A longitudinal study of transitions between smoking and smokeless tobacco use from the ITC Bangladesh Surveys: implications for tobacco control in the Southeast Asia region

Daniel Tzu-Hsuan Chen,[a,b,*] Nigar Nargis,[c] Geoffrey T. Fong,[d,e,f] Syed Mahfuzul Huq,[g] Anne C. K. Quah,[d] and Filippos T. Filippidis[a]

[a]Public Health Policy Evaluation Unit, School of Public Health, Imperial College London, UK
[b]Nuffield Department of Primary Care Health Sciences, University of Oxford, UK
[c]American Cancer Society, Washington, DC, USA
[d]Department of Psychology, University of Waterloo, Waterloo, Ontario, Canada
[e]School of Public Health Sciences, University of Waterloo, Waterloo, Ontario, Canada
[f]Ontario Institute for Cancer Research, Toronto, Ontario, Canada
[g]Country Office of World Health Organization, Dhaka, Bangladesh

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Summary

Background In Southeast Asia, tobacco use is a major public health threat. Tobacco users in this region may switch between or concurrently use smoked tobacco and smokeless tobacco (SLT), which makes effective tobacco control challenging. This study tracks transitions of use among different product users (cigarettes, bidis, and SLT) in Bangladesh, one of the largest consumers of tobacco in the region, and examines factors related to transitions and cessation.

Methods Four waves (2009–2015) of the International Tobacco Control (ITC) Bangladesh Survey with a cohort sample of 3245 tobacco users were analysed. Generalized Estimating Equations (GEE) models were used to explore the socioeconomic correlates of transitions from the exclusive use of cigarettes, bidis, or SLT to the use of other tobacco products or quitting over time.

Findings Among exclusive cigarette users, most remained as exclusive cigarette users (68.1%). However, rural smokers were more likely than urban smokers to transition to bidi use (odds ratio [OR] = 3.02, 95% confidence interval [CI] = 1.45–6.29); to SLT use (OR = 2.68, 95% CI = 1.79–4.02) and to quit tobacco (OR = 1.57, 95% CI = 1.06–2.33). Among exclusive bidi users, transitional patterns were more volatile. Fewer than half (43.3%) of the exclusive bidi users maintained their status throughout the waves. Those with higher socio-economic status (SES) were more likely to quit (OR = 4.16, 95% CI = 1.08–13.12) compared to low SES smokers. Exclusive SLT users either continued using SLT or quit with minimal transitions to other products (≤2%). Nevertheless, males were more likely to switch to other tobacco products; younger (OR = 2.94, 95% CI = 1.23–6.90 vs. older), more educated (OR = 1.55, 95% CI = 1.77–3.12 vs. less educated), and urban SLT users (OR = 0.52, 95% CI = 0.30–0.86 for rural vs. urban users) were more likely to quit.

Interpretation Complex transitional patterns were found among different types of tobacco product users over time in Bangladesh. These findings can inform more comprehensive and multi-faceted approaches to tackle diversified tobacco use in Bangladesh and neighbouring countries in the Southeast Asia region with similar tobacco user profiles of smoked tobacco and SLT products.

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*Corresponding author. Room 319, Reynolds Building, Imperial College London, St. Dunstan's Road, London, W6 8RP, UK.
E-mail address: t.chen17@imperial.ac.uk (D.T.-H. Chen).

Research in context

Evidence before this study

Previous research has focused mainly on cross-sectional patterns and individual-level correlates of tobacco use. Evidence taking into consideration both person and product-related characteristics in understanding tobacco use behaviours are scarce. Moreover, little is known about the transitions between different tobacco products use over time in the Southeast Asia region. Specifically in Bangladesh, where a large number of tobacco users and a high prevalence of dual- and poly-product use of smoked tobacco and SLT products exist, no longitudinal studies have been conducted to date that examine use patterns and factors related to transition and cessation.

Added value of this study

This study provides a comprehensive evaluation of transitional patterns in cigarettes, bidis, and SLT use in Bangladesh. This is also the first study using a large-scale, nationally representative cohort in the Southeast Asia region to longitudinally examine the patterns and factors related to the transition and cessation of cigarette, bidi, and SLT use among Bangladeshi populations over a seven-year period. We identified product-specific trajectories of the three main tobacco products used and user attributes associated with the complex transitional patterns among different types of tobacco product users over time. A study of these transition patterns can shed light on the importance of people, product, and policies in tobacco control in the Southeast Asia region and shed insights into the interplay between the markets for all three products.

Implications of all the available evidence

To understand how tobacco use patterns change over time among users exposed to a diverse market of tobacco products and the factors affecting their transition patterns, it is imperative to analyse tobacco use patterns over time. Exclusive cigarette users were less likely to quit or switch to other products, but when they did, they were more likely to use SLT and become dual cigarette and SLT users. Bidi users typically switched to relatively expensive cigarettes or dual use with SLTs over time. There is no evidence that SLT users were transitioning to any other products. SLT has had little substitution or transition over time, indicating that it has a distinct market and user base. Stratified analysis of different user subgroups identified varying levels of association with transitions in product use based on age, area of residence, and sociodemographic status. The identified transitional patterns can be used as a starting point for a more comprehensive understanding of the interactions between different tobacco products used in Bangladesh and countries with similar user profiles, such as India and Sri Lanka. These can serve as a starting point for developing effective tobacco control strategies for limiting tobacco use in the region.

Introduction

Tobacco smoking is a major threat to public health in Southeast Asian countries, killing 1.6 million lives in the region alone in 2020.[1] The region is also home to the largest producers and consumers of tobacco products in the world. The World Health Organization Southeast Asia region accounts for more than 22% of global smokers and more that 80% of smokeless tobacco (SLT) users.[2] In this region, tobacco is consumed in diverse forms, including smoked products, such as cigarettes and bidis (a cheaper hand-rolled form of smoked tobacco), and the widely used SLT, for which awareness of negative health effects may be limited due to culture-related customs and misbeliefs of their health effects.[3,4]

Several countries in this region have witnessed an increased prevalence of concurrent use of these products (i.e., dual- and poly-tobacco use) in recent years.[5,6] Evidence has shown that combined use of two or more tobacco products increases exposure to potentially harmful toxicants; therefore, it raises the risks of developing tobacco-related diseases[7] and might prevent users from successfully quitting tobacco.[8,9] This is extremely relevant in Southeast Asian countries such as Bangladesh, one of the top ten countries with the highest smoking prevalence in the world.[10,11]

Global Adult Tobacco Survey (GATS) data show that in 2017, over one in three adults (35.3%) in Bangladesh were currently using smoked tobacco, such as cigarettes and bidis, or smokeless tobacco (SLT) or a combination of the two.[5,12] The prevalence of tobacco use was much higher among men (46%) than among women (25.2%) and in rural areas (37.1%) than in urban areas (29.9%).[12] Female tobacco users are primarily SLT users (16.2% men vs. 24.8% women). Almost one in 10 adults (9.3%) is a dual user of both ST and SLT products, and one in 11 (8.8%) is a poly user of three or more products.[5]

Dual- and poly-tobacco use reflect patterns of tobacco product substitution/initiation and nicotine seeking behaviour, which in turn can be influenced by underlying policy and person-level factors.[13] The availability of smoked tobacco and SLT products in Southeast Asia potentially contributes to high dual and poly use of cigarettes, bidis, and SLT, making it easier for users to transition between products. Evidence suggests that significant price differences persist across smoked and SLT products (overall cheaper) in the Southeast Asia

region, particularly in India and Bangladesh, potentially contributing to the incentives for product substitution.[14,15] Previous studies have largely focused on cross-sectional patterns of smoked tobacco and SLT use among various socioeconomic and demographic subgroups. Further investigation of the impact of these factors on the transitions of tobacco use and quitting could deepen our understanding of these phenomena. There have been limited studies that have tracked the trajectory of tobacco use, differentiated by product type and user profile, in the Southeast Asia region. The current study is the first longitudinal analysis in the Southeast Asian region of the patterns and factors related to the transition and cessation of the three most consumed products—cigarette, bidi, and SLT within the population and user subgroups.

Methods

Data and sample

Data were from all four waves of the International Tobacco Control (ITC) Bangladesh Surveys conducted in 2009, 2010, 2011–2012, and 2014–2015. The ITC Project is undertaking large-scale prospective cohort surveys with the principal goal of assessing behavioural aspects of tobacco use and psychosocial effects of national tobacco control programmes implemented in accordance with the Framework Convention on Tobacco Control (FCTC) in its 31 partner countries.[16]

For the Bangladesh surveys, the interwave retention rates (the proportion of respondents of the previous wave retained in the subsequent survey wave) were between 87.1% and 94.0%.[17–20] A total of 3245 respondents who participated in all four waves, including 1451 exclusive single product users (N = 986 exclusive cigarette users; N = 115 exclusive bidi users; and N = 350 exclusive SLT users at baseline Wave 1) were included to examine individual-level changes and transition patterns of tobacco use over time. Bangladesh had implemented many policy initiatives during the four waves of the ITC Bangladesh Survey in 2009–2015—the 2005 Tobacco Control Act was amended in 2013 with new rules formulated in 2015 to supersede the previous Act, bringing the country closer to compliance with the WHO FCTC. The detailed timeline of the tobacco control policies and the ITC surveys in Bangladesh from 2009 to 2015 is provided in Supplementary Figure S1, and Supplementary Figure S2.

The ITC Bangladesh Survey uses a nationally representative probability sample of adult tobacco users and non-users ≥15 years old, recruited using a multistage cluster sampling design. Details on survey interview procedures, questionnaires, sampling, weighting, and information on accessing the data are documented elsewhere.[17–20] All tobacco use-related questions and data were retrieved from the tobacco user survey. In the first two waves, the tobacco user questionnaire was designed to collect information on smoked tobacco products only; those respondents who used smokeless tobacco (SLT) provided information about their use in the non-users' survey. The current study thus included all valid responses in both questionnaires, which led to a complete collection of data on both smoked tobacco and smokeless tobacco among a cohort that was representative of the general population and all product users. Nevertheless, the tribal sample, the slum areas, and the border regions sampled purposively in selective waves of the survey were not included in the general population due to study design, the high mobility and the complex data registration histories of these populations.

Measures

Sociodemographic characteristics

Several sociodemographic variables were included in the analysis as potential covariates. These were sex, age groups (15–17, 18–24, 25–39, 40–54, 55+), residence area (urban, rural), marital status (married, single or living alone [including divorced or widowed]), and educational status (illiterate, 1–8 years, or 9 years or more). A categorical variable indicating low, moderate, and high socio-economic status (SES) constructed by the original ITC researchers based on the terciles of the housing index was used as the basis for stratification of the population in each survey area by socioeconomic position.[21]

Tobacco use definitions

Tobacco products surveyed at each wave included cigarettes, bidis, and SLT. Respondents were identified as current users if they reported current use of any of the above products on a daily, weekly, or less than weekly basis (e.g., monthly) using the tobacco user survey. The questions were: "Do you currently smoke cigarettes/bidis?". Those who answered "yes" (Wave 1) or "daily/weekly/less than weekly" (Waves 2, 3, and 4) were categorised as current users. A similar principle was followed for the identification of SLT users. However, in Wave 1 and Wave 2, current SLT users would include respondents from both the tobacco user survey, and non-user survey who reported using SLT. The relevant questions were: "In the past 6 months, have you used any smokeless products?" (yes/no) and "I generally use SLT at least weekly." (yes/no). Those who responded "yes" to both the former and latter questions were classified as current SLT users. For Waves 3 and 4, the questions from the user survey were: "Do you currently use SLT?" Responding daily, weekly, or less than weekly to the question indicates current use. Those who gave a negative response to the above questions were classified as non-users or quitters.

Dual- and poly-tobacco use

Current dual- and poly-tobacco use were operationalised consistent to previous studies.[5,22,23] Individuals currently

using two distinct tobacco products were classified as dual-tobacco users (i.e., cigarette + bidi, cigarette + SLT, or bidi + SLT), whereas those concurrently using all three tobacco products at the time of the survey were classified as poly-tobacco users (cigarette + bidi + SLT).

Analysis

Transition modelling

To examine respondents' transitions in tobacco product use between consecutive waves from Wave 1 to Wave 4, we conducted separate analyses on each group of exclusive users in Wave 1, namely exclusive cigarette, exclusive bidi, and exclusive SLT users. Each respondent was assessed for transitions from one wave (wave t) to the next wave (wave t + 1) with binary indicators where 1 = transition in product use at wave t + 1, and 0 = no transition with respect to five key transitional outcomes for each exclusive user group. For example, among exclusive cigarette users at Wave 1, the transitional, not mutually exclusive, outcomes investigated were: (1) transition to bidi use (exclusive use or in combination with cigarettes/SLT); (2) transition to SLT use (exclusive use or in combination with cigarettes/bidis); (3) quitting (transition to non-tobacco use); (4) any transition other than quitting (transition to any other combination of tobacco use other than "quitting"); (5) transition to dual or poly use (i.e., using at least two/three products). At Wave 1, similar binary indicators were constructed for exclusive bidi users and exclusive SLT users (five outcomes for each group). Classifying transitional outcomes in this way made it possible to examine longitudinal transitions of specific tobacco product/patterns over time at the individual level.

Analytical framework

Due to the low prevalence of cigarette and bidi use among females in Bangladesh (less than 2% in each survey wave), all analyses regarding the transitions of exclusive cigarette and exclusive bidi users were conducted only among males. A series of longitudinal analyses were carried out to present the trajectories of tobacco use transitions for Wave 1 exclusive cigarette users (males only, n = 986), exclusive bidis users (males only, n = 115), and exclusive SLT users (both sexes, n = 350) who completed all four waves.

Separate alluvial diagrams (river plots) were used to visually depict the transition trajectories between successive waves. A series of Generalized Estimating Equations (GEE) logistic models were utilised to evaluate the sociodemographic correlates for transitions from exclusive product use to the initiation of other products or quitting in subsequent waves. Potential covariates (predictors) were selected based on epidemiological knowledge in tobacco control science and previous evidence.[2,10,24] We considered sex,[25] age group (categorical variable), residential area,[12] socioeconomic status (using the housing index as a proxy),[21] education level, and marital status[26] as covariates to explore the relationship between these sociodemographic factors and product use transitions. The transitions analysis also tested whether there were significant time effects across waves using ITC "wave" (a proxy for time) as a categorical variable (Wave 1–4).

The GEE models estimated in the study employed an unstructured working correlation matrix to account for correlations between repeated observations.[27] Logistic regression using population-averaged GEE with unstructured correlation structure among outcomes was fit using "xtlogit" with the "pa" and the "corr(unstructured)" option in STATA 17. All analyses were weighted so that results are representative of the Bangladeshi population of tobacco users.

Ethics

The survey protocols and all materials, including the survey questionnaires, were cleared for ethics by the Research Ethics Board, University of Waterloo, Canada (REB#15019 and REB#19862/30312); Bangladesh Medical Research Council, Bangladesh (IRB BMRC/ERC/2013-2016/1729 and IRB BMRC/ERC/2007-2010/1372).

Role of funding source

None.

Results

Sample characteristics

The sample's descriptive characteristics are presented in Table 1.

Product-specific transitions over time

Fig. 1A–C illustrates the transitional patterns of exclusive tobacco product users from Wave 1 to Wave 4. The height of the coloured knots at each wave indicates the weighted proportion of transitions. The wider the knots, the greater the proportion.

According to Fig. 1A, exclusive cigarette users at baseline were likely to remain as exclusive cigarette users at Wave 4 (68.1%). This was significantly higher than the percentage of exclusive bidi users who remained exclusive bidi users (43.4%) (Fig. 1B) or the percentage of exclusive SLT users who remained exclusive SLT users (44.3%) (Fig. 1C). at Wave 4. Transitions to being non-users, dual users (cigarettes + SLT, or SLT + bidis) or poly users of all three products in this subgroup were less frequently observed (≤4%) (Fig. 1A). Generally, transitions to quitters from exclusive tobacco product use were low (<17%) except for SLT users (49%–52%).

Transitional patterns were more volatile for exclusive bidi users compared to other exclusive product users (Fig. 1B). Fewer than half of the exclusive bidi users maintained their status throughout the waves. Transitions from exclusive bidi use to exclusive cigarette use were rather stable across all waves (13.2%–14.7%) and

Sample characteristics	Weighted percentages (%) with 95% Confidence Interval			
	Longitudinal sample W1 (N = 3245)	Exclusive cig users at W1 (N = 986, male only)	Exclusive bidi users at W1 (N = 115, male only)	Exclusive SLT users at W1 (N = 350)
Sex				
Male	51.4 (49.7–53.1)	—	—	26.2 (21.8–31.0)
Female	48.6 (46.9–50.3)	—	—	73.8 (69.0–78.2)
Age group				
15–24	22.3 (20.9–23.7)	20.0 (17.6–22.6)	2.8 (0.7–8.0)	9.3 (6.7–12.9)
25–39	36.5 (34.8–38.1)	42.8 (39.7–45.9)	19.0 (12.8–27.2)	33.4 (28.6–38.5)
40–54	24.1 (22.7–25.6)	23.4 (20.9–26.1)	36.5 (28.2–45.6)	35 (30.1–40.1)
55+	17.2 (16.0–18.6)	13.9 (11.8–16.2)	41.8 (33.2–50.9)	22.4 (18.3–27)
Residence				
Urban	30.4 (28.9–32.0)	35.5 (32.6–38.5)	8.6 (4.5–15.3)	21.8 (17.8–26.5)
Rural	69.6 (68.0–71.1)	64.5 (61.5–67.5)	91.4 (84.7–95.5)	78.2 (73.5–82.2)
SES: housing index				
Low	30.7 (29.1–32.3)	30.9 (28.1–33.9)	43.8 (35.0–52.9)	38.0 (33.1–43.2)
Moderate	33.8 (32.2–35.4)	34.4 (31.5–37.4)	37.0 (28.7–46.1)	35.1 (30.3–40.3)
High	35.6 (33.9–37.2)	34.7 (31.8–37.7)	19.3 (13–27.5)	26.9 (22.5–31.8)
Education				
Illiterate	25.1 (23.6–26.6)	17.9 (15.6–20.4)	50.8 (41.8–59.8)	42.8 (37.7–48.1)
1–8 years	54.0 (52.3–55.7)	53.0 (49.8–56.1)	41.9 (33.3–51)	49.4 (44.2–54.6)
9 years or more	20.9 (19.6–22.4)	29.2 (26.4–32.1)	7.3 (3.6–13.7)	7.8 (5.4–11.1)
Marital status				
Married	81.1 (79.7–82.4)	77.0 (74.2–79.5)	90.1 (83.1–94.5)	83.4 (79.1–87.0)
Single/live alone	18.9 (17.6–20.3)	23.0 (20.5–25.8)	9.9 (5.5–16.9)	16.6 (13.0–20.9)

Note: — no data points for female respondents. Males constitute 100% of analytical sample. Longitudinal survey weights are applied to all estimates; 95% CI are reported to indicate of the degree of uncertainty.

Table 1: **Sample characteristics of the longitudinal sample.**

much more frequent than from exclusive cigarette use to exclusive bidi use (2.8%–3.2%) (Fig. 1A).

A large proportion of exclusive SLT users (Fig. 1C) remained as SLT users, whereas a sizable number transitioned to quitting. There were few transitions to using other products throughout the waves (overall ≤2%). The most likely transition to dual use for both exclusive cigarette and exclusive bidi users was with SLT.

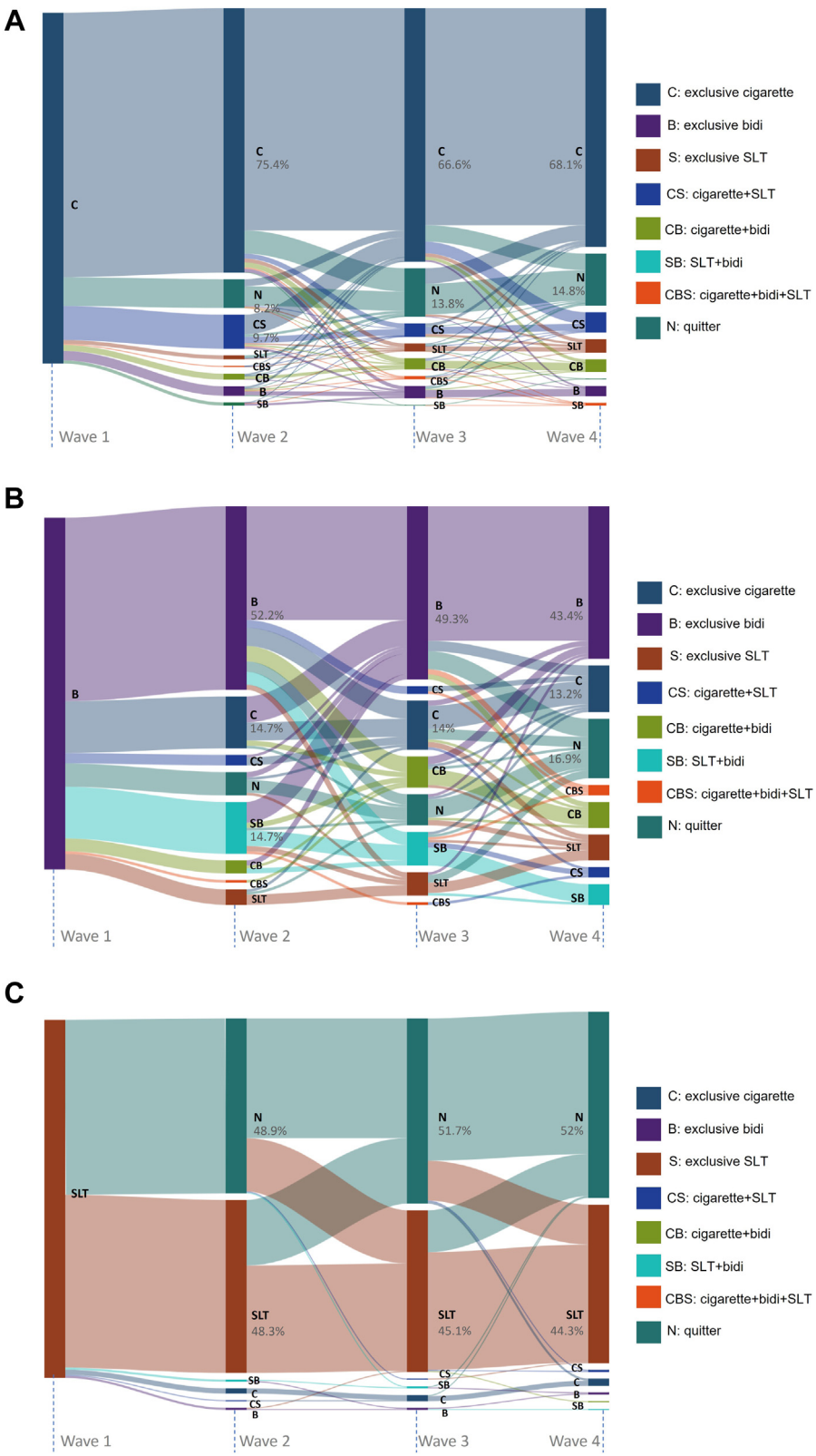
Correlates of transitions between products over time

The GEE models examined factors associated with transitions including quitting in subsequent waves (Tables 2–4). Among exclusive cigarette users, rural respondents were more likely to transition than urban respondents (transition to bidi: OR = 3.02, 95% CI = 1.45–6.29; transition to SLT: OR = 2.68, 95% CI = 1.79–4.02; quitting: OR = 1.57, 95% CI = 1.06–2.33; any transition: OR = 3.01, 95% CI = 2.02–4.49; transition to dual or poly use: OR = 2.49, 95% CI = 1.63–3.81). Housing index (SES indicator) was not associated with any transition. Generally, younger people were less likely to transition than older people. Transitions to bidi use and quitting were more likely to occur in later waves, whereas transitions to SLT were more likely in earlier waves (Table 2).

Among exclusive bidi users shown in Table 3, age and residential area were not associated with transitions. However, respondents with higher housing index (SES indicator) were more likely to quit (OR = 4.16, 95% CI = 1.08–13.12), but had lower odds to transition to exclusive cigarette use (OR = 0.49, 95% CI = 0.24–0.99) or make any transition (OR = 0.47, 95% CI = 0.22–0.98). Survey waves were not associated with transitions among exclusive bidi users.

Exclusive SLT users were frequently women and had significantly lower odds to transition to any other products compared to exclusive cigarette or bidi users. Quitting tobacco was more likely among younger respondents (OR = 2.94, 95% CI = 1.23–6.90), those more educated (OR = 1.55, 95% CI = 1.77–3.12), and SLT users living in urban areas (OR = 0.52, 95% CI = 0.30–0.86 for rural users) compared to their counterparts. Due to the small numbers of transitions to exclusive cigarette use, exclusive bidi use, and any transitions, the estimations for these three models were unstable with wide confidence intervals.

A more aggregated view of the trajectories of the transitions of single-, dual-, and poly-tobacco use in the ITC Bangladesh Surveys is presented in Supplementary Figure S3.


A
C
C
75.4%
N
8.2%
CS
9.7%
SLT
CBS
CB
B
SB
C
66.6%
N
13.8%
CS
SLT
CB
CBS
B
SB
C
68.1%
N
14.8%
CS
SLT
CB
B
SB
Wave 1
Wave 2
Wave 3
Wave 4
C: exclusive cigarette
B: exclusive bidi
S: exclusive SLT
CS: cigarette+SLT
CB: cigarette+bidi
SB: SLT+bidi
CBS: cigarette+bidi+SLT
N: quitter
B
B
52.2%
C
14.7%
CS
N
SB
14.7%
CB
CBS
SLT
B
49.3%
CS
C
14%
CB
N
SB
SLT
CBS
B
43.4%
C
13.2%
N
16.9%
CBS
CB
SLT
CS
SB
Wave 1
Wave 2
Wave 3
Wave 4
C: exclusive cigarette
B: exclusive bidi
S: exclusive SLT
CS: cigarette+SLT
CB: cigarette+bidi
SB: SLT+bidi
CBS: cigarette+bidi+SLT
N: quitter
C
SLT
N
48.9%
SLT
48.3%
SB
C
CS
B
N
51.7%
SLT
45.1%
CS
SB
C
B
N
52%
SLT
44.3%
CS
C
B
SB
Wave 1
Wave 2
Wave 3
Wave 4
C: exclusive cigarette
B: exclusive bidi
S: exclusive SLT
CS: cigarette+SLT
CB: cigarette+bidi
SB: SLT+bidi
CBS: cigarette+bidi+SLT
N: quitter

	OR (95% CI)				
	Transition to any bidi use	Transition to any SLT use	Quitting	Any transitions[a]	Transition to dual or poly use
N of transitions in Wave 2	52	117	80	159	123
N of transitions in Wave 3	75	70	136	135	78
N of transitions in Wave 4	73	104	146	167	104
Age Group					
55+	1	1	1	1	1
40–54	0.78 (0.51–1.20)	1.18 (0.76–1.83)	0.61 (0.36–1.02)	0.94 (0.67–1.32)	1.17 (0.76–1.79)
25–39	0.39 (0.22–0.69)***	1.03 (0.64–1.64)	0.63 (0.39–1.02)	0.63 (0.42–0.95)*	1.02 (0.65–1.63)
15–24	1.05 (0.40–2.71)	0.45 (0.22–0.95)*	0.82 (0.44–1.52)	0.63 (0.33–0.96)*	0.92 (0.43–1.99)
Education					
Illiterate	1	1	1	1	1
Less educated	1.19 (0.77–1.83)	1.06 (0.66–1.71)	1.1 (0.65–1.85)	1.14 (0.80–1.61)	1.12 (0.7–1.79)
More educated	0.74 (0.39–1.39)	0.68 (0.38–1.22)	1.41 (0.83–2.42)	0.76 (0.48–1.19)	0.62 (0.34–1.1)
Marital status					
Married	1	1	1	1	1
Single/live alone	0.4 (0.22–0.8)**	0.5 (0.25–0.99)*	1.04 (0.67–1.6)	0.46 (0.28–0.74)**	0.57 (0.32–1.98)*
Residence					
Urban	1	1	1	1	1
Rural	3.02 (1.45–6.29)**	2.68 (1.79–4.02)***	1.57 (1.06–2.33)*	3.01 (2.02–4.49)***	2.49 (1.63–3.81)***
Housing index					
Low	1	1	1	1	1
Moderate	1.18 (0.61–2.27)	1.05 (0.63–1.75)	1.42 (0.88–2.28)	1.11 (0.71–1.72)	1.17 (0.71–1.92)
High	1.41 (0.72–2.77)	0.96 (0.56–1.66)	1.3 (0.8–2.12)	1.07 (0.68–1.69)	1.26 (0.76–2.08)
Wave					
2	1	1	1	1	1
3	1.77 (1.22–2.58)**	0.51 (0.36–0.69)***	1.82 (1.37–2.42)***	0.91 (0.7–1.17)	0.67 (0.47–0.95)*
4	1.55 (1.1–2.22)*	0.77 (0.59–1.01)	1.98 (1.44–2.72)***	1.08 (0.87–1.33)	0.82 (0.62–1.09)

[a]Any transitions except for transition to quitting. Longitudinal survey weights are applied to all estimates; 95% CI are reported to indicate of the degree of uncertainty. * p < 0.05, ** p < 0.01, *** p < 0.001.

Table 2: **Associations between sociodemographic factors and transitional patterns of exclusive cigarette users at W1 (N = 986) to W4, adjusted for longitudinal weights (male respondents only).**

Discussion

This study tracked tobacco use transitions and examined factors related to the transition and cessation of different smoked tobacco and SLT products using a nationally representative sample of Bangladeshi tobacco users. This study is, to our knowledge, the most extensive analysis of smoked tobacco and SLT use transitions over time in Bangladesh and in the Southeast Asia region. Findings revealed profound and distinct transitional patterns across the exclusive users of each of the three products—cigarettes, bidis, and SLT. In addition, our longitudinal analyses showed product-specific correlates of transitions between products among subgroups of users.

Exclusive cigarette users were much less likely to quit or transition to other products than exclusive bidi and SLT users. This is consistent with previous research from the global South[14,28] and the United States, which showed that cigarette users rarely switch to other products.[29] A recent review found evidence that the tobacco industry's pricing tactics in response to tax changes, such as increased tax absorption and differential pricing, make cigarette users stick with their brand choice or shift to cheaper cigarette alternatives, rather than

Fig. 1: Product specific transitions over time in the ITC Bangladesh Surveys. A). Transitions of exclusive cigarette users from Wave 1 to Wave 4 (n = 986). B). Transitions of exclusive bidi users from Wave 1 to Wave 4 (n = 115). C). Transitions of exclusive SLT users from Wave 1 to Wave 4 (n = 350). Note: The graphs depict the representative changes of tobacco product use over time from Wave 1 (left) to Wave 4 (right) on parallel vertical axes. Each coloured block represents a specific type or combination of tobacco products used in the cohort. The height of the coloured blocks at each wave indicates the weighted percentages of different product use at each wave, and the flow streams that pass through each block represent different proportions of product use that change over time from the previous wave (left) to the next wave (right).

	OR (95% CI)				
	Transition to any cig use	Transition to any SLT use	Quitting	Any transitions[a]	Transition to dual or poly use
N of transitions in Wave 2	30	22	8	47	26
N of transitions in Wave 3	35	15	9	46	25
N of transitions in Wave 4	36	17	16	45	23
Age group					
55+	1	1	1	1	1
40–54	0.97 (0.41–2.29)	1.05 (0.45–2.47)	0.41 (0.13–1.29)	1.11 (0.66–1.87)	1.45 (0.76–2.79)
25–39	1.85 (0.77–4.45)	0.38 (0.12–1.16)	0.49 (0.09–2.7)	1.06 (0.5–2.28)	0.82 (0.28–2.36)
15–24	2.76 (0.6–12.66)	0.26 (0.02–2.93)	0.28 (0.04–2.12)	1.51 (0.41–5.64)	0.31 (0.04–2.37)
Education					
Illiterate	1	1	1	1	1
Less educated	0.7 (0.37–1.33)	0.85 (0.41–1.75)	1.26 (0.41–3.85)	0.87 (0.41–1.86)	1.01 (0.53–1.94)
More educated	1.24 (0.52–2.96)	0.14 (0.02–1.06)	0.63 (0.13–3.15)	0.76 (0.34–1.7)	0.37 (0.1–1.33)
Marital status					
Married	1	1	1	1	1
Single/live alone	0.69 (0.2–2.46)	0.89 (0.24–3.23)	2.42 (0.41–14.34)	0.55 (0.21–1.42)	1.15 (0.26–4.99)
Residence					
Urban	1	1	1	1	1
Rural	0.40 (0.1–1.66)	1.61 (0.4–6.62)	0.46 (0.09–2.4)	0.64 (0.15–2.78)	1.49 (0.28–7.96)
Housing index					
Low	1	1	1	1	1
Moderate	0.85 (0.39–1.83)	1.41 (0.55–3.62)	3.31 (0.71–15.38)	1.1 (0.52–2.29)	0.77 (0.35–1.7)
High	0.49 (0.24–0.99)*	0.41 (0.12–1.39)	4.16 (1.08–13.12)*	0.47 (0.22–0.98)*	0.53 (0.2–1.46)
Wave					
2	1	1	1	1	1
3	0.97 (0.51–1.86)	0.64 (0.27–1.51)	1.02 (0.38–2.72)	0.98 (0.51–1.87)	0.6 (0.26–1.37)
4	1.06 (0.5–2.43)	0.57 (0.22–1.33)	3.25 (1.31–8.03)*	0.87 (0.4–1.87)	0.56 (0.27–1.14)

[a]Any transitions except for transition to quitting. Longitudinal survey weights are applied to all estimates; 95% CI are reported to indicate of the degree of uncertainty. * $p < 0.05$.

Table 3: **Associations between sociodemographic factors and transitional patterns of exclusive bidi users at W1 (N = 115) to W4, adjusted for longitudinal weights (male respondents only).**

decreasing/quitting tobacco use.[30] Bangladesh's cigarette tax has been a weak instrument in raising cigarette prices at rates over and above general inflation and the high-income growth experienced in Bangladesh in the recent past. The differential cigarette tax and price structure in Bangladesh inherently favours low-priced cigarettes and may lead cigarette smokers to switch to lower-priced brands following tax and price increases. As a consequence, most cigarette smokers are not incentivised to quit smoking.[14,31–33]

However, when exclusive cigarette users do transition, we found that they are more likely to take up SLT than bidis and become cigarette-SLT dual users, despite both cigarettes and bidis being smoked products. One possible explanation is that because cigarettes have much higher social status than bidis, cigarette users may be actively rejecting bidis. Another explanation may have to do with how smokers perceive SLT with respect to its function. We note that when exclusive cigarette users took up SLT, they were about ten times more likely to use SLT in conjunction with cigarettes than to switch completely to SLT. A similar pattern was found with exclusive bidi users who took up SLT. This suggests that SLT may be seen by smokers as an additional source of nicotine rather than as a replacement. SLT is also more widely accepted in Bangladeshi society, which might make such transitions easier.

Furthermore, we found that some exclusive cigarette users transitioned to either dual or poly use of cigarettes and SLT, or exclusive SLT use before eventually quitting. This might suggest that for some cigarette users, dual use with SLT might be a step towards smoking cessation with a product that is perceived as less harmful,[25,34] although it could also lead to long-term use of both products, which may reflect greater nicotine dependence. Previous studies found that more dual users of smoked tobacco and SLT intend to quit smoking than exclusive smokers[35,36] suggesting that dual use may be part of the users' cessation activity.

Among exclusive bidi users, transition patterns were more dynamic over time as exclusive bidi use was less persistent. The majority of people either switched to

	OR (95% CI)				
	Transition to any cig use	Transition to any bidis use	Quitting	Any transitions[a]	Transition to dual or poly use
N of transitions in Wave 2	6	4	171	10	30
N of transitions in Wave 3	7	4	181	11	29
N of transitions in Wave 4	10	4	182	13	26
Sex					
Male	1	1	1	1	1
Female	0.03 (0.01–0.18)***	0.08 (0.01–0.62)*	0.84 (0.47–1.5)	0.06 (0.01–0.32)**	0.05 (0.01–0.71)*
Age Group					
55+	1	1	1	1	1
40–54	0.61 (0.16–2.33)	—	1.55 (0.99–2.35)	1.35 (0.11–17.21)	1.74 (0.1–10.69)
25–39	0.77 (1.63–2.33)	0.71 (0.05–11.08)	1.42 (0.79–2.55)	1.6 (0.06–3.38)	1.21 (0.05–12.13)
15–24	1.96 (0.33–11.4)	—	2.94 (1.23–6.9)*	6.82 (2.58–12.49)*	4.67 (0.2–16.62)
Education					
Illiterate	1	1	1	1	1
Less educated	0.92 (0.25–3.37)	0.04 (0.01–1.32)	0.9 (0.6–1.38)	0.67 (0.12–3.71)	0.57 (0.09–3.82)
More educated	0.46 (0.06–3.34)	0.14 (0.01–3.15)	1.55 (1.77–3.12)**	1.29 (0.81–7.54)	—
Marital status					
Married	1	1	1	1	1
Single/live alone	0.85 (0.22–3.37)	0.26 (0.02–3.17)	1.11 (0.7–1.77)	1.21 (0.34–4.29)	2.01 (0.66–6.55)
Residence					
Urban	1	1	1	1	1
Rural	2.74 (0.43–17.67)	—	0.52 (0.3–0.86)*	8.9 (1.91–13.41)**	—
Housing index					
Low	1	1	1	1	1
Moderate	0.31 (0.03–2.85)	4.09 (0.98–16.71)	0.91 (0.49–1.7)	0.56 (0.05–6.78)	0.16 (0.01–4.4)
High	2.28 (0.46–11.36)	0.86 (0.01–11.55)	1.18 (0.62–2.26)	6.24 (1.05–8.36)*	1.84 (0.2–6.49)
Wave					
2	1	1	1	1	1
3	—	—	1.13 (0.75–1.7)	3.43 (0.24–12.47)	0.67 (0.13–3.36)
4	1.93 (1.11–3.46)*	1.54 (0.38–6.81)	1.12 (0.72–1.74)	3.12 (1.19–12.49)*	1.52 (0.21–11.18)

[a]Any transitions except for transition to quitting. Longitudinal survey weights are applied to all estimates; 95% CI are reported to indicate of the degree of uncertainty. * p < 0.05, ** p < 0.01, *** p < 0.001, —no data points.

Table 4: **Associations between sociodemographic factors and transitional patterns of exclusive SLT users at W1 (N = 350) to W4, adjusted for longitudinal weights.**

exclusive cigarette use or became dual users with SLT. However, exclusive bidi users were much more likely to transition to exclusive cigarette use than the opposite. This pattern is consistent with the fact that cigarettes are seen as aspirational products with higher status than the relatively inexpensive bidis in the Southeast Asia region.[28] In 2022, the minimum price for 10 sticks of low-tier cigarettes is 39 Bangladeshi Taka (~$0.40 US), and the minimum price of 12-stick hand-rolled bidis is 9 Taka (~$0.09 US).[32] These findings may also reflect that the disposable income of Bangladeshi smokers has been increasing, making it possible for them to afford the more expensive cigarettes.[14]

Exclusive SLT users showed very different patterns of use compared to exclusive cigarette and exclusive bidi users. Fewer than 3% of exclusive SLT users transitioned to other products. Instead, the most substantial transitions of exclusive SLT users were to quit all tobacco products, with about 50% of SLT users not using any product at all, and with about ¼ of SLT users who had quit relapsing back to SLT use by the following wave. The lack of transitions from SLT to other tobacco products suggests that SLT constitute a separate market, distinct from cigarettes and bidis. This may also be related to the fact that in Bangladesh as well as in neighbouring Southeast Asian countries, the use of SLT is incorporated in traditional values, beliefs, festivals, lifestyle, and rituals such as marriage and cultural celebrations.[37]

Our longitudinal modelling found associations between transitions and various sociodemographic characteristics. The tobacco industry's targeted advertising to appeal to younger smokers in Southeast Asian countries may explain why younger males were more interested in cigarettes and experimenting with such products.[38,39] Younger SLT users were more likely to switch between products and quit than older users, which is not unexpected as young age is when people experiment

with various products. Certain socio-cultural norms in Southeast Asian countries may also influence smoking habits.[36] For example, unmarried men were more likely to use cigarettes than married men, who have family and dependents.[26]

We found that transition patterns differed between urban and rural areas. Cigarette smokers in rural areas were more likely to transition to bidi use, whereas rural exclusive bidi users were less likely to switch to cigarettes, which reflects the greater prevalence of bidis in rural areas.[12,40] Similar associations were seen among rural users transitioning to SLT, although some associations were not statistically significant due to small sample size. Together, the results indicate that bidis and SLT are popular in rural areas, potentially due to their lower price and the greater social acceptability for these products in rural areas, as well as among women and young people.[6] Our findings reinforce recent evidence that social and environmental factors play an important role in influencing tobacco users' behaviours and product use transitions within the context of Bangladesh[4] and Southeast Asian countries.[41] Furthermore, our findings confirm existing evidence that suggests both person-level and contextual factors (i.e., price and affordability, etc.) influence users' behavioural changes related to tobacco product substitution.[13,23]

Although this was the first analysis of its kind in a representative sample of Bangladeshi tobacco users spanning a seven-year period, the findings of our study are subject to some limitations. Since not all waves of surveys employed the same definition of current SLT use, caution is warranted when interpreting the results. Small sample sizes for exclusive bidi and SLT users limited the precision of our estimates. For similar reasons, we did not control for regional variations, but instead included residential area (i.e., urban/rural) as potential correlate to account for the effect of residential environment on transitions between products over time. Use of tobacco products was self-reported, hence may not have been accurate; additionally, our analysis did not consider frequency and intensity of use. As the availability of frequency data for each tobacco product varied widely across the waves, we were not able to incorporate frequency data in our analysis. Because smoking has much lower prevalence among females, most regression models involving smoked products included only male respondents, which limits the generalisability of our findings. Furthermore, given the nature of the data and the rather limited sample sizes of each subpopulation of the analyses, we studied only the transitions in tobacco product use as a time-varying factor in the current study. The transition analysis of different products, taking into account variation in tobacco price, change in SES, and other potential time-varying factors, could be a follow-up study to investigate how change in price and SES would interact with users' behaviours and transitional patterns. Nevertheless, this study will provide a greater understanding of the interaction between different tobacco products used in Southeast Asian countries based on the transition patterns observed among Bangladeshis. In the broader context, it will offer insight into producer strategies, product perceptions, and policies affecting the use of different products in neighbouring countries such as India, and Sri Lanka with similar tobacco user profiles.

In this study, we identified product-specific trajectories and attributes related to complex transitional patterns among different types of tobacco product users over time in Bangladesh, a country of high prevalence of smoked tobacco and SLT use in the Southeast Asia region. The patterns of transition were not incidental: some product consumers were more inclined to switch than others e.g., cigarette users being much more likely to transition to SLT than bidis, while SLT users were much less likely to transition at all.

These transition patterns shed light on the interplaying nature of the markets for all three products. The use of multiple tobacco products and transition patterns observed in this study suggest the ability of Bangladeshi tobacco users to choose from an array of options to maintain their nicotine dependence rather than quit. Although we were not able to assess how perceptions of harm and social status, as well as tobacco control policies may influence these behaviours, our findings provide a starting point for a deeper analysis of the dynamic between these tobacco products in Bangladesh. Future research can explore these additional elements and include more products that are relevant to local markets, including e-cigarettes, heated tobacco, and other emerging nicotine products.[42] Understanding transitions and trajectories of tobacco users can lead to better-targeted, and hence more effective tobacco control strategies to limit tobacco use in the Southeast Asia region.

Contributors

DTHC and FTF conceived of the study idea and study methodology, DTHC designed and conducted the analyses. DTHC wrote the first draft, and FTF contributed to the development of the final version of the manuscript. All authors contributed to review and editing of the manuscript, provided comments and accepted the final version. All the authors were involved in the interpretation of data and revision for critical intellectual input.

Data sharing statement

In each country participating in the International Tobacco Control Policy Evaluation (ITC) Project, the data are jointly owned by the lead researcher(s) in that country and the ITC Project at the University of Waterloo. Data from the ITC Project are available to approved researchers 2 years after the date of issuance of cleaned data sets by the ITC Data Management Centre. Researchers interested in using ITC data are required to apply for approval by submitting an International Tobacco Control Data Repository (ITCDR) request application and subsequently to sign an ITCDR Data Usage Agreement. The criteria for data usage approval and the contents of the Data Usage Agreement are described online (http://www.itcproject.org). The authors of this paper obtained the data following this application process. They did not have any special access privileges. Others would be able to access these data in the same manner as the authors.

Declaration of interests

GTF has served as an expert witness or a consultant for governments defending their country's policies or regulations in litigation. All other authors have no conflicts of interest to declare. The authors alone are responsible for the views expressed in this article and they do not necessarily represent the views, decisions or policies of the institutions with which they are affiliated. No WHO fund is involved in developing this manuscript.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lansea.2023.100185.

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