

# Motivators of impulsivity to smoke waterpipe tobacco among Nigerian youths: the moderating role of social media normalisation of waterpipe tobacco

Agatha Oluwafunmilayo Adu

Universiti Sains Malaysia

Nurzali Ismail (✉ [nurzali@usm.my](mailto:nurzali@usm.my))

Universiti Sains Malaysia

Shuhaida Md Noor

Universiti Sains Malaysia

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## Research Article

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# Abstract

**Background:** Impulsivity is a formidable cause of waterpipe tobacco smoking among the youths, however, it is less well studied among African youths. Using PRIME behavioural theory, this study aimed to develop a model that examines the motivators of impulsivity to smoke waterpipe tobacco in linkage to the moderating role of social media normalisation of waterpipe tobacco among youths in Nigeria.

**Methods:** Data were drawn from 695 youths who smoke waterpipe tobacco across six Nigerian universities in the south-west zone using the chain-referral sampling procedure. Descriptive analyses of the obtained data were carried out using the Statistical Package for Social Sciences (SPSS) version 25. The constructs in the developed model were validated through Partial Least Squares Structural Equation Modelling (PLS-SEM) in SmartPLS version 3.

**Results:** Among the Nigerian youths who smoke waterpipe tobacco, intention ( $\beta=0.442$ ,  $P<0.001$ ) is the strongest motivator of impulsivity to smoke waterpipe tobacco as compared to positive evaluations ( $\beta=0.302$ ,  $P<0.001$ ). Additionally, social media normalisation of waterpipe tobacco acts as a moderator that strengthens the relationship between intention and impulsivity ( $\beta=0.287$ ,  $P<0.01$ ) as well as between positive evaluations and impulsivity ( $\beta=0.186$ ,  $P<0.01$ ) among the youths.

**Conclusion:** Willingness greatly instigates the Nigerian youths' impulsivity to smoke waterpipe tobacco, and social media normalisation of waterpipe tobacco also considerably increases their impulsivity to smoke waterpipe tobacco. Youth-focused educative waterpipe tobacco cessation-oriented programmes that will utilise diverse constructive-based learning approaches like illustrative learning and counselling, are needed to enlighten and encourage the Nigerian youths on the importance of shunning the desirability to smoke waterpipe tobacco.

## Introduction

Over the years, the use of tobacco has remained a worldwide hazardous issue causing a mortality rate of over 7 million annually [1]. Consumption of tobacco is often by various means such as cigarette, cigar, chewing, snuff, snus, waterpipe, amongst others [2]. Among these forms of tobacco use, waterpipe is perhaps the most dangerous as it is mostly assumed to be minimally harmful and addictive when compared to other methods of tobacco use, and so the level of waterpipe tobacco smoking (WTS) continue to rise especially among the youths [3]. In North America for instance, a 42% increase in youths' WTS has been reported in Canada [4] as well as a 2% increase among the youths in the USA [5]. Also in Asia, growing rate in WTS is noticeable among 26.6% of Iranian youths [6] and 23% of Palestinian youths [7]. In Africa, although related empirical data among the youths is scant [8], studies have shown a rapid growth in WTS among 26.1% of the youths in Rwanda [9], 36.4% in Uganda [10], and also 44% in Nigeria [11].

Contrary to the misperceptions indicating that the health detriments of waterpipe tobacco (WT) are merely slight, which have been contributing to the increase in its use among the youths [3], its health effects are notably more harmful compared to other methods of tobacco use [12]. Risk of respiratory damage is higher among WT smokers as in addition to the smoke from the lit charcoal in the waterpipe, they also inhale greater amount of tobacco smoke due to the lengthy propensity of smoking sessions, often lasting up to an hour or

more unlike cigarette smoking for instance that can be done within five minutes [13]. The unsanitary act of sharing waterpipe hose during smoking sessions is also related to the transmission of communicable diseases like tuberculosis and meningitis [14]. More recently is that the deadly Corona Virus Disease 2019 (COVID-19) which is elicited by a group of immensely transferrable viruses known as Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) is also an associated disease of WTS [15]. A COVID-19 infected WT smoker can infect other persons as the exhalation of tobacco smoke is mingled with fluid from the salivary gland [16]. Worldwide, as of April 23, 2020, COVID-19 contracted cases were around 2,700,800 with more than 189,000 mortality rate, and there remains an upsurge [17]. In Nigeria, report as of September 22, 2021, shows that COVID-19 was responsible for 2,664 mortality rate [18]. Thus, the youths' unceasing impulsivity to smoke WT remains a public health concern that should be further comprehended.

Impulsivity is describable as an uncontrollable nudge to carry out an action, such that when it arises, there is a high possibility for the associated action to immediately take place, as such, impulsive tobacco smoking can become troublesome to control [19]. One major motivating factor of the youths' impulsivity to smoke WT is intention, also referred to as willingness. Supporting instance is a study in Canada that discovered an 18% propensity to smoke WT among youths who had the willingness to do so [20]. Positive evaluations, also known as positive beliefs or feelings, is another influential motivator of the youths' impulsivity to smoke WT. Of relevance is a study in Jordan revealing that the vulnerability to smoke WT among youths is strongly associated with such positive evaluations as the sweetness of its tobacco flavours like chocolate, strawberry, amongst others, as well as the ability to smoke it within a social gathering [21].

Furthermore, social media normalisation of waterpipe tobacco seems to have the ability to heighten the relationship between youths' related intention, positive evaluations, and impulsivity. Normalisation in the tobacco context symbolises the situation whereby many people in the society now consider an unhealthy behaviour like tobacco smoking as a normal and social behaviour rather than a harmful one that should be disposed of in the society [22]. As such, social media normalisation of WT is a concept that explains that the majority of the social media content related to WT in the format of text, pictures, videos, etc., frequently encourage rather than discourage its use [23]. That is, information pertaining to the use of waterpipe tobacco on social media like Twitter, Facebook, Instagram, etc., is more pro-smoking than anti-smoking [24]. This implies that the dawn of social media, which allows unrestrictive exposure to all manner of information, has made majority of the youths to become bombarded with a variety of information that are devoid of the harmful nature of WT [23], especially as the youths are the highest populace on social media [25].

Consequently, the research objective is to develop a model that investigates the relationship between intention, positive evaluations, and impulsivity while considering the moderating effect of social media normalisation in relation to WTS among the youths in Nigeria. To achieve this study's aim, we concentrate on the perspective of PRIME (plans, responses, impulses, motives, evaluations) behavioural theory which explains that actions that are unhealthy and addictive are heralded by an impulsiveness which is instigated by intention, positive evaluations, as well as outer environmental factors such as information from the media [26]. The salient contributions of this study are as follows: (a) In the African context, as empirical research on WT especially among youths is quite limited [8], this study contributes to emerging studies on youths WTS in an African country like Nigeria; (b) In the Nigerian context, as studies on WT are only just emerging with very minimal assessment among the youths [11, 27, 28], this study responds to the vital need for empirical research on WTS

among the Nigerian youths. Moreover, the study also responds to the call for future researchers to theoretically elucidate the Nigerian youths' tendency to smoke WT [29, 30]; (c) Based on suggestion that further research should employ newer and developing theories in the understanding of addictive behaviour [31], this study responds to this call by utilising a relatively new theory such as PRIME in the development of the research model; (d) As scholars have mostly so far employed PRIME theory in the assessment of tobacco smoking cessation [32, 33], this study expands the understanding of PRIME by extending its relevance to examining the impulsivity to smoke tobacco as related to waterpipe.

## Theoretical Underpinning

Our theoretical foundation is built upon the PRIME behavioural theory by Robert West describing plans, responses, impulses, motives, and evaluations as related to addictive behaviour [34]. Diverging from other behavioural theories i.e., theory of planned behaviour, theory of reasoned action, amongst others, that focuses on the nature of intention [31], PRIME focuses on the nature of impulsivity and inhibition [26]. The PRIME perspective explains that impulsivity is the drive behind an individual's susceptibility to an addictive behaviour while inhibition is the drive behind an individual's ability to refrain from an addictive behaviour [35]. Regarding impulsivity, an individual's prior intent (or plan) to act on an addictive behaviour, encouragement from outer environmental or personal motivators to act on the addictive behaviour, as well as positive evaluations (or beliefs) about such addictive behaviour can stimulate an irresistible response to act on such behaviour [36]. However, in the presence of inhibition, an individual's prior intent not to act on an addictive behaviour, discouragement from outer environmental or personal motivators on the addictive behaviour, as well as negative evaluations about such addictive behaviour can generate an ability to resist the desirable urge to act on such behaviour [37]. Thus, impulsivity is laced by irrationality while inhibition is laced by rationality [38].

A variety of existing studies have successfully shown the applicability of inhibition based on PRIME's perspective to effective tobacco smoking cessation efforts [33, 39–41]. Nevertheless, PRIME's relevance to the understanding of impulsivity as related to tobacco smoking is less well studied [31]. Considering that PRIME is a developing theory [42], empirical studies from not just the angle of inhibition, but also the angle of impulsivity are both of relevance in expounding its applicability to the understanding of an addictive behaviour like tobacco smoking. The present study formulates a predictive model which indicates that there is a positive link between impulsivity, intent (or plan), and positive evaluations (or beliefs) as suggested in existing studies on youths' WTS [7, 43]. Also, based on prior evidences [23, 44], we include social media normalisation of WT as an outer environmental factor that can moderate the relationship between intention, positive evaluations, and impulsivity among the youths.

### Hypotheses development

We developed hypotheses for the concepts of intention to smoke waterpipe tobacco, positive evaluations of waterpipe tobacco, and social media normalisation of waterpipe tobacco.

**Intention to smoke waterpipe tobacco (ITSW).** Intention refers to the willingness to carry out an action [45]. In the context of this study, intention refers to the willingness to smoke WT which can generate an impulsiveness or urge to smoke it. Studies have shown that the readiness to experiment with WT constitute the urge to smoke

it among majority of the youths [9, 10, 20, 43, 46]. In Nigeria, willingness is also a key factor in the growing tendency to smoke WT among the youths, particularly those in the university [11]. As such, we assume that there is a positive connection between intention and impulsivity among the Nigerian youths who tend to smoke WT. Thus, we propose the following hypothesis:

**H1.** Intention to smoke waterpipe tobacco will be positively related to impulsivity among the Nigerian youths who have a tendency to smoke waterpipe tobacco.

**Positive evaluations of waterpipe tobacco (PEOW).** Positive evaluations entail the beliefs, feelings, or notions that depicts something in an advantageous manner [47]. In the context of waterpipe tobacco, positive notions that WT is merely trifling in terms of harm and addiction persists among many of the youths thereby instigating their continuous urge to smoke it [7]. Further stimulating the youths' tendency to smoke WT are such positive feelings as it being sociable, tasty due to flavours, entertaining, amongst others [48]. Positive feelings about WT also relates to the Nigerian context as many of the youths are known to mostly consider it as more of a fun activity [29]. Consequently, we propose that there is a positive association between positive evaluations and impulsivity among the Nigerian youths who tend to smoke WT and hypothesised that:

**H2.** Positive evaluations of waterpipe tobacco will be positively related to impulsivity among the Nigerian youths who have a tendency to smoke waterpipe tobacco.

**Social media normalisation of waterpipe tobacco as a moderator (SMNW).** Social media normalisation of waterpipe tobacco indicates the enormous depiction of WT on social media platforms like Facebook, Twitter, Instagram, YouTube, etc, as mostly a normal and acceptable behaviour rather than a highly detrimental one [49]. The illustration of WT on social media is quite bothersome as while harmful potential is often acknowledged in the social media messages related to other tobacco smoking methods like cigarette for instance [44], those associated with WT regularly describe it as more of a safer tobacco smoking alternative [23]. In fact, majority of the texts, pictures, videos, and other graphics related to WT on social media are reportedly representative of waterpipe as socially acceptable, fun, interesting, entertaining, enjoyable, attractive, amongst others [50, 51]. Studies have shown that exposure to pro-smoking social media messages increases the youths' tendency to smoke tobacco [52, 53], especially among those who hold positive beliefs and are willing to experiment with tobacco [54]. Taken together, we therefore consider that the positive relationship between intention, positive evaluations, and impulsivity will be more intense among the youths with high exposure to pro-smoking social media messages that relate to WT. Consequently, we hypothesised that:

**H3a.** Social media normalisation of waterpipe tobacco will moderate the positive relationship between intention and impulsivity such that the tendency to smoke waterpipe tobacco will be stronger for the Nigerian youths with high exposure to pro-smoking social media messages relating to waterpipe tobacco.

**H3b.** Social media normalisation of waterpipe tobacco will moderate the positive relationship between positive evaluations and impulsivity such that the tendency to smoke waterpipe tobacco will be stronger for the Nigerian youths with high exposure to pro-smoking social media messages relating to waterpipe tobacco.

**(Please insert Fig. 1 here)**

# Methodology

## Research setting and design

This study adopted the survey research design. Given that more of the Nigerian youths in the university consider WT as a normal and social activity [11], we surveyed Nigerian youths between ages 18–35 who: smoke WT, are social media users, and are current university students in a location like the south-west zone where many of the youths are increasingly prone to tobacco smoking [55].

Specifically, one university was purposively selected in each of the six states in the south-west zone of Nigeria namely: Ekiti State University Ado-Ekiti [EKSU] (Ekiti State); Lagos State University [LASU] (Lagos State); Federal University of Technology Akure [FUTA] (Ondo State); University of Ibadan [UI] (Oyo State); Obafemi Awolowo University Ile-Ife [OAU] (Osun State); and Federal University of Agriculture Abeokuta [FUNAAB] (Ogun State) [56]. In terms of sample size, we employed the G\*power method with effect size of 0.15, alpha of 0.05, and a power of 0.80 to get a minimum sample of 68. However, since we are dealing with a heterogenous group [57], we increased our sample size to 660. As such, 110 respondents were required for the survey in each of the selected universities. Nevertheless, for data collection purposes, based on the likelihood for missing data as well as youths who do not smoke WT, the required sample size ( $n = 110$ ) per university was increased by 40% as recommended [58]. As an increase of 110 by 40% is 154, we therefore surveyed 154 participants in each of the six selected universities rounding up to a total of 924 respondents.

The survey questionnaires were physically administered and the chain-referral non probability sampling procedure was utilised for the participants' recruitment [59]. To facilitate the field work, one student was recruited as a field assistant in each of the six universities and were extensively briefed on the study's criteria. To ensure that only WT smokers were recruited, tracking was done through the following affirmation in the questionnaire, "*Never smoked waterpipe.*" Regarding social media usage, all the participants were required to affirm the specific type of social media they use in the questionnaire. Also, age category in the questionnaire was strictly within the margin of 18–35 years to ensure the recruitment of only the participants who are within the study's age requirement.

The data were collected between May 2021 to August 2021. To keep safe from the COVID-19, all field assistants were required to use face masks during interactions with the respondents, maintain social distance, and also take along at least one bottle of hand sanitiser in order that they and the participants can disinfect their hands. Additionally, whenever they met with participants, field assistants were required to take along few new packs of face masks for the participants use. The hand sanitisers and face masks were provided by the researchers. In total, 695 (response rate 75.2%) questionnaires were useable for analyses. A sample size of 695 will generate a power of over 95%, as such, our sample is enough to generate confident outcomes [60]. Table 1 displays the respondents' characteristics.

## Constructs and measures

We had four constructs, two independent variables (intention to smoke WT, positive evaluations of WT), one dependent variable (impulsivity to smoke WT), and one moderating variable (social media normalisation of WT). All items were rated on a seven-point Likert scale ranging from "1 = *strongly disagree* to 7 = *strongly agree*," and all were reflective measures. The four items for intention were adapted from one study [61]. Also,

the nine items for impulsivity were adapted from a prior study [62]. However, the items for positive evaluations of WT and social media normalisation of WT were developed using the construct development process from one study [63]. First, we interviewed six youths (3 males, 3 females) who smoke WT and are social media users. The youths were recruited for the interview through one of the authors contact who works in a Nigerian based university and anonymity was requested and has been guaranteed.

For the construct of positive evaluations of WT, the interviewees were asked to describe their preference for WT as opposed to other tobacco smoking methods. Only one of the participants (female) expressed that she enjoys smoking WT even though she feels it is harmful to health. All other participants considered WT as less harmful and addictive, and generally had favourable opinion on it. For the construct of social media normalisation of WT, the interviewees were asked to confirm whether they had ever come across social media messages that promote the use of WT and to give their opinion on the influence of such messages based on their experiences. One of the interviewees (female) mentioned coming across such messages only a few times. The other five respondents affirmed that they regularly see such messages. Of the five, four (3 males, 1 female) expressed a likeness for the usually colourful and interesting nature of social media WT messages to the point that they often click the like button, post a comment, or even share with friends.

Secondly, based on the above interviews as well as existing studies as follows: positive evaluations of WT [21, 64]; social media normalisation of WT [54, 65], we generated eight initial items for both constructs. Thirdly, we then consulted five experts who are conversant with youth behavioural studies and are all social media users. At this stage, the items for both positive evaluations of WT and social media normalisation of WT became nine and six respectively.

Finally, to further minimise ambiguity in the survey, we conducted a preliminary study with 70 youth respondents in a Nigerian based university. Questionnaires were physically administered using the chain-referral procedure. Of the 70 questionnaires distributed, 53 (response rate 75.7%) were useable. The final questionnaire is presented in Table 2.

**(Please insert Table 1 here)**

### **Data analyses method**

Statistical Package for Social Sciences (SPSS) version 25 was relevant in the descriptive segment for frequencies, percentages, mean, and standard deviation of the participants' characteristics and variables distribution. We also assessed common method bias (CMB) in SPSS through Harman's single factor test and a single factor was less than 50% signifying that no single factor explained the majority of the variance in our data. Partial least squares structural equation modelling (PLS-SEM) was applied in SmartPLS version 3 to assess the significance of the model constructs through measurement model, structural model, and moderator analyses [66]. We also checked for collinearity in SmartPLS by examining the variance inflation factor (VIF) of the constructs and none exceeded the boundary of 5 (see Table 3) [57]. Consequently, CMB and collinearity posed no problem in our study [67].

## **Results**

## Measurement model

Except for IMP8 which had a loading of 0.519, the study's indicator loadings, composite reliability, and Cronbach's alpha values were above 0.70 [68]. It is recommended that an indicator loading  $>0.40$  but  $<0.70$  should be retained if the Average Variance Extracted (AVE) is  $>0.50$  [66], consequently, IMP8 was retained since its related AVE exceeded 0.50 (see Table 2). For discriminant validity, all values were below 0.90 as recommended [69] (see Table 4).

## Structural model

We tested the significance of the study's model by using a 5000 bootstrapping procedure at 5% significance level (one-tailed) [68]. Table 4 and Figure 2 shows that intention ( $\beta=0.442$ ,  $P<0.001$ ) and positive evaluations ( $\beta=0.302$ ,  $P<0.001$ ) positively predicted impulsivity in relation to WT. Therefore, H1 and H2 were supported in our study. In addition, gender had no significant effect on impulsivity to smoke WT, but age ( $\beta=0.054$ ,  $P<0.05$ ) and year of study ( $\beta=0.056$ ,  $P<0.05$ ) were significant. Effect sizes for H1 ( $f^2=0.194$ ) and H2 ( $f^2=0.091$ ) were acceptable based on the rule of thumb of 0.02, 0.15, and 0.35 as small, medium, and large respectively [70]. Also, the predictive relevance ( $Q^2$ ) of our model is 0.312  $>0$ , signifying that the model has excellent predictive relevance [60]. Finally, our model explains 46.8% of the variance ( $R^2$ ) in the youths' impulsivity to smoke WT. A variance that is equal to or  $>0.10$  is considered to be adequate [71]. As such, the predictors in our model substantially explained the dependent variable.

## Testing the moderator

Results showed that social media normalisation of WT moderates the relationship between intention and impulsivity ( $\beta=0.287$ ,  $P<0.01$ ) as well as between positive evaluations and impulsivity ( $\beta=0.186$ ,  $P<0.01$ ). Figure 3 and Figure 4 further clarifies that the two moderating effects are significant. Furthermore, effect size ( $f^2$ ) in moderation analysis is 0.025, 0.01, and 0.005 for large, medium, and small respectively [72], thus, the  $f^2$  values of the moderating effects, H3a (0.136) and H3b (0.112) indicates large moderation effects (see Table 4).

(Please insert Table 2 here)

(Please insert Figure 2 here)

## Discussion Of Findings

For the main effects, our findings show that both intention and positive evaluations predicted impulsivity in relation to WTS among the youths. As such, willingness and positive feelings trigger youths' impulsiveness to smoke WT. Of both constructs, intention had more effect on impulsivity to smoke WT compared to positive evaluations. This is consistent with previous research which positioned intention as a formidable predictor of the youths' likelihood to smoke WT [73]. Therefore, willingness creates an acceptability that strongly contributes to the tendency to smoke WT among the youths. In addition, age and year of study predicted the youths' impulsivity to smoke WT. Specifically, youths who are below the age of 30 are more likely to impulsively smoke WT. This aligns with prior research which found that youths above 'age 20' but below 'age

30' often impulsively smoke WT [9]. On the other hand, we found that the youths who are at postgraduate level are more likely to impulsively smoke WT. This contradicts prior research showing that impulsivity and addictiveness in relation to WT is prevalent among the youths who are undergraduate students [74]. This contradiction may be tilted towards the higher length of time (between 6 to 10 years) that more of the youths at the postgraduate level in this study had been smoking WT. The lengthier the period of impulsive tobacco smoking, the more challenging it becomes to control [38]. As WT contains high levels of nicotine, many of the youths who impulsively smoke it over a longer period of time gradually become addicted without being aware of their addiction [75].

In terms of the moderation effects, findings (see Fig. 3) show that the relationship between intention and impulsivity to smoke WT is stronger among the youths with high exposure to pro-smoking social media messages related to WT. These findings indicate that social media messages that encourages the use of WT has the ability to increase the youths' desirability to smoke it. This result is similar to prior research which found a positive link between social media pro-smoking messages and tobacco smoking among the youths [53]. Furthermore, as displayed in Fig. 4, we found that social media normalisation of WT moderates the relationship between positive evaluations and impulsivity to smoke WT among the youths. In other words, positive beliefs, feelings, or notions about WT is stronger among the youths with high exposure to social media pro-smoking messages related to WT. This outcome is comparable to previous findings showing that there is a significant connection between social media and positive expressions of tobacco smoking among the youths [54].

**(Please insert Fig. 3 here)**

**(Please insert Fig. 4 here)**

## **Conclusion**

Our study demonstrated that intention and positive evaluations are factors instigating the impulsivity to smoke WT among the Nigerian youths. Greater effect of intention was found on the youths' impulsivity to smoke WT as compared to positive evaluations. Also, social media normalisation of WT increases the effect of intention and positive evaluations on the youths' impulsivity to smoke WT. Additionally, age and year of study influences the youths' impulsivity to smoke WT. These outcomes have some theoretical and practical implications as demonstrated in the following sections.

## **Theoretical And Empirical Implications**

Our study contributes to the advancement of the PRIME theory. Previous studies often utilised PRIME from its perspective of inhibition by applying it in the assessment of tobacco smoking cessation [33, 39–41]. Thus, by expounding its perspective of disinhibition as related to impulsivity to smoke WT, this study has responded to the call to show the applicability of a developing theory like PRIME to addictive behaviour [31]. Moreover, this study has also responded to the recommendation for researchers to theoretically explicate the Nigerian youths tendency to smoke WT [30]. In addition, we developed items for the measurement of two constructs (positive evaluations of WT, social media normalisation of WT) which future researchers may find useful.

## Practical Implications

We posit that although governmental policies that restrict WTS in the country may discourage its use among the youths, however, to a large extent, enactment of policies is not enough to minimise the youths' impulsivity to smoke WT. Thus, we suggest that the Nigerian government should collaborate with other stakeholders such as the university council, conventional media professionals, and public health professionals, to introduce and implement youth-focused educative WT cessation programmes that will utilise diverse constructive-based learning approaches like counselling, cooperative learning, illustrative learning, amongst others, which can help the youths to feel a sense of enlightenment and encouragement, rather than the forceful expectancies divulged through policies. We also recommend that digital-based platforms should be increasingly incorporated in WT related cessation efforts as this may help to neutralise the influential role of social media normalisation of WT among the Nigerian youths.

## Limitations And Suggestion For Further Studies

Even though this study has broadened our understanding of youths' impulsivity as related to WT in an under explored region like Nigeria, the study has some limitations that should be mentioned. The study focused on the Nigerian youths who are current university students in the south-west zone. This was due to WTS being on rapid rise among the youths in the university [11], and because it is still difficult to locate current WT smokers in Nigeria [76], we specifically surveyed in the south-west zone where the use of tobacco is reportedly popular among the youths [55]. Nonetheless, future researchers should recruit from other geopolitical zones like the north-central, south-south, etc., and should extend to the Nigerian youths who are not current students in the university. Also, future researchers could assess youths' impulsivity related to WT using other measures i.e., peer influence, family influence, etc., either as direct effects or mediators.

## Abbreviations

WT: Waterpipe Tobacco; WTS: Waterpipe Tobacco Smoking; COVID-19: Corona Virus Disease 2019; ITSW: Intention to Smoke Waterpipe; PEOW: Positive Evaluations of Waterpipe; SMNW: Social Media Normalisation of Waterpipe; IMP: Impulsivity to Smoke Waterpipe; PRIME: Plans, Responses, Impulses, Motives, Evaluations; PLS-SEM: Partial Least Squares Structural Equation Modelling; SPSS: Statistical Package for Social Sciences; CMB: Common Method Bias; VIF: Variance Inflation Factor; AVE: Average Variance Extracted; CA: Cronbach Alpha; CR: Composite Reliability; M: Mean; SD: Standard Deviation; EKSU: Ekiti State University; LASU: Lagos State University; FUTA: Federal University of Technology Akure; UI: University of Ibadan; OAU: Obafemi Awolowo University; FUNAAB: Federal University of Agriculture Abeokuta.

## Declarations

### Acknowledgements

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## **Authors' contributions**

Adu Agatha wrote the main text including analysis. Nurzali Ismail and Shuhaida Md Noor assisted in preparing the framework, instrument and reviewed the text.

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## **Availability of data and materials**

Datasets are available from the corresponding author on reasonable request.

## **Declarations**

This study has received ethical approval from the Human Research Ethics Committee, Universiti Sains Malaysia (USM). Prior to their participation, the participants have given informed written consent to participate in this research. They also consent for the findings of the research to be published.

## **Ethics approval and consent to participate**

Ethical approval was obtained from the Human Research Ethics Committee, Universiti Sains Malaysia (protocol USM/JEPeM/21020181). The research complied with the declaration of Helsinki. All the participants gave an informed written consent and were well informed on the study's purpose as well as their confidentiality and rights to withdraw at any point from the survey.

## **Consent for publication**

The participants were well informed on the publications that will be published based on this research and have given informed written consent.

## **Competing interests**

The authors declare that they have no competing interests.

## **Author details**

<sup>1</sup>School of Communication, Universiti Sains Malaysia, Penang, Malaysia.

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## Tables

**Table 1** Participants' profile

| <b>Characteristics</b> | <b>Frequency</b> | <b>Percentage (%)</b> |
|------------------------|------------------|-----------------------|
| <b>Gender</b>          |                  |                       |
| Male                   | 325              | 46.8                  |
| Female                 | 370              | 53.2                  |
| <b>Age</b>             |                  |                       |
| 18-20                  | 155              | 22.3                  |
| 21-23                  | 266              | 38.3                  |
| 24-26                  | 169              | 24.3                  |
| 27-29                  | 88               | 12.7                  |
| 30-32                  | 14               | 2.0                   |
| 33-35                  | 3                | 0.4                   |
| <b>University</b>      |                  |                       |
| FUTA                   | 114              | 16.4                  |
| EKSU                   | 117              | 16.8                  |
| FUNAAB                 | 113              | 16.3                  |
| OAU                    | 116              | 16.7                  |
| UI                     | 114              | 16.4                  |
| LASU                   | 121              | 17.4                  |
| <b>Year of study</b>   |                  |                       |
| First year             | 172              | 24.7                  |
| Second year            | 181              | 26.0                  |
| Third year             | 168              | 24.2                  |
| Fourth year            | 122              | 17.6                  |
| Fifth year             | 28               | 4.0                   |
| Postgraduate studies   | 24               | 3.5                   |
| <b>Rate of WTS</b>     |                  |                       |
| At least once          | 137              | 19.7                  |
| Occasional smoker      | 267              | 38.4                  |
| Frequent smoker        | 291              | 41.9                  |
| <b>Length of WTS</b>   |                  |                       |
| 1-5 years              | 673              | 96.8                  |

|                             |     |      |
|-----------------------------|-----|------|
| 6-10 years                  | 22  | 3.2  |
| <b>Social media usage</b>   |     |      |
| Between 1-5 hours daily     | 238 | 34.2 |
| Between 5-10 hours daily    | 342 | 49.2 |
| More than 10 hours daily    | 115 | 16.5 |
| <b>Type of social media</b> |     |      |
| Facebook                    | 134 | 19.3 |
| Twitter                     | 110 | 15.8 |
| Instagram                   | 147 | 21.2 |
| Tik-Tok                     | 125 | 18.0 |
| YouTube                     | 93  | 13.4 |
| Others                      | 86  | 12.4 |
| <b>Ethnicity</b>            |     |      |
| Yoruba                      | 244 | 35.1 |
| Igbo                        | 185 | 26.6 |
| Hausa                       | 137 | 19.7 |
| Others                      | 129 | 18.6 |

**Table 2** Construct reliability, composite reliability, AVE, and VIF values

| Constructs  | Code  | Items   | Outer loading | CA $\alpha$ | CR    | AVE   | VIF   | <i>M</i> | <i>SD</i> |
|---|-------|---|---------------|-------------|-------|-------|-------|----------|-----------|
| <b>Intention to smoke waterpipe</b><br>[61]                         | ITSW1 | I intend to continue smoking waterpipe.   | 0.828         | 0.890       | 0.924 | 0.753 | 1.897 | 4.13     | 1.78      |
|   | ITSW2 | I will buy waterpipe if I happened to see it in a store, café, lounge, or restaurant.             | 0.883         |             |       |       |       | 3.96     | 1.86      |
|   | ITSW3 | I will actively seek out waterpipe in a store, café, lounge, or restaurant to purchase it.        | 0.886         |             |       |       |       | 3.73     | 1.85      |
|   | ITSW4 | I will patronise waterpipe as a tobacco smoking product.  | 0.872         |             |       |       |       | 3.96     | 1.87      |
| <b>Positive evaluations of waterpipe</b><br><b>(Self-developed)</b> | PEOW1 | Waterpipe smoking is attractive.  | 0.878         | 0.943       | 0.952 | 0.688 | 1.959 | 4.72     | 1.87      |
|   | PEOW2 | Waterpipe smoking is fun.   | 0.859         |             |       |       |       | 5.01     | 1.74      |
|   | PEOW3 | Waterpipe smoking is relaxing.  | 0.901         |             |       |       |       | 4.83     | 1.83      |
|   | PEOW4 | Waterpipe smoking is romantic.  | 0.819         |             |       |       |       | 4.49     | 1.83      |
|   | PEOW5 | Waterpipe smoking offers enjoyable fruity flavours.   | 0.830         |             |       |       |       | 5.13     | 1.73      |
|   | PEOW6 | Waterpipe smoking is more acceptable in the society compared to other methods of tobacco smoking. | 0.787         |             |       |       |       | 4.95     | 1.74      |

|   |       |   |       |       |       |       |   |      |      |
|---|-------|---|-------|-------|-------|-------|---|------|------|
|   | PEOW7 | Waterpipe smoking is less addictive compared to other methods of tobacco smoking. | 0.800 |       |       |       |   | 4.77 | 1.71 |
|   | PEOW8 | Waterpipe smoking is less harmful compared to other methods of tobacco smoking.   | 0.790 |       |       |       |   | 4.73 | 1.72 |
|   | PEOW9 | In general, I have favourable opinion on waterpipe smoking.                       | 0.790 |       |       |       |   | 4.63 | 1.73 |
| <b>Impulsivity to smoke waterpipe</b><br>[62] | IMP1  | I often smoke waterpipe spontaneously.  | 0.833 | 0.937 | 0.948 | 0.674 | — | 4.39 | 1.78 |
|   | IMP2  | “Just do it” describes the way I smoke waterpipe.                                 | 0.836 |       |       |       |   | 4.55 | 1.78 |
|   | IMP3  | I often smoke waterpipe without thinking.   | 0.851 |       |       |       |   | 4.46 | 1.83 |
|   | IMP4  | “I see waterpipe, I smoke it” describes me.                                       | 0.891 |       |       |       |   | 4.30 | 1.89 |
|   | IMP5  | “Smoke waterpipe now, think about it later” describes me.                         | 0.868 |       |       |       |   | 4.47 | 1.81 |
|   | IMP6  | Sometimes I feel like smoking waterpipe on the spur of the moment.                | 0.847 |       |       |       |   | 4.48 | 1.71 |
|   | IMP7  | I smoke waterpipe according to how I feel at the moment.                          | 0.845 |       |       |       |   | 4.62 | 1.73 |
|   | IMP8  | I carefully plan  | 0.519 |       |       |       |   | 5.13 | 1.48 |

|   |       |  |       |       |       |       |       |      |      |
|---|-------|--|-------|-------|-------|-------|-------|------|------|
|   |       | most of my waterpipe smoking sessions. (R)   |       |       |       |       |       |      |      |
|   | IMP9  | Sometimes, I am a bit reckless about waterpipe smoking.  | 0.836 |       |       |       |       | 4.25 | 1.88 |
| <b>Social media normalisation of waterpipe (Self-developed)</b> | SMNW1 | In the past 6 months, I have regularly seen pictures, videos, or other pro-smoking content promoting the use of waterpipe on social media (e.g., Facebook, Instagram, YouTube, Twitter, TikTok, etc.).   | 0.785 | 0.911 | 0.927 | 0.680 | 1.050 | 5.36 | 1.48 |
| <b>Social media normalisation of waterpipe (Self-developed)</b> | SMNW2 | In the past 6 months, I have regularly commented positively, reposted, or clicked like on pictures, videos, or other pro-smoking content promoting the use of waterpipe on social media (e.g., Facebook, Instagram, YouTube, Twitter, TikTok, etc.). | 0.866 |       |       |       |       | 5.07 | 1.67 |
|   | SMNW3 | Pro-smoking waterpipe messages on social media makes me feel like waterpipe smoking is normal.   | 0.902 |       |       |       |       | 5.15 | 1.63 |
|   | SMNW4 | Pro-smoking waterpipe messages on  | 0.889 |       |       |       |       | 5.12 | 1.62 |

social media makes me want to smoke waterpipe.

|       |   |       |  |  |      |      |
|-------|---|-------|--|--|------|------|
| SMNW5 | Pro-smoking waterpipe messages on social media can make people choose waterpipe as a tobacco smoking alternative. | 0.741 |  |  | 5.35 | 1.49 |
| SMNW6 | Pro-smoking waterpipe messages on social media can make people want to smoke waterpipe.                           | 0.750 |  |  | 5.43 | 1.39 |

\*R refers to reverse coded items

**Table 3** Discriminant validity: Heterotrait-Monotrait (HTMT)

| Variables | IMP   | ITSW  | PEOW  | SMNW |
|-----------|-------|-------|-------|------|
| IMP       |       |       |       |      |
| ITSW      | 0.707 |       |       |      |
| PEOW      | 0.634 | 0.743 |       |      |
| SMNW      | 0.211 | 0.113 | 0.202 |      |

**Table 4** Structural model results

| Code | Hypotheses     | $\beta$ | t values | Q <sup>2</sup> | f <sup>2</sup> | Decision  |
|------|----------------|---------|----------|----------------|----------------|-----------|
| H1   | ITSW -> IMP    | 0.442   | 8.414*** | 0.312          | 0.194          | Supported |
| H2   | PEOW->IMP      | 0.302   | 5.765*** | -              | 0.091          | Supported |
| H3a  | ITSW*SMNW->IMP | 0.287   | 3.899**  | -              | 0.136          | Supported |
| H3b  | PEOW*SMNW->IMP | 0.186   | 2.923**  | -              | 0.112          | Supported |

\*Significant at P<0.05, \*\*at P<0.01, and \*\*\*at P<0.001

## Figures

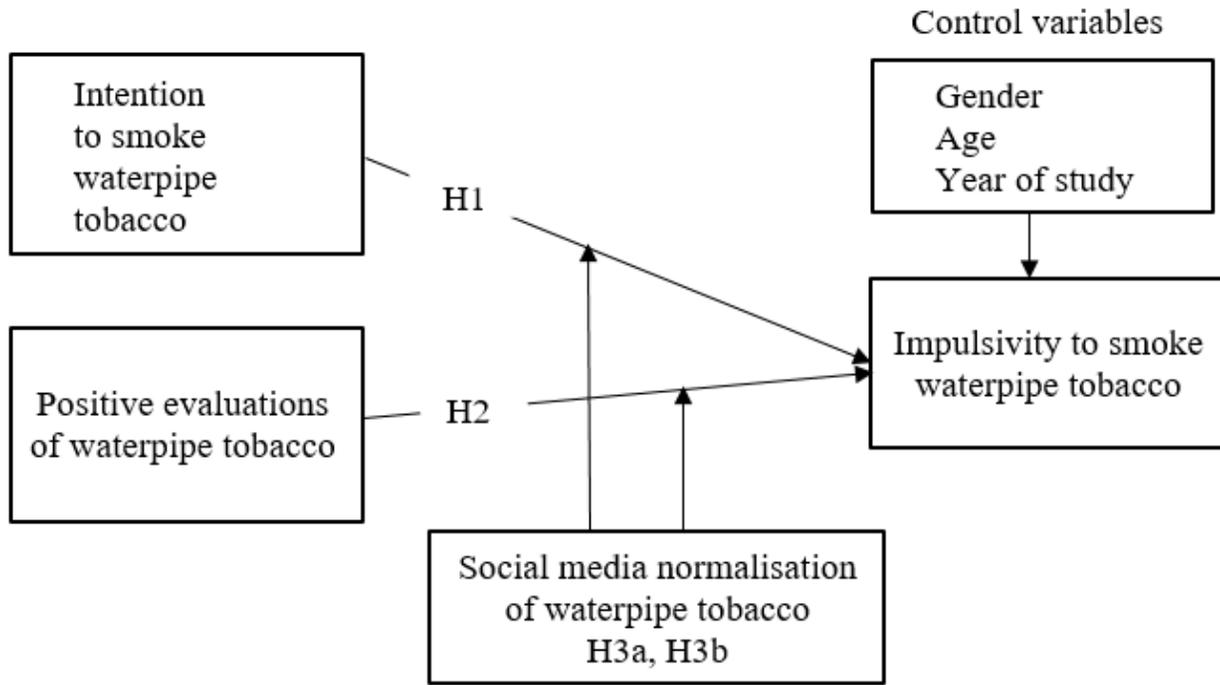


Figure 1

A research model for Nigerian youths' impulsivity to smoke waterpipe tobacco

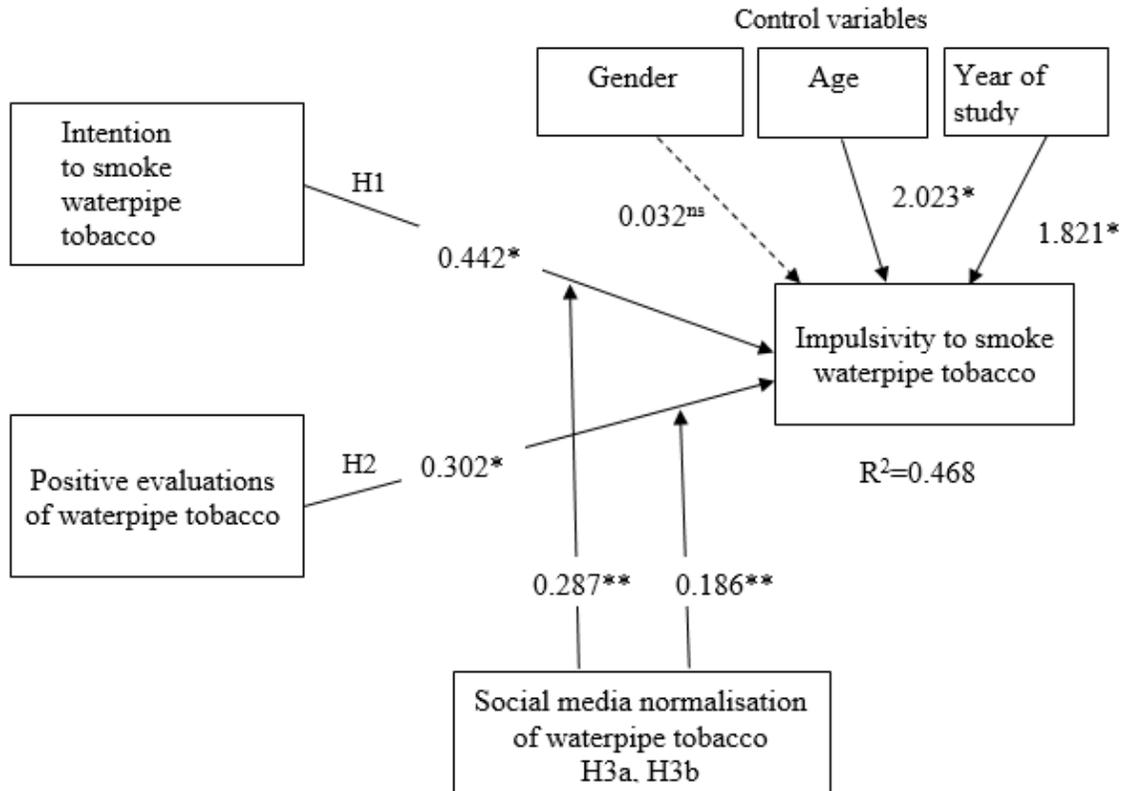


Figure 2

Structural model for Nigerian youths' impulsivity to smoke waterpipe tobacco. \*Significant at  $P < 0.05$ , \*\*at  $P < 0.01$ , \*\*\*at  $P < 0.001$ , and NS-not significant

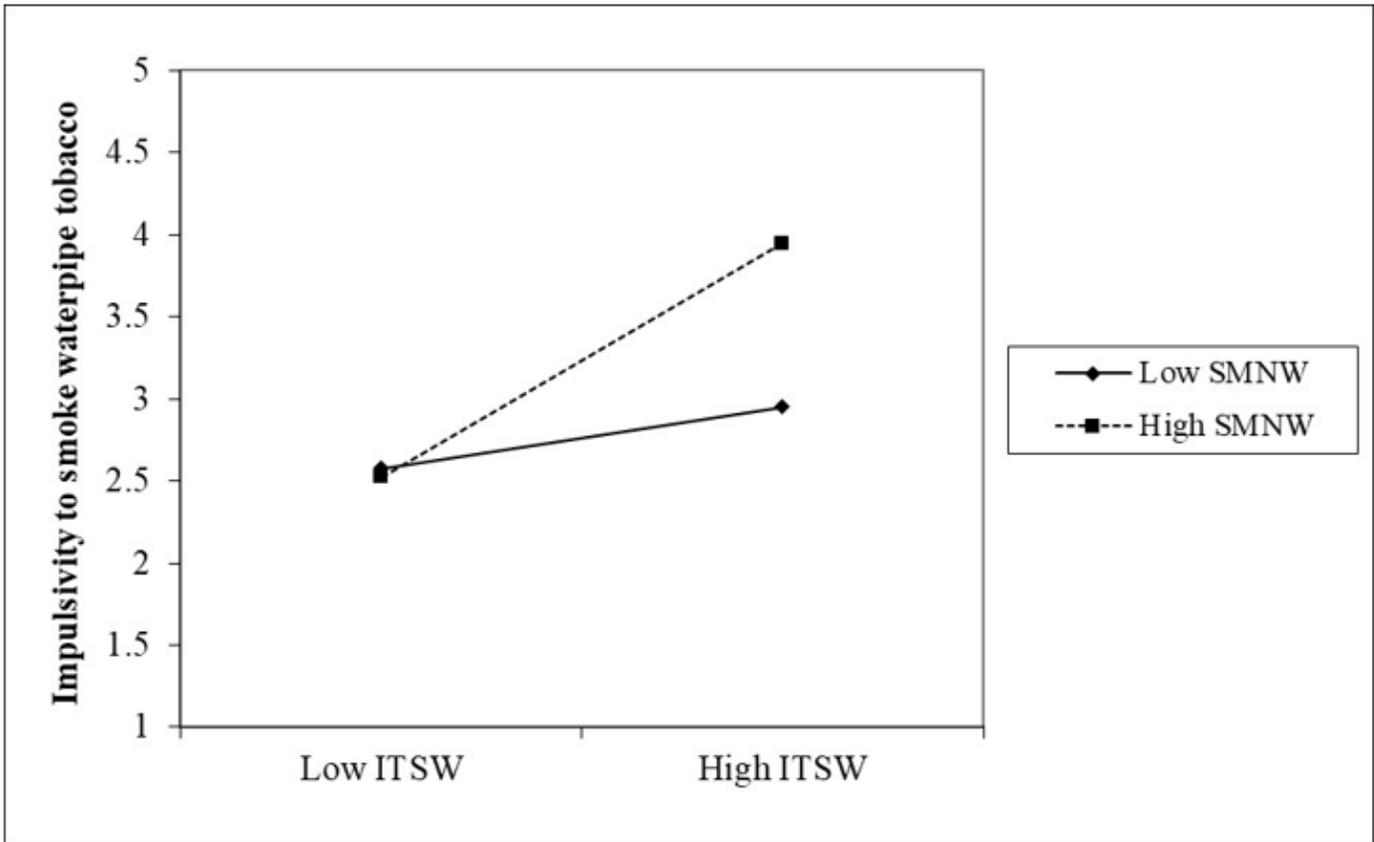


Figure 3

Moderation effect of SMNW on ITSW and impulsivity to smoke waterpipe tobacco

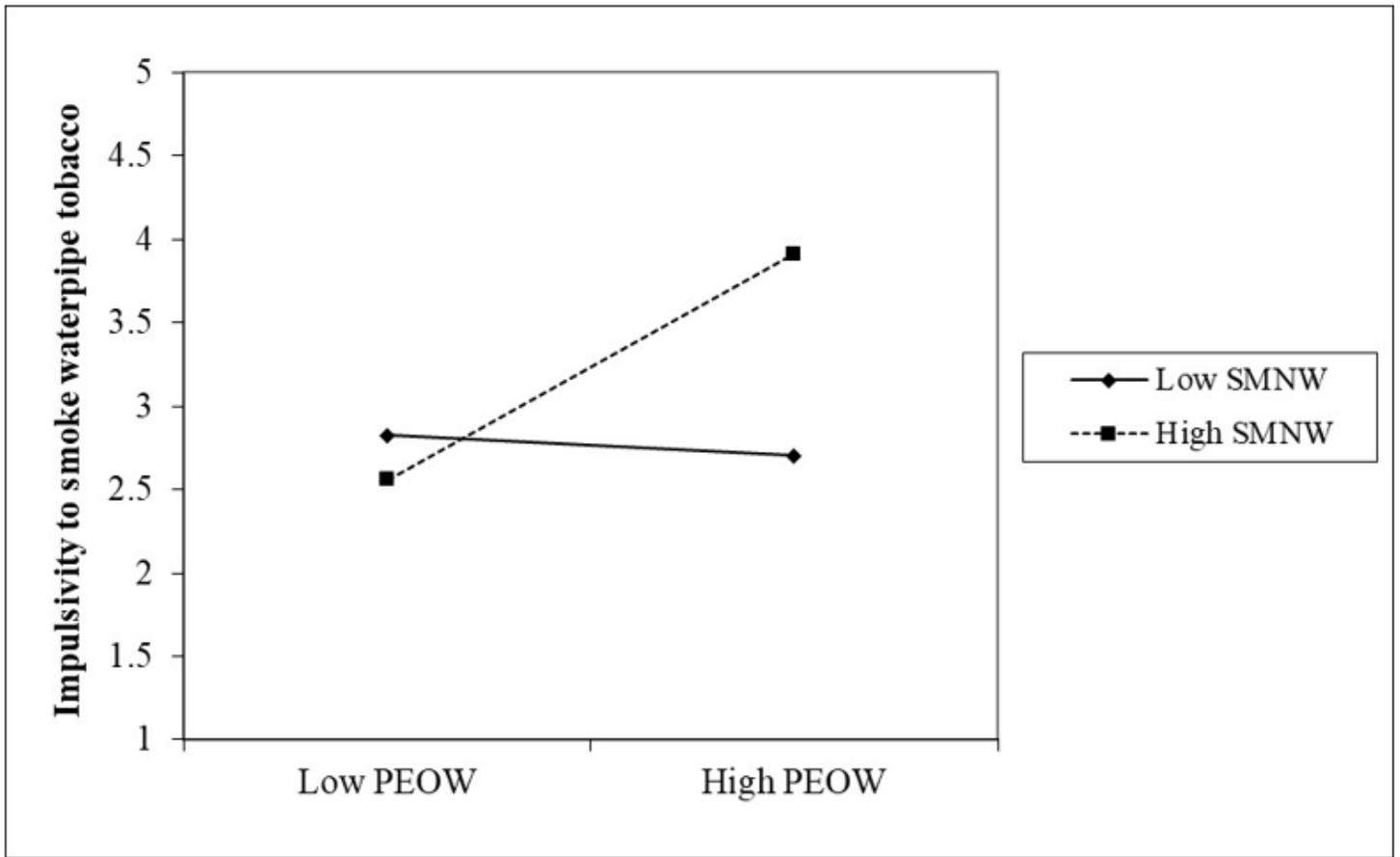


Figure 4

Moderation effect of SMNW on PEOW and impulsivity to smoke waterpipe tobacco