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## Short Communication

## Perceived family relationship quality and use of poly-tobacco products during early and late adolescence

Tzu Tsun Luk<sup>a</sup>, Man Ping Wang<sup>a,\*</sup>, Lok Tung Leung<sup>b</sup>, Jianjiu Chen<sup>b</sup>, Yongda Wu<sup>a</sup>, Tai Hing Lam<sup>b</sup>, Sai Yin Ho<sup>b</sup><sup>a</sup> School of Nursing, The University of Hong Kong, Hong Kong Special Administrative Region<sup>b</sup> School of Public Health, The University of Hong Kong, Hong Kong Special Administrative Region

## HIGHLIGHTS

- Data from a large, population-based sample of 42,250 adolescents were analysed
- Poor perceived family relationship predicts adolescent use of poly-tobacco products
- The associations were stronger for alternative tobacco than cigarettes
- The associations were stronger in early than late adolescents

## ARTICLE INFO

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## ABSTRACT

**Background:** The role of family relationship in adolescent use of emerging tobacco products, which have become increasingly popular, is unknown. We examined the associations of perceived family relationship quality with current use of poly-tobacco products including cigarettes, electronic cigarettes (e-cigarettes), waterpipe and smokeless tobacco in adolescents.

**Methods:** Data from a representative sample of 42,250 US grade 7–12 equivalent students (mean  $\pm$  SD age 14.6  $\pm$  1.9 years; 51.3% boys) from 75 randomly selected secondary schools in Hong Kong (2012–13) were analysed. Logistic regressions yielded adjusted odds ratios (AORs) for current (past 30-day) use of cigarettes, e-cigarettes, waterpipe, smokeless tobacco and poly-tobacco ( $\geq 2$  products) in relation to perceived family relationship quality, adjusted for age, sex, perceived family affluence, parental education, family structure, parental and sibling smoking and secondhand smoke exposure at home. Subgroup analyses were conducted to compare the associations in early (aged  $\leq 14$  years) versus late ( $> 14$ ) adolescents.

**Results:** The odds of current use increased with worse perceived family relationship quality with AORs (95% confidence interval) of up to 2.92 (2.32–3.68) for cigarettes, 7.28 (4.71–11.2) for e-cigarettes, 5.04 (3.44–7.40) for waterpipe, 8.09 (4.87–13.4) for smokeless tobacco and 5.25 (3.45–8.01) for poly-tobacco products use (all  $P$  for trend  $< .001$ ). The associations for all tobacco use outcomes were stronger in early than late adolescents (all  $P$  for interaction  $< .001$ ).

**Conclusions:** Dose-response relationships were found between negatively perceived family relationship quality and current poly- and individual tobacco product use by Hong Kong Chinese secondary students. The associations were stronger for alternative tobacco products and in early adolescents.

## 1. Introduction

Family dysfunction jeopardises adolescent health and development and predisposes them to health-risking behaviours, which may have lasting health consequences across the lifespan (Felitti et al., 1998; Resnick et al., 1997). Adolescents exposed to family conflict have higher risk of psychological distress (Lucas-Thompson & Goldberg,

2011; Sheeber, Hops, Alpert, Davis, & Andrews, 1997), which predicts later initiation of tobacco use (T. H. Lam et al., 2005; Leventhal et al., 2017). Functional neuroimaging research has also found negative family relationship quality hampers cognitive control (McCormick, Qu, & Telzer, 2016), rendering adolescents vulnerable to risky behaviours like substance misuse (Casey & Jones, 2010; Geier, 2013). Numerous studies have linked negative family relationship quality to cigarette smoking in

\* Corresponding author at: School of Nursing, The University of Hong Kong, 21 Sassoon Road, Pokfulam, Hong Kong Special Administrative Region.  
E-mail address: [mpwang@hku.hk](mailto:mpwang@hku.hk) (M.P. Wang).

adolescents across different cultures (Mahabee-Gittens, Xiao, Gordon, & Khoury, 2012; Nelson et al., 2016; Rajesh, Diamond, Spitz, & Wilkinson, 2015; Shakib et al., 2005). However, it is unknown whether this association extends to emerging alternative tobacco products such as electronic cigarettes (e-cigarettes) and waterpipe, which have become more popular than conventional cigarettes among adolescents (Gilreath et al., 2016). Recognizing risk factors for alternative tobacco use is imperative to guide preventive measures.

In general, the influence of family on adolescents changes as they grow older (Smetana, Campione-Barr, & Metzger, 2006). Perceived family relationship quality was found to be more strongly associated with depressive symptoms, a risk factor for smoking, in early adolescents than late adolescents (Greenberger & Chen, 1996). However, very little is known about whether the effect of family relationship quality on adolescent tobacco use differs by stage of adolescence.

Hong Kong is the most westernized city of China with remarkably successful tobacco control measures and the lowest prevalence of daily smoking in the developed world (10.0% in 2017) (Census and Statistics Department, 2018). However, current use of e-cigarette and waterpipe were more prevalent among adolescent than adults (Jiang, Ho, Wang, Leung, & Lam, 2016; Jiang, Wang, Ho, Leung, & Lam, 2016). Research on poly-tobacco use among youths was reported exclusively in western populations. Using the first data on poly-tobacco products use in a large, population-representative sample of Chinese secondary school students in Hong Kong, we examined whether dose-response relationships existed between perceived family relationship quality and current use of cigarette, e-cigarette, waterpipe, smokeless tobacco and poly-tobacco products. We also examined whether these associations vary by stage of adolescence.

## 2. Material and methods

### 2.1. Study design

The School-based Survey on Smoking among Students (2012/13), a biennial survey, was commissioned by the Food and Health Bureau of the Hong Kong government to monitor smoking prevalence in students. Detailed methods were reported previously (Jiang, Wang, et al., 2016). Briefly, a representative sample of 75 secondary schools was selected from all 18 districts in Hong Kong using a stratified proportionate random sampling strategy. After obtaining passive consents from parents, students were invited to voluntarily complete an anonymous, 96-item, paper-and-pencil questionnaire in Chinese. A total of 45,857 secondary 1 to 6 (equivalent to US grade 7 to 12) students (96% of all invited) responded. Ethical approval was granted by the Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster.

### 2.2. Measures

#### 2.2.1. Exposure measures

This study used a brief, 3-item perceived family relationship quality scale developed based on our findings from 2 qualitative studies on family relationship in Hong Kong Chinese (Chan et al., 2011; W. W. Lam et al., 2012). The students rated: (1) interparental relationship (what do you think is the relationship between your father and mother?) and (2) family harmony (how well your family gets along?), each recoded as 0 for “very good/good” or 1 for “fair/ bad/ very bad”, and (3) family happiness (all things considered, you think your family is...) with responses recoded as 0 for “very happy/ happy” and 1 for “not very happy/ not happy at all”. These 3 items have satisfactory internal consistency (Cronbach's  $\alpha = 0.70$ ) and 8-day test-retest reliability (intraclass correlation coefficient  $s = 0.67$  to  $0.85$ ), and strongly predict intention to smoke in Chinese never-smoking youths in Hong Kong (Luk et al., 2017). The sum of these 3 items formed the perceived family relationship quality score ranging from 0 (reference) to 3, with higher

scores indicating worse perceived family relationship.

#### 2.2.2. Outcome measures

Questions were adapted from the Global Youth Tobacco Survey (GYTS) to assess cigarette smoking behaviour (P. Chen, Chiou, & Chen, 2008). Students who reported occasional/ daily cigarette smoking and smoked cigarette(s) in the past 30 days were regarded as current cigarette smokers. Current (past 30-day) use of alternative tobacco products, including e-cigarettes, waterpipe (or hookah) and smokeless tobacco (e.g. chewing tobacco and snus), were also reported. Poly-tobacco products use was defined as concurrent use of  $> 1$  type of these tobacco products (Gilreath et al., 2016).

#### 2.2.3. Potential confounders

As household smoking and secondhand smoke exposure at home may contribute to both negatively perceived family relationship quality (J. Chen, Ho, Au, Wang, & Lam, 2015) and tobacco use in youths (Wang, Ho, & Lam, 2011), we collected data on parental smoking (recoded as none, either or both), sibling smoking (no/ yes) and number of days exposed to secondhand smoke at home in the past week (0–7). Information on other potential confounders, including age, sex, perceived family affluence (rich/ average/ poor), parental education levels (primary or below/ secondary/ tertiary/ don't know) and family structure (intact/ single parent/ no-parent) (Wellman et al., 2016), were also recorded. Perceived family affluence is a reliable measure of family socioeconomic status in Hong Kong adolescents (Ho et al., 2010). Peer smoking was not considered a confounder because it may lead to tobacco use but not negative family relationship quality.

### 2.3. Statistical analysis

All analyses were conducted in Stata/IC 13.1 with svy commands to account for the school clustering effect. Data were weighted by age, sex, and grade distributions of the Hong Kong official secondary student enrolment statistics in 2012/13. After excluding students reporting “not applicable” for interparental relationship ( $n = 2453$ ) and those with missing data in any question assessing perceived family relationship quality ( $n = 1362$ ), a final weighted sample of 42,250 students was analysed. Students with or without missing data in perceived family relationship quality were similar in age, sex and grade (effect sizes = 0.02 to 0.06).

The associations of sociodemographic characteristics with family relationship quality score were analysed using one-way analysis of variance for continuous variables and chi-square test for categorical variables. Logistic regression was used to compute adjusted odds ratio (AOR) for each tobacco product and poly-tobacco use in relation to perceived family relationship quality analysed as a categorical variable (0 [reference] to 3), adjusting for all potential confounders. To examine dose-response relations, perceived family relationship quality was also analysed as a continuous variable to compute  $P$  value for linear trend ( $P$  for trend). Subgroup analyses were conducted by the stage of adolescence: early (age  $\leq 14$  years,  $n = 19,605$ ) and late (age  $> 14$  years,  $n = 22,646$ ) (Irwin & Burg, 2002). A multiplicative interaction term of perceived family relationship quality  $\times$  stage of adolescence (early vs late) was included in the regression models with adjusted Wald test used to calculate an omnibus  $P$  value for interaction for each tobacco use outcome. Complete case analyses were conducted as missing values were minimal ( $< 1\%$ ). A 2-sided  $P < .05$  denotes statistical significance.

## 3. Results

The mean (SD) age of students was 14.6 (1.9) years and 51.3% were boys. More negatively perceived family relationship quality was associated with older age, male sex, perceived poorer family affluence, lower parental education, non-intact family structure, parental

**Table 1**  
Sample characteristics by perceived family relationship quality score in Hong Kong adolescents ( $N = 42,250$ ).

	n	(% )	Perceived family relationship quality <sup>a</sup> , %				P value <sup>b</sup>
			0 (n = 22,735)	1 (n = 9249)	2 (n = 6737)	3 (n = 3529)	
Mean (SD) age, year	14.6	(1.9)	14.5 (1.9)	14.7 (1.9)	14.8 (1.9)	14.9 (2.0)	< .001
Sex							< .001
Boy	21,663	(51.3)	48.4	55.5	54.5	52.5	
Girl	20,588	(48.7)	51.6	44.5	45.5	47.5	
Perceived family affluence							< .001
Rich	6510	(15.4)	17.9	14.4	11.2	10.1	
Average	23,673	(56.2)	59.8	55.1	51.7	44.0	
Poor	11,970	(28.4)	22.3	30.5	37.1	45.9	
Paternal education level							< .001
Primary or below	6379	(15.1)	13.5	15.5	17.4	20.1	
Secondary	18,527	(43.9)	44.6	43.2	43.3	42.9	
Tertiary	8344	(19.8)	23.1	18.2	14.0	13.2	
Don't know	8944	(21.2)	18.8	23.2	25.3	23.9	
Maternal education level							< .001
Primary or below	6722	(15.9)	14.1	16.3	19.0	20.1	
Secondary	20,340	(48.2)	49.6	47.2	46.2	45.7	
Tertiary	6941	(16.5)	18.8	16.1	11.8	11.2	
Don't know	8181	(19.4)	17.5	20.4	23.0	22.4	
Family structure							< .001
Intact	34,050	(80.5)	86.7	76.0	72.6	68.7	
Single-parent	5545	(13.1)	8.9	16.3	19.1	22.0	
No-parent	2655	(6.3)	4.6	7.7	8.3	9.3	
Parental smoking.							< .001
No	28,871	(68.6)	72.8	67.1	61.6	58.9	
Either	11,591	(27.5)	23.9	29.2	33.4	35.9	
Both	1622	(3.9)	3.4	3.7	5.0	5.2	
Sibling smoking							< .001
No	39,849	(94.7)	96.6	94.1	92.0	89.0	
Yes	2234	(5.3)	3.4	5.9	8.1	11.0	
Mean days (SD) exposed to SHS at home in the past 7-day	1.0	(2.1)	0.7 (1.8)	1.0 (2.2)	1.4 (2.4)	1.7 (2.7)	< .001

All data were weighted by age, sex, and grade.

<sup>a</sup> Higher score indicates more negatively perceived family relationship quality.

<sup>b</sup> Calculated by one-way analysis of variance for continuous variables and Pearson chi-square tests for categorical variables.

smoking, sibling smoking and a greater number of days exposed to second hand smoke at home (all  $P < .001$ ) (Table 1).

Overall, the prevalence (95% confidence interval) of current use was 3.0% (2.4–3.7%) for cigarettes, 1.1% (0.8–1.4%) for e-cigarettes, 1.2% (0.9–1.5%) for waterpipe, 1.1% (0.8–1.4%) for smokeless tobacco, and 2.7% (2.1–3.4%) for any alternative tobacco products other than cigarettes. Poly-tobacco products use was reported by 1.1% (0.8–1.4%) of students, including 0.8% for 2 products and 0.3% for 3 or more products.

Both the prevalence and crude odds ratios of all tobacco product use increased with worse perceived family relationship quality (Table 2). After adjusting for potential confounders, the associations were attenuated but remained significant with the strongest AORs observed for smokeless tobacco (AORs ranged from 4.00 to 8.09), followed by e-cigarettes (5.20 to 7.28) and waterpipe (4.49 to 5.04). The AORs of any alternative tobacco product use (4.90 to 9.64) were higher than those of conventional cigarettes (1.94 to 2.92) at every level of perceived family relationship quality. Dose-response relations between perceived family relationship quality and all tobacco use outcomes were evident (all  $P$  for trend  $< .001$ ) in all students. Analyses using the original ordinal scales measuring interparental relationship, family harmony and family happiness produced similar results (Supplementary Tables 1 to 3).

Subgroup analyses showed that the associations between perceived family relationship quality and all tobacco use outcomes were stronger in early adolescence (AORs ranged from 3.89 to 13.3) than late adolescence (1.54 to 8.34) (all  $P$  for interaction  $< .001$ ).

#### 4. Discussion

With a large, population-representative sample of Chinese secondary school students in Hong Kong, we provided the first evidence on

graded associations of negatively perceived family relationship quality with current use of each type of tobacco products and poly-tobacco products use. Consistent with previous studies on adolescents from other cultures (Mahabee-Gittens et al., 2012; Nelson et al., 2016; Rajesh et al., 2015; Shakib et al., 2005), a dose-response relationship was found between negatively perceived family relationship quality and current conventional cigarette smoking. We extended the understanding of family relationship quality as a significant risk factor for current use of emerging alternative tobacco products including e-cigarettes, waterpipe and smokeless tobacco, and poly-tobacco products in adolescents. The associations remained robust after accounting for several potential confounders (J. Chen et al., 2015; Wang et al., 2011; Wellman et al., 2016).

Much stronger associations of perceived family relationship quality with alternative tobacco products than conventional cigarettes were observed. The prevalence of any alternative tobacco product use among the students increased more sharply (from 0.6% to 8.3%) than that of conventional cigarettes (from 1.5% to 7.1%) with worse perceived family relationship quality. Exposure to negative family relationship quality may prompt adolescent to acquire and use alternative tobacco products (e.g. through attachment to deviant peers), particularly as alternative tobacco products are less accessible than cigarettes in Hong Kong. Adolescents' beliefs that alternative tobacco products are less harmful and more fashionable than cigarettes may also contribute to the observed discrepancy (Roditis, Delucchi, Cash, & Halpern-Felsher, 2016).

We also observed stronger associations of perceived family relationship quality with tobacco use in early adolescence than late adolescence. As young adolescents are more attached to their parents than older adolescents (Buist, Deković, Meeus, & van Aken, 2002; Larson, Richards, Moneta, Holmbeck, & Duckett, 1996), exposure to

**Table 2**  
Associations of perceived family relationship quality with tobacco product use in Hong Kong adolescents.

Perceived family relationship quality <sup>a</sup>	All (N = 42,250)			Early adolescence (N = 19,605)	Late adolescence (N = 22,646)	P for interaction
	Current use, %	Crude <sup>b</sup> OR (95% CI)	Adjusted <sup>c</sup> OR (95% CI)	Adjusted <sup>d</sup> OR (95% CI)		
Score	Cigarettes					
0	1.5	1	1	1	1	< .001
1	3.7	2.53 (2.00–3.19)	1.94 (1.53–2.46)	3.89 (2.41–6.30)	1.54 (1.20–1.98)	
2	5.2	3.64 (2.90–4.57)	2.42 (1.99–2.96)	5.58 (3.31–9.41)	1.79 (1.46–2.18)	
3	7.1	5.06 (3.96–6.46)	2.92 (2.32–3.68)	4.70 (2.68–8.24)	2.58 (2.00–3.33)	
P for trend		< .001	< .001	< .001	< .001	
Score	Electronic cigarettes					
0	0.3	1	1	1	1	< .001
1	1.7	6.45 (4.45–9.36)	5.20 (3.41–7.93)	6.96 (3.27–14.8)	4.44 (2.86–6.91)	
2	2.1	7.84 (5.31–11.6)	5.27 (3.51–7.91)	6.03 (3.07–11.8)	4.89 (2.91–8.23)	
3	3.0	11.2 (7.29–17.3)	7.28 (4.71–11.2)	9.17 (5.02–16.8)	6.28 (3.60–11.0)	
P for trend		< .001	< .001	< .001	< .001	
Score	Waterpipe					
0	0.3	1	1	1	1	< .001
1	1.8	5.85 (4.07–8.42)	4.49 (2.94–6.86)	6.19 (2.48–15.5)	3.97 (2.60–6.05)	
2	2.4	7.95 (5.56–11.4)	5.43 (3.74–7.90)	7.69 (3.61–16.4)	4.67 (3.21–6.78)	
3	2.7	8.90 (6.23–12.7)	5.04 (3.44–7.40)	5.38 (2.27–12.7)	4.86 (3.18–7.44)	
P for trend		< .001	< .001	< .001	< .001	
Score	Smokeless tobacco					
0	0.2	1	1	1	1	< .001
1	1.4	5.45 (3.60–8.23)	4.00 (2.54–6.31)	6.80 (3.41–13.6)	3.12 (1.88–5.17)	
2	2.1	8.15 (5.19–12.8)	4.80 (2.87–8.05)	9.11 (4.49–18.5)	3.66 (2.11–6.33)	
3	3.6	14.1 (9.09–21.7)	8.09 (4.87–13.4)	12.0 (6.73–21.4)	7.03 (3.77–13.1)	
P for trend		< .001	< .001	< .001	< .001	
Score	Alternative tobacco <sup>e</sup>					
0	0.6	1	1	1	1	< .001
1	3.6	6.43 (4.78–8.65)	4.90 (3.55–6.77)	7.68 (4.26–13.8)	4.04 (2.99–5.46)	
2	5.8	10.5 (7.56–14.6)	7.01 (4.97–9.89)	11.1 (6.36–19.5)	5.75 (4.02–8.20)	
3	8.3	15.5 (11.5–21.1)	9.64 (6.96–13.4)	13.3 (8.08–21.9)	8.34 (5.64–12.3)	
P for trend		< .001	< .001	< .001	< .001	
Score	Poly-tobacco <sup>f</sup>					
0	0.3	1	1	1	1	< .001
1	1.6	4.78 (3.33–6.87)	4.01 (2.70–5.98)	7.39 (3.28–16.7)	3.05 (2.00–4.65)	
2	1.9	5.67 (3.86–8.32)	3.75 (2.46–5.70)	7.18 (3.47–14.9)	2.82 (2.00–3.96)	
3	2.7	8.03 (5.30–12.2)	5.25 (3.45–8.01)	5.10 (2.39–10.9)	5.31 (3.26–8.67)	
P for trend		< .001	< .001	< .001	< .001	

All data were weighted by age, sex and grade; All odds ratios  $P < .001$ .

<sup>a</sup> Higher score indicates more negatively perceived family relationship quality.

<sup>b</sup> Adjusted for school clustering.

<sup>c</sup> Additionally adjusted for age, sex, perceived family affluence, paternal and maternal education, family structure, parental smoking, sibling smoking, and secondhand smoke exposure at home.

<sup>d</sup> Equivalent to c without adjusting for age.

<sup>e</sup> Any use of electronic cigarettes, waterpipe and smokeless tobacco.

<sup>f</sup> Current use of > 1 type of tobacco products.

negative family relationship quality may induce greater level of psychosocial distress in younger adolescents (Greenberger & Chen, 1996) and thus higher risk of tobacco products use. Cognitive control ability also gradually matures as adolescents age (Luna, Padmanabhan, & O'Hearn, 2010), which may buffer the impact of negative family relationship quality on their health-risking propensity and reduce the risk of tobacco use (Casey & Jones, 2010).

This study has several limitations. First, the temporal sequence between perceived family relationship quality and tobacco use cannot be determined by cross-sectional data. Reverse causation, whereby adolescent tobacco use causes negatively perceived family relationship quality, seems less likely although possible. Besides, prospective associations of family relationship with cigarette smoking initiation has been demonstrated previously (Rajesh et al., 2015). Second, tobacco product use was self-reported. Although we ensured confidentiality to encourage candid reporting, underreporting (misclassification bias of outcome) would likely attenuate the strength of associations observed in our study. Third, like many previous studies (Nelson et al., 2016;

Rajesh et al., 2015; Shakib et al., 2005), perceived family relationship quality was measured only in adolescents. Nevertheless, we showed that the adolescents' perceptions were coherent in the expected direction to parental education level, family structures and household smoking (Table 1). It should also be their own perceptions that are more meaningful and relevant to their uses of tobacco products. Lastly, our findings may be less applicable to other populations, whose family culture is different from that of Chinese. However, family relationship has been consistently found to be a significant predictor of cigarette smoking in adolescents of different cultures or ethnicities (Mahabee-Gittens et al., 2012; Nelson et al., 2016; Rajesh et al., 2015; Shakib et al., 2005). Our findings also have implications to other regions in mainland China, home to the world's largest producers of e-cigarettes (about 95% worldwide) and the largest group of adolescents, with rapidly rising rate of alternative tobacco use among youths (Jiang, Ho, & Lam, 2016). Further studies using longitudinal design and in different population are warranted to provide stronger evidence to inform family-based interventions to prevent adolescents from using

conventional and emerging alternative tobacco products.

## 5. Conclusions

In a large and representative sample of Chinese secondary school students in Hong Kong, we found strong associations of poor perceived family relationship quality with current use of cigarettes, e-cigarettes, waterpipe and smokeless tobacco, and poly-tobacco products. Stronger associations were observed for alternative tobacco products than conventional cigarettes, and in early adolescence than late adolescence. While further research is needed to infer a causal relation between family relationship quality and poly-tobacco products use, perceived family relationship quality can be a useful tool to identify high-risk adolescents as targets for tobacco prevention and cessation programs.

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## Contributors

MPW, SYH and THL designed the study. MPW, LTL, JC and SYH collected the data. TTL, YW and MPW analysed the data. TTL and MPW drafted the manuscript. All authors critically revised and approved the final version of the manuscript.

## Conflict of interest

All authors declare no conflict of interest.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.addbeh.2018.05.011>.

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