in WTS—either encouraging or discouraging its use.<sup>100</sup> Up to 90% of university

students in the USA and over 2/3 of 13–19 year-olds in Beirut, Lebanon indicated that they first tried WTS with family or friends.<sup>75 124</sup> Despite the fact that smokers agreed that the WTS ‘set-up’ was burdensome, they felt that almost any form of planning for social interaction required preparation time, and was therefore a necessary commitment.<sup>77</sup>

#### Peer influences

Peer WTS use and encouragement/pressure from peers to use WTS seem to be powerful influences on initiation and continued smoking.<sup>69–72 74–76 79 82 85 99 114 115 120 124 129–135</sup> Across different neighbourhoods in Beirut, the only consistent variable influencing current WTS was peer encouragement.<sup>124</sup> In support of peer influence, and in contrast, “having friends who disagree with smoking was correlated with lower WP smoking”.<sup>136</sup>

#### Parental influences

Family members were identified as another influential factor in WTS<sup>69 75 76 109 134 135 137</sup> both in initiation of use and in continued use at home and in social gatherings.<sup>85 87</sup> Having a mother and/or father who smoked a waterpipe was associated with youth WTS.<sup>99 114 124 129 130 132 138</sup> Families can also discourage its use. In a study from San Francisco, the majority (61%) of parents who knew about their children’s use of the waterpipe disapproved of it.<sup>85</sup>

#### Organisational/institutional influences

Curricular requirements are often one aspect of organisational influences. The Global Youth Tobacco Survey (GYTS) asks a question about exposure to education about smoking in the curriculum. This question is usually a general question and not specific to the waterpipe. In 2011, the Lebanon GYTS asked specifically about whether students had been taught about the dangers of WTS, and whether they had discussed the reasons why people their age smoke waterpipes. Results indicated that 42.0% of students had been taught about the dangers of WTS in school, yet only 30.6% had discussed the reasons why people their age smoked a waterpipe.

Surveys of prevalence of WTS among health professional students also indicate inadequate knowledge,<sup>139–141</sup> and high rates of use.<sup>123 139 142–145</sup> These misperceptions and behaviour resulted in health professional students encouraging others to smoke the waterpipe and intending to smoke it themselves in the future.<sup>140 143</sup> In addition, health professional students often are not exposed in the curricula to information about tobacco use, particularly WTS, and methods of smoking cessation.<sup>144 146</sup> This suggests that curricula of health profession schools may also be falling short of transmitting critically needed information on this epidemic to key health personnel.

Another aspect of organisational support is the availability of clinical prompts to ask about WTS smoking status during each and every consultation visit, especially with young adults.<sup>147</sup> Clinical guidelines around tobacco use, including the 5As, are applied to cigarette smoking, but rarely to WTS.

Organisational influences also include the commercial ‘pull’ factors that encourage WTS. Young people have indicated that the easy availability, affordability and innovations in waterpipe apparatus designs and flavours encourage their use.<sup>148</sup> The availability of commercial waterpipe venues around university campuses also encourages WTS, and home delivery has boosted waterpipe use in recent years.<sup>112 148</sup>

#### Community level influences

Research points to the normative acceptability of WTS,<sup>95 111 149</sup> even in societies where cigarette smoking is seen to be inappropriate for women.<sup>88</sup> Being perceived as closer to the local traditions/culture, WTS may escape the societal taboos of cigarette smoking by women.<sup>16</sup> In Western countries, surveys of young people indicate 60–95% of respondents stating that WTS is very socially acceptable, and is perhaps the most socially acceptable form of tobacco, with projections of increased popularity in the next 5 years.<sup>75</sup> In the EM region, the extent of social acceptability of waterpipe smoking appears to vary by country. In Syria and Pakistan, family attitudes towards WTS were mostly either neutral or positive, particularly compared with cigarette smoking,<sup>16 74 150</sup> though some point to the religious unacceptability of WTS.<sup>78</sup> In contrast, respondents from Lebanon and Egypt mostly felt that family members disapproved of WTS.<sup>87 108</sup>

Several studies have looked at the mass media environment surrounding young people in relation to WTS, particularly in the USA. Advertisements for waterpipes on internet websites as well as social media sites such as YouTube, and print newspapers, have been analysed to assess the focus of messages being promoted.<sup>72 151–153</sup> Several key themes cut across the newspaper and website analysis: (1) the websites target young consumers by emphasising the ‘opportunity to be part of a global youth culture’ (ref. 72, p. 127); (2) the images associated with WTS include sociability, entertainment, relaxation, pleasure, sensuality and harm reduction; and (3) most advertisements and websites do not include the word ‘tobacco’ when discussing WTS, and health warnings are rare.<sup>72 151 153</sup> WTS smoking advertisements in Lebanon depict sensuous modern women enjoying a waterpipe. Weight concerns of young women also are targeted through promotion of ‘diet hookah’.<sup>154</sup> The ‘healthy’ aspects of smoking a waterpipe are further suggested in advertisements through its association with fruit.<sup>155</sup> Across advertisements in newspapers or websites, indicators of quality were highlighted whether through linkages to words such as ‘untouched by human hands’ or ‘eco-friendly’ or through an explicit mention of product ‘quality’. When comparing YouTube videos on cigarettes or waterpipes, those focused on the latter were less likely to depict smoking negatively or to include a discussion of the short-term or long-term health effects, and were equally likely to depict smoking (of either product) as attractive, sexual, sociable, powerful and exotic. A study in Lebanon found an association between increasing internet usage/week and WTS.<sup>132</sup>

Other qualitative research has reported on perceptions of young people—both waterpipe tobacco smokers and non-smokers—about media influences on WTS.<sup>78</sup> Focus group participants noted the image of waterpipe smoking promoted by the media to be glamorous, sexy and cool.

#### Policy influences on WTS

With the spread of WTS, attention of public health advocates to policies governing their use has grown. Analyses—from various countries of the world—have focused on laws recommended by the Framework Convention on Tobacco Control (FCTC), the first global health treaty, ratified by 179 countries worldwide. Results suggest that current tobacco control legislation may inadequately cover WTS.<sup>72 156–160</sup> In a review of regulations in seven countries around the world,<sup>125</sup> India and Pakistan were found to have the most effective regulations to control waterpipe tobacco smoking. In an analysis of availability of clean air

regulations in 100 large US cities,<sup>156</sup> Primack *et al* found that only 4% clearly had regulations which seem to include WTS, despite the proliferation of ‘hookah’ bars since 2000.<sup>125 159</sup> In addition, regulations in the USA and the EU exempt the flavoured moassel waterpipe tobacco, and include taxes on waterpipe tobacco that are lower than those on cigarettes.<sup>158 159 161</sup> A review of warning labels on a sample of waterpipe tobacco products and related accessories from Lebanon and other countries found all the countries to be non-compliant with FCTC article 11.<sup>153</sup> A recent thesis documented the positive impact of waterpipe-specific warnings on knowledge and quit intentions.<sup>162</sup> Regulation of prices—one of the most effective policies to curb tobacco use—is also less stringent with waterpipes than cigarettes, at least in the USA.<sup>163</sup> The impact on youth WTS of policies that control the location of waterpipe cafes is evident in a recent finding that indicate that students attending schools in neighborhoods with a higher density of such cafes were less likely to be waterpipe tobacco smokers than student attending schools in neighborhoods with fewer such cafes.<sup>99</sup>

Research has also reported on perceptions of young people vis-à-vis WTS legislation.<sup>148 164</sup> Participants in focus group discussions in Lebanon and England noted the importance of legislation in curbing WTS among young persons and stated that the different approaches of governments in legislating cigarettes versus waterpipes promote the idea that one is a safer alternative than the other. They also cautioned that the passage of a law is only the first step. Effective implementation and enforcement is key. Differences in coverage and application of tobacco control laws to cigarettes and waterpipe may limit comprehensive tobacco control efforts as individuals may merely shift their smoking patterns from one tobacco product to another.<sup>164</sup>

## DISCUSSION

Research and publications are increasing globally around WTS.<sup>165</sup> However, a recent comparison with e-cigs indicates that WTS scholarship is lagging behind.<sup>166</sup> Given the rising prevalence of WTS among young persons globally and the identified health effects, continued vigilance is critical. A variety of research areas around epidemiology and health effects have been suggested in articles in this issue. This review provides guidance for the development of targeted interventions (including policy) to prevent WTS.

Within a socioecological framework, the review has identified determinants of WTS at the intrapersonal, interpersonal, organisational, community and policy levels. While previous reviews have pointed to knowledge, beliefs and attitudes—as well as social factors—as key drivers of WTS, they often did not tackle the wider issues and structure their analysis within a conceptual framework. Doing so allows a comprehensive understanding of the multitude of factors influencing youth use. Indeed, our findings clearly point to the complex web of causation leading to increasing rates of youth WTS initiation and progression globally. The understanding of this web should lead to the development of comprehensive interventions which target both the proximal and distal causes of youth use. This is in line with the FCTC, the M-POWER report of the WHO<sup>167</sup> and the recently released ‘Best practices for comprehensive tobacco control programs’ that states: “A comprehensive statewide tobacco control program is a coordinated effort...(that) combines educational, clinical, regulatory, economic, and social strategies (ref. 168, p. 6).”

This current review of determinants of WTS follows the first review of WTS after a decade.<sup>169</sup> That review stated that “very few studies have investigated attitudes and beliefs towards waterpipe use” (p. 329), whereas the current review has identified

over 80 studies globally that tackle these concepts with reference to youth (table 3). In addition, over the past decade and particularly in the past 5-year interval (2010–2014), researchers have begun to investigate the broader levels of influence on WTS by young persons. Whereas most of the research remains quantitative in nature, qualitative studies are beginning to unpack the context around which WTS occurs (table 1).

On the basis of the findings of this review, the remainder of the discussion will highlight some necessary steps forward to control this global epidemic of WTS among youth.

At the intrapersonal level, interventions need to focus on enhancing knowledge and shifting attitudes. Social media is a popular mechanism of communication of this generation, and public health professionals should learn to make use of it effectively. *Twitter and Facebook posts* have been used to assess key themes discussed around use of waterpipes and e-cigs.<sup>170 171</sup> The number of hours of internet use per week was associated with WTS, suggesting that media messages transmitted through this medium have a powerful impact on behaviour. An internet-based experimental study demonstrated that providing university students brief information about the harms of waterpipe smoking increased the perceived risk and worry about harm and addiction, as well as the desire to quit.<sup>70</sup> Creative techniques such as these can also be used in promoting prevention, and in counter-advertisements. The messages sent by tobacco control advocates need to be as attractive and appealing as those sent by the pro-tobacco machinery. The Legacy Foundation has recently used YouTube to distribute key information around WTS.<sup>172</sup> Engaging youth in the development of these types of media messages will ensure that they are in line with the technology and images of the new generation.

The interpersonal and organisational levels interact in interventions to prevent WTS. Parents, teachers and schools need to be engaged.<sup>72</sup> School policies prohibiting smoking on school premises must be implemented. Anecdotal evidence indicates that in some countries, WTS is allowed on school trips, and indeed is a shared experience between teachers and students. Parents should be engaged early and educated about the adverse health and dependence-producing features of WTS (see reviews of these areas in this issue).<sup>2 12 173 174</sup> Primary care health providers as well as dentists must be engaged in the promotion. Health professions schools curricula should include clear information on the hazards of WTS, as well as general tips for smoking cessation. In addition, smoking cessation services must be made available, accessible and affordable at the primary care level. A main reason for WTS stated by young people was the feeling of boredom or needing to fill time. At the community level, alternative sources of recreation need to be created to engage young people creatively and effectively when they are out of school.<sup>175</sup>

The FCTC has identified evidence-based policies to control tobacco use.<sup>17</sup> Though the convention covers all forms of tobacco use, its practical applications have focused most on cigarettes, leaving wide gaps in the development and implementation of alternative tobacco products. As succinctly stated by Jawad *et al*,<sup>176</sup> “Worryingly, the waterpipe industry including waterpipe cafes, operates in a almost completely unregulated market.” FCTC protocols and guidelines need to be developed to include WTS specificities.<sup>72</sup> Examples include—at a minimum—critically analysing the placement of warnings of tobacco products and accessories, ensuring that clean indoor air laws are not exempting waterpipe establishments, extending the ban on flavoured tobacco to include waterpipes, and increasing taxes on waterpipe products and accessories.

This review also highlights some important limitations in our understanding of the determinants of WTS by youth. In particular, the rather limited breadth and rigour of methodologies that have been used to assess determinants within the socioecological framework limit our ability to intervene effectively on this public health problem. Three-fourths of the studies included in this review were cross-sectional survey studies. Only six prospective observational studies and one experimental study were identified. The problems with relying on observational data to guide selection of determinants to target in theory-based interventions are well known.<sup>177</sup> Further, most studies enrolled small, geographically restricted (eg, single school or city) and/or non-representative samples, possibly limiting the generalisability of the findings. Our ability to prevent WTS would be enhanced by both rigorous qualitative work to better contextualise its determinants, as well as prospective observational and experimental studies that track and manipulate suspected determinants to assess their viability as intervention targets.

There were few preventive intervention/evaluation studies related to WTS that were found in our literature search. Despite the limitations of methods used to date, scholarship is advanced enough to move towards the testing of interventions to prevent or delay the uptake of WTS, as well as to encourage cessation. Developing, implementing and evaluating interventions is a critical area for future research and practice. For example, suggested pictorial warnings for waterpipe tobacco products and accessories have been developed and should continue to be tested for effectiveness.<sup>157</sup> These interventions can and should span all levels of the ecological model.

### What this paper adds

- ▶ Waterpipe tobacco smoking (WTS) is rising globally, particularly among young people.
- ▶ WTS is not a safe alternative to cigarettes. Its health effects are similar to or worse than those of cigarettes.
- ▶ A recent systematic review of motives, beliefs and attitudes found positive perceptions towards WTS, amid strong social acceptability and encouragement of its use.
- ▶ The published literature to date tends to focus mostly on determinants at the individual level, extending to peer and parent influences.
- ▶ A comprehensive analysis of determinants at ecological levels is missing.
- ▶ Despite the increasing prevalence of WTS among youth globally, no review has specifically focused on this age group.
- ▶ The methodological rigour of the published articles has not been systematically assessed as yet.
- ▶ The review was guided by the Ecological Model of Health Promotion as a framework for abstraction, analysis and conclusion. Within the framework, the review identified determinants of WTS at the intrapersonal, interpersonal, organisational, community and policy levels.
- ▶ The review found limited breadth and rigour of methodologies used to assess determinants of WTS among youth, and makes recommendations to strengthen the evidence base.
- ▶ Potential foci for intervention to control youth WTS are highlighted within the comprehensive framework.

The WHO mantra of ‘Make the healthy choice the easy choice’ is apt for the assessment of the extent to which public health approaches have effectively tackled WTS. Success would be achievable when the threads within the complex webs of causation have been severed, so that young people are surrounded by environments that promote a choice of non-smoking more easily than smoking. Two global efforts in tobacco control—the FCTC and the MPOWER toolkit<sup>167</sup>—both promote an ecological approach with suggested interventions at each of the EMHP levels. The public health community must always be looking ahead: “...Just as industry innovates in approaches to promotion, so must the public health community, seeking out new media, word of mouth, and organization-based efforts to reach young adults before they initiate use and to support cessation.”

This review was framed within the EMHP. Although more comprehensive than previous reviews, it still ignores the levels of influence beyond state/national policy. Critical analysis of global health efforts have clearly indicated the impact of global economic and trade policies as well as competing health policies in achieving impact in any one area.<sup>178 179</sup> “We are challenged to develop a public health approach that responds to the globalised world. The present global health crisis is not primarily one of disease, but of governance...”<sup>180</sup>

**Correction notice** This article has been corrected since it was published Online First. The middle initial has been added to author ‘E Akl’, and the spelling of author ‘T Loufti’ has been amended to ‘T Lofti’.

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**Contributors** RAA and EA conceptualised the manuscript. DB and RK abstracted the articles. KDW led the methodological review. All authors read and coded the articles, and analysed and wrote summaries of the results. RAA compiled these summaries and took the lead in writing the draft manuscript. All authors edited the draft, as well as read and approved the final version.

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