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Estimating the extent of illicit cigarette sales in Ghana: findings from a cross sectional survey

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1 1 **Estimating the extent of illicit cigarette sales in Ghana: findings from a cross** 2 2 **sectional survey**

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27 Keywords: Illicit, cigarette, Ghana, packs, survey, tobacco

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40 ABSTRACT

41
42 Objective This study aims to measure the size of Ghana’s illicit cigarette market, to
43 determine the nature and types of illicit cigarettes present in Ghana, and to identify the
44 factors associated with illicit cigarettes sales in Ghana.

45 Design A Cross-sectional study using empty cigarette packs generated by 1 day’s
46 single-cigarette sales collected from cigarette vendors.

47 Setting Five large cities (Accra, Kumasi, Takoradi, Tamale, and Bolgatanga) and three
48 border towns (Aflao, Paga, and Elubo) in the northern, middle and coastal belt of
49 Ghana

50 Procedure and Participants Ten areas were randomly selected in each city/town, and
51 all shops selling cigarettes within 1 km of the central point were surveyed.

52 Outcome measures (1) estimates of the share of illicit packs in the total cigarette sales
53 in Ghana using an empty pack survey method; (2) nature and types of illicit cigarette
54 packs; and (3) factors associated with illicit cigarette sales in Ghana.

55 Results

56 Of a total of 4461 packs, 19.5% were found to be illicit. Aflao (Ghana-Togo border)
57 and Tamale (cigarettes coming from Burkina Faso) had the highest percentage of illicit
58 cigarette sales at 98.6% and 45.8% respectively ($p<0.001$). Over half of the illicit packs
59 originated from Togo (51%), followed by Nigeria (14.8%) and then Cote d’Ivoire
60 (10.3%). Adjusted and unadjusted logistic regression models indicated that
61 convenience stores, border towns, and the northern zone had higher odds of illicit
62 cigarette sales.

63 Conclusion To effectively tackle illicit cigarettes, market surveillance and
64 strengthening supply chain control are required, particularly at the border towns and the
65 northern region of the country.

66 INTRODUCTION

67
68 Illicit tobacco trade continues to remain a threat to global tobacco control efforts. While
69 tobacco consumption is decreasing globally, the African Region is anticipated to
70 experience the world's largest ever increase in a region's number of smokers by 2030
71 (1) - a projection largely attributed to the rapid population growth, increased
72 advertising by the tobacco industry, and growing tobacco consumption among young
73 people in Africa. Further, the availability and accessibility of cheap, illicit tobacco
74 products is particularly attractive to the region's most vulnerable young population and
75 low-income smokers (2).

76 Illicit trade of tobacco products is a major public health problem as lower prices of
77 illicit cigarettes lead to increased cigarette consumption (3). Extent of illicit tobacco in
78 the market is difficult to measure, and was estimated to be 11.6% worldwide in 2007
79 and almost 10% in 2015 (3), and these figures are higher for low and middle income
80 countries (LMICs) including those in the African Region. In response to the threat
81 posed by illicit tobacco trade, the WHO FCTC Protocol to Eliminate Illicit Trade in
82 Tobacco Products (hereby referred to as "the Protocol") entered into force in 2018 (4).
83 This Protocol gives countries an opportunity to prevent tobacco-related morbidity and
84 mortality by enhancing tobacco supply chain control. Countries that ratify the Protocol
85 commit themselves to adopting a variety of measures, including track and trace systems
86 to prevent and counter illicit trade.

87 Ghana, one of the first countries to ratify the World Health Organization's (WHO)
88 Framework Convention on Tobacco Control (FCTC) in 2004, has made some
89 significant progress in tobacco control such as introducing an early advertising ban
90 (1982), the passage of the Tobacco Control Act (in 2012), banning of singlestick sales
91 (2017), introduction of mandatory graphic health warnings (2018) and tax stamps on

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92 tobacco products (2018) and more recently the ratification of the Protocol in October
93 2021 (5). Despite this progress, cigarettes continue to remain cheap and affordable in
94 Ghana (1). The total excise tax on tobacco products in Ghana accounts for only 31.8%
95 of the average retail price, far below the 70% benchmark set by the World Health
96 Organization (WHO) (1). Although, Ghana does not have an active tobacco industry
97 (British American Tobacco (BAT) ceased its local production in 2006), BAT continues
98 to dominate sales of cigarettes and remains the dominant importer of cigarettes into the
99 country via its manufacturing sites in Ibadan and Zaria in Nigeria (5). The distribution
100 networks of Ghana's leading tobacco companies are well organised in Ghana's major
101 urban cities including Greater Accra, Takoradi, Kumasi, and Tamale. The point of sale
102 of tobacco products including cigarettes in Ghana is mainly via the traditional grocery
103 retailers (also known as convenience or provision stores), street vendors, kiosks and
104 drinking bars most of which may be unregulated and without a license to operate (6).
105 An important challenge that exists in many African countries, including Ghana, is that
106 most governments do not measure the size of illicit tobacco market nor analyze its
107 features on a regular basis. To fully benefit from the Protocol, policymakers and
108 implementers seek to connect its normative guidance with empirical data and analysis
109 on countries' illicit tobacco trade. This means that they are not able to monitor and
110 adapt measures to control illicit trade (9). In light of the tobacco industry's use of illicit
111 trade to oppose tobacco control such as including tax increases (7), it is important to
112 understand the scope and nature of the illicit tobacco trade. To date, there have no
113 scientific studies to estimate the size of the illicit cigarette market in Ghana (1). The
114 only available estimates are those produced by the Euromonitor that reports an illicit
115 cigarette market accounting for 39% of total cigarette sales in 2018 (up from 35% in
116 2017) (10). Estimates by Euromonitor have been criticized for being unreliable and

117 inconsistent, and for lacking independence due to Euromonitor entering into business
118 contracts with Philip Morris International (PMI) (5,11). The objectives of this study
119 were to measure the size of Ghana's illicit cigarette market using an empty pack survey
120 method to determine the nature and types of illicit cigarettes present in Ghana, and to
121 identify the factors associated with illicit cigarettes sales in Ghana.

122 **METHODS**

123 **Study sites**

124 A cross sectional study was conducted during the months of August 2020 to January
125 2021 in four major cities in Ghana (Accra, Tamale, Kumasi, Takoradi and Bolgatanga)
126 and four border towns (Aflao, Paga and Elubu) across the three zones of Ghana
127 (Northern, Middle and Coastal) (Figure 1). These districts were selected to represent
128 socioeconomic, cultural and geographical diversity.

129 Insert figure 1

130 **Research design**

131 A modified approach based on the analysis of empty cigarette packs collected directly
132 from retailers was used. This method was adapted from similar studies in India (8) and
133 Bangladesh (9) and is particularly useful in countries where single stick sales are a
134 common practice. Within each large city or border town, up to 10 smaller geographical
135 areas were selected using Ghana Post Codes. A central point (such as a government
136 building, market place or taxi station) was determined in each of them for retailer pack
137 collection. A team of four research assistants and a coordinator walked 1 km along both
138 sides of a busy street (0.5 km forward and 0.5 km back) starting from the central point
139 to identify tobacco retailers. All retailers identified were provided with verbal and
140 written information about the study and requested to sign a consent form if they agreed
141 to participate. Following consent being obtained, an empty bag with a unique identifier
142 was given to retailers and they were asked to deposit all cigarette packs emptied

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143 throughout the day as a result of single sticks of cigarette sales in the bag provided. The
144 bags were collected back from the retailers at the end of a 24-hour period and retailers
145 were given a small monetary reward (up to USD 10) commensurate with the number of
146 packs provided. Consenting retailers also participated in a 20-25 minutes survey on
147 illicit cigarette sales, common brands, and pricing of cigarettes sold each day. The
148 sample size equation to obtain the minimum number of packs collected from each
149 selected city/town was adapted from a toolkit for measuring illicit tobacco in LMICs
150 (10). We obtained a minimum sample size of 2600 packs to estimate a size of 25%
151 illicit cigarette sales with a 95% level of confidence.

152 **Classification of packs**

153 Empty cigarette packs were cleaned and assigned unique IDs, and were analysed and
154 their characteristics recorded. Pack data included the brand name, country of origin, the
155 presence of graphical and/or textual health warnings, the language of the warning, the
156 pack size (10/20 stick pack), and compliance of these warning messages with existing
157 packaging requirement for Ghana. A conservative definition to classify an illicit
158 cigarette pack (packs on which appropriate duties have not been paid) in Ghana
159 according the Food and Drugs Authority (11), includes at least one of the following
160 attributes:

- 161 (a) Absence of authentic tax stamps;
 - 162 (b) Absence of textual and pictorial warnings;
 - 163 (c) Absence of the inscription “*FOR SALE IN GHANA ONLY*” displayed on the side
164 panel of the product pack and
 - 165 (d) Health warnings not in English
- 166 Trained research assistants evaluated tax stamp authenticity using the tax stamp mobile
167 application developed by the Ghana Revenue Service (12).

168 Analysis

169 Data were first entered into excel, cleaned and analyzed via R studio version 1.4.1717.
170 The unit of analysis was each cigarette pack. Continuous variables such as price/pack
171 were changed to categorical (low and high price category) for 2-7 GHC and 8-14 GHC
172 respectively for purposes of analysis (1USD=6GHC). Descriptive information was
173 reported as frequencies and percentages for city, country zone (northern, middle and
174 coastal zones), retail shop type (drinking bars, convenience stores and kiosks), border
175 and non-border towns, country of origin and illicit and licit cigarette. Pack
176 characteristics such as pictorial health warning (absent/present), textual health warning
177 (absent/present), warning labels in English (absent/present), tax stamps (absent/present)
178 and “for sale in Ghana” sign (absent/present) were captured. The relationship between
179 illicit tobacco and the categorical variables (city type, country zone, type of shops,
180 border and non-border town, price/packs, cigarette brand and country of origin) were
181 first studied using χ^2 or Fisher’s exact test (when the number in the table was <6). Due
182 to the binary nature of the outcome variable (licit/illicit), simple and multiple logistic
183 regression was performed to evaluate the unadjusted and adjusted predictive values of
184 the potential confounding variables respectively based on existing literature (13,14).
185 The results are presented as odds ratios (OR) with a 95% confidence interval, with
186 significance set at an alpha level of 5% ($p \leq 0.05$).

187 Patient and public Involvement

188 No patient involved

189 RESULTS

190 A total of 425 retailers were approached for the study, of whom 384 (90%) consented
191 to collect packs and participate in the survey. An average of 12 cigarette packs were
192 collected by in a 24-hour period. A total of 4461 packs were collected from 384
193 retailers in the selected cities and towns. All retailers (100%) in the study sold single

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194 sticks (100%). A total of 871 out of 4461 (19.5%) packs were classified as illicit based
195 on the criteria for classification approved by the FDA. Over half of the packs (58.6%)
196 were collected from drinking bars of which 18.2% were illicit (Table 1). A third
197 (30.6%) of the packs collected from the northern zone of Ghana were illicit and almost
198 seven out of 10 (68.5%) packs from the border towns were illicit. Almost all the packs
199 collected from Aflao (Ghana-Togo border) were illicit (98.6%), followed by Tamale
200 (45.8%) and the Paga/Hamele (Ghana-Burkina Faso border) (26.6%) and Elubu
201 (21.1%) (Ghana - Cote d'Ivoire border). In terms of the retail selling points, three out
202 of 10 (29%) packs collected from convenience stores were illicit, followed by drinking
203 bars (18.2%) ($p<0.001$). Over 60% of the packs collected within the price category of
204 2-7 GHC were illicit. The most common brand of cigarettes sold in Ghana is Rothmans
205 Kingsize, London Brown/White and Pallmall (Figure 2).

206 Insert Figure 2

207 Of all the 871 illicit packs, the most common brands were Business Royal (24.1%),
208 followed by Fine (20.8%) and Oris (12.3%). All packs from 555 and London
209 Brown/White (manufactured by BAT) were licit (100%) (Table 1).

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221 Table 1: **Determinants of illicit cigarette sale in Ghana**

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	Illicit cigarette packs (n=871)	Licit cigarettes packs (n=3590)	Total
<i>Country Zone</i>			
Northern	368 (30.6)	835 (69.4)	1203 (100)
Middle	8 (1.2)	656 (98.8)	664 (100)
Coastal (south)	495 (19.1)	2099 (80.9)	2594 (100)
<i>P-value*</i>	0.000		
<i>Border/non-border</i>			
Border	493 (68.5)	227 (31.5)	720 (100)
Non-border	378 (10.1)	3363 (89.1)	3741 (100)
<i>P-value*</i>	0.000		
<i>City/town (border/non border)</i>			
Accra (non border)	17 (1.5)	1147 (98.5)	1164 (100)
Kumasi (non border)	8 (1.2)	651 (98.8)	659 (100)
Takoradi (non border)	1 (0.1)	767 (99.9)	768 (100)
Bolgatanga (non border)	7 (1.8)	390 (98.2)	397 (100)
Tamale (non border)	345 (45.8)	408 (54.2)	753 (100)
Elubu (Cote d'ivoire border)	44 (21.1)	165 (78.9)	209 (100)
Paga/Hamele (Burkina Faso border)	16 (26.6)	42 (72.4)	58 (100)
Aflao (Togo border)	433 (98.6)	20 (1.4)	453 (100)
<i>P-value*</i>	0.000		
<i>Shop type</i>			
Drinking bar	477 (18.2)	2139 (81.8)	2616 (100)
Kiosks	31 (5.2)	563 (94.8)	594 (100)
Convenience stores	363 (29.0)	888 (71.0)	1251 (100)
<i>P-value*</i>	0.000		
<i>Price/pack (GHC)</i>			
Low price (2-7)	778 (61.2)	494 (38.8)	1272 (100)
High price (8-14)	93 (2.9)	3096 (97.1)	3189 (100)
<i>P-value*</i>	0.000		
<i>Cigarette brand (manufacturer)</i>			
555 (BAT)	0 (0)	190 (100)	190(100)
London Brown/White (BAT)	0 (0)	928 (100)	928 (100)
Pallmall (BAT)	70 (14.2)	433 (85.8)	494 (100)
Business Royal (Independent Tobacco Inc)	210 (70.0)	90 (30.0)	300 (100)
Fine (unknown)	181 (78.3)	50 (21.6)	231 (100)
Rothmans Kingsize (BAT)	29 (1.6)	1798 (98.4)	1827 (100)
Oris (Oriental General Trading Inc)	107 (81.1)	35 (18.9)	132 (100)
Rothmans Royals (BAT)	99 (86.1)	20 (13.9)	115 (100)
Gold Seal (China Tobacco)	85 (91.4)	8 (8.6)	93 (100)
Tusker (BAT)	29 (100)	0 (0)	29 (100)
Others (Fisher, menthol, Cherry etc.)	61(50.0)	61 (50.0)	122 (100)
<i>P-value*</i>	0.000		

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*P-value based on χ^2 or Fisher's exact test

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224 Majority of the illicit packs were characterized by absence of tax stamps (94.3%), ‘for
225 sale in Ghana’ sign (92.2%) and warning labels in English (77.3%).

226 Almost all the packs collected were the 20-stick pack (98.2%). The average
227 price/pack of the 20-stick packs was 8.5 GHC and that for 10-stick was 3.3 GHC.

228 Illicit packs had an average price/pack of 5.4 GHC (SD 1.5, range 2-12 GHC) whilst
229 licit pack was 9.1 GHC (SD 2.1, range 2-14 GHC). Close to half of the illicit packs
230 originated from Togo (51%), followed by Nigeria (14.8%) and then Cote d’Ivoire
231 (10.3 %). About 1.5% of packs that were destined for Ghana were classified as illicit
232 as the packs did not conform to the current labeling requirements as approved by
233 FDA.

234 Table 2 shows the results from adjusted and unadjusted logistic regression of the
235 factors associated with illicit cigarette sales in Ghana. The odds of illicit cigarette
236 sales were 1.8 folds and 2.68 folds higher in convenience stores as compared to
237 drinking bars in the unadjusted and adjusted models respectively (Table 2). Also, the
238 sale of illicit cigarettes was 19.32 and 69.69 odds higher in border towns as compared
239 to non-border towns in both the adjusted and unadjusted models respectively. The
240 middle and coastal country zones had lower odds of illicit cigarettes sales than the
241 northern zones in both the unadjusted and adjusted regression models respectively.

242 Table 2: Unadjusted and unadjusted factors for illicit cigarette sales in Ghana

Variable	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
Retail shop type				
<i>Drinking bars</i>	1		1	
<i>Kiosks</i>	0.25	0.17 - 0.35	0.26	0.15-0.45
<i>Convenience stores</i>	1.83	1.57-2.15	2.68	1.78-4.05

Country Zone				
<i>Northern</i>	1		1	
<i>Middle</i>	0.03	0.01-0.05	0.06	0.03 -0.12
<i>Coastal</i>	0.54	0.46-0.63	0.17	0.11-0.25
Border/non border towns				
<i>Non-border town</i>	1		1	
<i>Border town</i>	19.32	16.0-23.4	69.69	51.45-96.05

DISCUSSION

This study found out that 19.5% of the packs collected were illicit of the total 4461 packs. Majority of the illicit packs were reported from Aflao (Ghana-Togo border) (98.6%) and Tamale (northern zone with cigarettes coming from Burkina Faso) (45.8%). Close to half of the illicit packs originated from Togo (51%), followed by Nigeria (14.8%) and then Cote d'Ivoire (10.3 %). The most common brand of cigarettes sold in Ghana was from BAT including Rothmans Kingsize, London Brown/White and Pallmall. One out four of the illicit packs belonged to Business Royal (Independent Tobacco Company), a fifth were from Fine (unknown company) and about one out of ten were from Oris brand (Oriental Genral Trading). Absence of tax stamps, 'for sale in Ghana' sign and warning labels in English were among the most common characteristic of the illicit packs. Adjusted and unadjusted logistic regression models indicated that convenience stores, border towns and northern zone of the country had higher odds of sale of illicit cigarettes in Ghana.

Our study provides an objective measure and describes the nature of the illicit cigarette market. This plays a critical role in developing comprehensive and effective tobacco control policies, particularly in countries within SSA such as Ghana, where

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261 data on illicit cigarettes sales is lacking. The direct interaction with retailers also
262 allowed us to obtain additional information about the price, the daily retail volume
263 and pack characteristics of the cheapest cigarette brand sold in the store by each
264 vendor. Our illicit cigarette estimate (19.5%), is lower than the estimates of the
265 Euromonitor (37% in 2018) (15). This is not surprising based on the lack of
266 transparency in the Euromonitor data and their funding from the tobacco industry (TI)
267 (15). The TI is known for quoting high estimates of the illicit market as a means of
268 deterring governments from imposing tobacco tax increases, which contributes to
269 ineffective tobacco control and lost opportunities for the governments to collect more
270 revenue.

271 There are various methods to assess the extent of illicit tobacco in any country, such
272 as measuring the difference between consumption and tax paid sales (gap analysis),
273 interviewing smokers, examination of littered cigarette packs and econometric
274 modeling (16). We employed the empty pack methodology, which is particularly
275 suitable in countries with single stick sales, such as in India (8), Pakistan (17),
276 Bangladesh (9) and Argentina (18). Indeed, in our study, despite a ban on single stick
277 sales, all retailers (100%) sold single sticks, calling for enforcement of the ban. Our
278 estimates of illicit cigarette sales are similar to countries with a higher tobacco use
279 prevalence such as Pakistan (17.8%) and Argentina (13.7%) that used a similar
280 methodology (17,18). Despite the lack of estimates of illicit cigarettes from many
281 countries in the African Region, countries such as South Africa, Kenya, Gambia and
282 Nigeria have available estimates of their illicit market. Our estimates were found to be
283 lower than South Africa (over 30% of the total market in 2017) (19), Nigeria (26.3%)
284 (20) and Kenya (26%) (21) but higher than the Gambia (8.6%) (22). With the
285 ratification of the Protocol in Ghana, and estimates suggesting 1 out 5 cigarette packs

286 to be illicit, there is an urgent need for governments to address this by fully
287 implementing the recently ratified protocol (which has specific requirements to
288 improve traceability of tobacco products and increase tobacco industry
289 accountability).

290 British American Tobacco (BAT) continues to dominate sales of cigarettes as
291 evidenced by the most common cigarettes sold in Ghana (Rothmans Kingsize,
292 London Brown/White and PallMall). This is largely due to the company's long
293 history in Ghana. While the company ceased domestic production in 2006, it remains
294 the dominant importer of cigarettes into the country. There are also very low-priced
295 brands available, such as BAT's Tusker brand (of which all packs were illicit). While,
296 all packs from London Brown/White were found to be licit, about 14% of PallMall
297 and 1.6% of Rothmans Kingsize were illicit, demonstrating the industry's
298 involvement in illicit trade. Further, the small-scale convenience stores were found to
299 be a major selling point of illicit cigarettes. These are legally operating, widely
300 available settings to the low-income Ghanaian smoker (who prefers to buy single
301 stick) widely available in both rural and urban locations. Convenience stores were
302 also found to have higher odds of illicit cigarette sales as compared to drinking bars in
303 both the adjusted and unadjusted logistic regression models, indicating that it is a
304 significant predictor of illicit cigarette sales in the country.

305 Geography was found to play an important role in the illicit cigarette market in
306 Ghana. A third of the packs collected from the northern zone of the country were
307 found to be illicit. According to the Euromonitor, the north of Ghana sees particularly
308 strong illicit trade, with most smuggling from Burkina Faso finding their way to this
309 region (15). This could also be strongly linked to the high smoking prevalence in the
310 region as compared to other regions (23). Similarly, border towns were also found to

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311 be strong predictors of illicit cigarette sales. Six out of 10 packs collected from border
312 towns were illicit and almost 100% of the packs collected from Aflao (Ghana-Togo
313 border), and close to half of the packs from Tamale (large city in Northern Ghana
314 linked to Burkina Faso) were found to be illicit. This finding is consistent with other
315 studies in Vietnam (24) and Georgia (25) where border towns were more vulnerable
316 to illicit trade. This finding reinforces the need for strengthening patrolling and border
317 control in addition to building capacity and training for authorities belonging to
318 customs, police and immigration. The illicit cigarettes originated from Togo (51%),
319 followed by Nigeria (14.8%) and then Cote d'Ivoire (10.3 %). Nigerian products are
320 mostly smuggled in via Togo and most products smuggled in from Togo originate
321 from BAT's Nigerian operations, with lower taxes in Nigeria enabling these to be
322 sold at a lower price in Ghana. As observed in our study, the health warnings on
323 cigarette packages are also in French, indicating a French-speaking West African
324 source country.

325 In terms of pricing of cigarettes, illicit packs were found to be almost 50% cheaper
326 than licit packs. Africa in general, lags behind other regions (such as European and
327 the Americas) in implementing strong tobacco tax policies (1). Close to 90% of the
328 illicit packs were found in the low price category (2-7 GHC). In Ghana, the total
329 excise tax on tobacco products accounts for only 31.8% of the average retail price, far
330 below the 70% benchmark set by the WHO with no significant change in the
331 affordability of cigarettes since 2010 (1). Over half of the smuggled cigarettes in the
332 study originated from Togo (where cigarette are less affordable as compared to
333 Ghana). Around Ghana's neighboring countries, the total excise tax on tobacco
334 products account for 41.4%, 35.1% and 34.5% of the average retail price in Togo,
335 Nigeria and Cote d'Ivoire respectively. Although, the TI argues that smuggling is

336 heavily influenced by cross-border price differences, and higher taxation increases its
337 profitability, this is highly debatable (26). Available data shows that price levels do
338 not predict levels of illicit trade and the relationship between taxation and smuggling
339 is more complex than it appears (27). An important point to consider is that, regional
340 cooperation and coordination of tobacco tax and price levels remains a powerful
341 strategy to consider in order to weaken the link between tobacco tax increases and
342 illicit trade. Limiting tax discrepancies between neighboring countries can reduce
343 arbitrage opportunities for smugglers at borders. Thus, it is important to intensify
344 implementation efforts for such coordinated measures, for example within the
345 Economic Community of West African States (ECOWAS) region to harmonize tax
346 options (28).

347 Our study findings should be considered in the light of some limitations. First, despite
348 the wide geographical dispersion in the three zones of the country (northern, middle
349 and coastal), the representativeness to the country is limited. Also, as data was
350 collected during COVID-19 lockdown period in Ghana and we could not explore
351 other border towns that were planned due to pertaining restrictions. Secondly, the
352 empty pack collection relies on retailers to provide us with all the empty packs sold
353 that day. It could be possible that retailers would want to hide the illegal packs, which
354 could underestimate our findings. Nevertheless, retailers were motivated with a
355 monetary reward commensurate with the number of packs collected, which, to an
356 extent, mitigated this issue. Third, our survey was able to collect empty cigarette
357 packs from retailers mainly from drinking bars, kiosks and convenience stores. Thus
358 street hawkers and dealers, if any, who are on the move and sell cigarettes are not
359 covered by the survey.

360 CONCLUSION

Our study found a total of 19.5% illicit packs in the entire sample of packs collected across the eight cities in Ghana. Our estimate of the illicit cigarette market share is below with the estimates provided by the Euromonitor. This study provides valuable information for policymakers and law enforcement in the region and bringing to light the inadequacy of the current monitoring and regulatory activities of the FDA and customs. Our findings have three important policy implications; first, the regulatory body and the focal point for tobacco control in Ghana (FDA) in collaboration with the customs, police and immigration, should strengthen the supply chain control and market surveillance at retail points in the towns and cities, particularly those close to the border in the northern and coastal zones of the country, aside from border monitoring and transportation tracing. Secondly, among the ECOWAS member states, there is a need to harmonise excise and taxation levels on tobacco across West Africa. This could reduce the problem of smuggled goods, as the competitive price advantage for some ECOWAS member states would be removed. Finally, with the introduction of Tax Stamp Policy since March 2018, Ghana should also consider the implementation of a supply chain control that resembles a track and trace system (like Kenya), independent of any industry influence to effectively monitor the illicit market.

What this paper adds

- There is an absence of an independent and scientifically verifiable estimate of illicit cigarette sales in Ghana.
- The study provides estimates of the share of illicit packs in the total cigarettes sales in Ghana.
- One out of five cigarette packs sold in Ghana is illicit, using a rigorous empty pack survey methodology in eight cities/towns including border towns.

- We highlight the urgent action needed in Ghana to strengthen supply chain control and border control to effectively combat illicit trade.

380

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384 **CONTRIBUTORS**

385 AS drafted the initial version of the manuscript. HR, FD, TK and AG contributed to
386 the revision of the manuscript for important intellectual content and final approval.

387 All other authors reviewed the final draft for approval.

388 **COMPETING INTEREST**

389 None declared

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395 **Ethics Approval**

396 The study protocol was approved by the Committee on Human Research, Publication
397 and Ethics (Reference number: CHRPE/AP/441/18) and the University of Bath's
398 Research Ethics Approval Committee for Health (REACH) (EP 19/20 063).

399 **Data sharing statement**

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400 The data are owned and shared by the Tobacco Control Capacity Program (TCCP)
401 and the School of Public Health, KNUST, Ghana. Requests for data sharing can be
402 made to artisingh_uk@yahoo.com.

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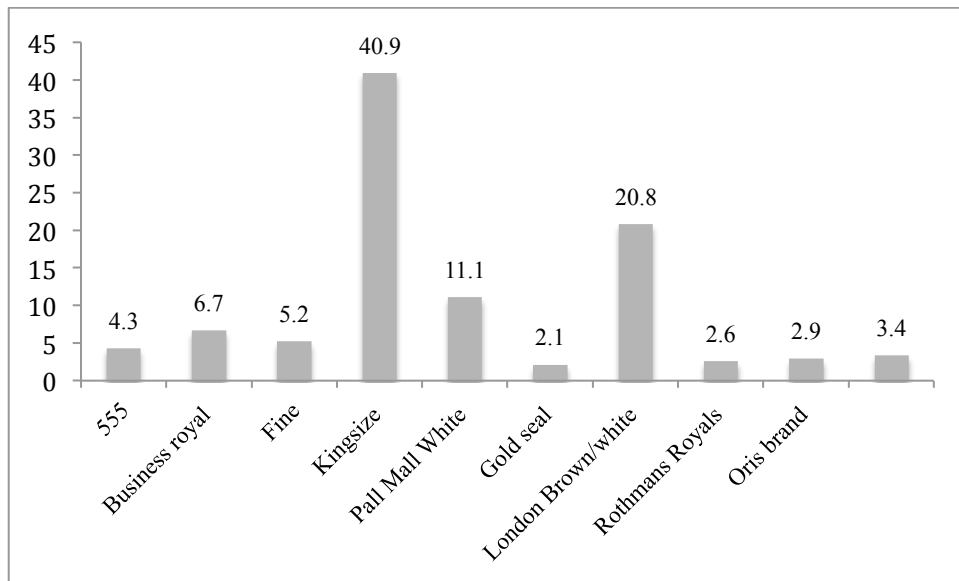
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500	CIGARETTE TAXES IN AFRICAN COUNTRIES. 2020.
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503	Legends for figures
504	Figure 1: Location of the eight cities for pack collection in Ghana
505	Figure 2: Cigarette brands sold in Ghana
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Extent of illicit cigarette market from single stick Sales in Ghana: findings from a cross-sectional survey

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Extent of illicit cigarette market from Single Stick Sales in Ghana: findings from a cross sectional survey

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Keywords: Illicit, cigarette, Ghana, packs, survey, tobacco

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40 ABSTRACT

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42 **Objective** This study aims to measure the extent of illicit cigarette consumption from
43 single stick sales, to determine the nature and types of illicit cigarettes present in
44 Ghana, and to identify the factors associated with illicit cigarettes consumption in
45 Ghana.

46 **Design** A Cross-sectional study using empty cigarette packs generated by 1 day's
47 single stick cigarette sales collected from cigarette vendors.

48 **Setting** Five large cities (Accra, Kumasi, Takoradi, Tamale, and Bolgatanga) and three
49 border towns (Aflao, Paga/Hamele and Elubo) in the northern, middle and coastal belt
50 of Ghana.

51 **Procedure and Participants** Ten areas were randomly selected in each city/town, and
52 all shops selling cigarettes within 1 km of the central point were surveyed.

53 **Outcome measures** (1) estimates of the share of illicit cigarette packs in the total
54 cigarette sales from vendors selling single stick cigarettes in Ghana; (2) nature and
55 types of illicit cigarette packs; and (3) factors associated with illicit cigarette sales in
56 Ghana.

57 **Results**

58 Of a total of 4461 packs, about 20% (95% CI: 18.34-20.66) were found to be illicit.
59 Aflao (Ghana-Togo border) and Tamale (Ghana-Burkina Faso border) had the highest
60 percentage of illicit cigarette sales at 99% and 46% respectively ($p<0.001$). Over half
61 of the illicit packs originated from Togo (51%), followed by Nigeria (15%) and then
62 Cote d'Ivoire (10%). Adjusted and unadjusted logistic regression models indicated that
63 convenience stores, border towns, pack price and the northern zone had higher odds of
64 illicit cigarette sales.

Conclusion To effectively tackle illicit cigarettes, market surveillance and strengthening supply chain control are required, particularly at the border towns and the northern region of the country.

Strengths and limitations of this study

- This study provides the first independent estimate of the share of illicit cigarette consumption in five big cities and four border towns in Ghana using a new method suitable for countries with prevalent single-cigarette sales.
- The empty pack survey required little time and resources to conduct.
- Some retailers may not provide all the packs over the last 24 hours, which could underestimate our findings.
- The study was limited to five cities and three border towns and is not representative of illicit cigarettes sales in Ghana as a whole.

INTRODUCTION

Illicit tobacco trade continues to remain a threat to global tobacco control efforts. While tobacco consumption is decreasing globally, rapid population growth, increased advertising by the tobacco industry, and growing tobacco consumption among young people in Africa may result in increased number of smokers in the region (1). Further, the availability and accessibility of cheap, illicit tobacco products is particularly attractive to the region's most vulnerable young population and low-income smokers (2).

Illicit trade of tobacco products is a major public health problem as lower prices of illicit cigarettes lead to increased cigarette consumption (3). Despite the difficulties in measuring the extent of illicit tobacco in the market, available estimates indicates that it was about 11.6% worldwide in 2007 and almost 10% in 2015 (3), and these figures are higher for low and middle income countries (LMICs) including those in the African Region. In response to the threat posed by illicit tobacco trade, the WHO FCTC

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84 Protocol to Eliminate Illicit Trade in Tobacco Products (hereby referred to as “the
85 Protocol”) entered into force in 2018 (4). This Protocol gives countries an opportunity
86 to prevent tobacco-related morbidity and mortality by enhancing tobacco supply chain
87 control. Countries that ratify the Protocol commit themselves to adopting a variety of
88 measures, including track and trace systems to prevent and counter illicit trade.

89 Ghana, one of the first countries to ratify the World Health Organization’s (WHO)
90 Framework Convention on Tobacco Control (FCTC) in 2004, has made some
91 significant progress in tobacco control such as introducing an early advertising ban
92 (1982), the passage of the Tobacco Control Act (in 2012), banning of single stick sales
93 (2017), introduction of mandatory graphic health warnings (2018) and tax stamps on
94 tobacco products (2018) and more recently the ratification of the Protocol in October
95 2021 (5). Despite this progress, cigarettes continue to remain cheap and affordable in
96 Ghana (1). For instance, the price of a pack of the most commonly sold brand of
97 cigarette in Ghana is less than one USD. Although, Ghana does not have an active
98 tobacco industry (British American Tobacco (BAT) ceased its local production in
99 2006), BAT continues to dominate sales of cigarettes and remains the dominant
100 importer of cigarettes into the country via its manufacturing sites in Ibadan and Zaria in
101 Nigeria (5). The distribution networks of Ghana’s leading tobacco companies are well
102 organised in Ghana’s major urban cities including Greater Accra, Takoradi, Kumasi,
103 and Tamale. Tobacco products including cigarettes in Ghana is mostly sold at
104 unlicensed and unregulated points of sale such as traditional grocery retailers (also
105 known as convenience or provision stores), street vendors, kiosks and drinking bars (6).
106 An important challenge that exists in many African countries, including Ghana, is that
107 most governments do not measure the size of illicit tobacco market nor analyze its
108 features on a regular basis. To fully benefit from the Protocol, policymakers seek to

connect its normative guidance with empirical data and analysis on countries' illicit tobacco trade (ref). In light of the tobacco industry's use of illicit trade to oppose tobacco control measures such as tax increases (7), it is important to understand the scope and nature of the illicit tobacco trade. To date, there have been no scientific studies to estimate the size of the illicit cigarette market in Ghana (1). The only available estimates are those produced by the Euromonitor that reports an illicit cigarette market accounting for 39% of total cigarette sales in 2018 (up from 35% in 2017) (8). Estimates by Euromonitor have been criticized for being unreliable and inconsistent, and for lacking independence due to Euromonitor entering into business contracts with Philip Morris International (PMI) (5,11). The objectives of this study were to measure the extent of the illicit cigarette market in selected border and non-border towns in Ghana using an empty pack survey method from single stick sales. The study also assessed the nature and types of illicit cigarettes present in Ghana including the factors associated with illicit cigarettes sales in Ghana.

METHODS

Study sites

A cross sectional study was conducted during the months of August 2020 to January 2021 in five major cities in Ghana (Accra, Tamale, Kumasi, Takoradi and Bolgatanga) and three border towns (Aflao, Paga/Hamele and Elubu) across the three zones of Ghana (Northern, Middle and Coastal) (Figure 1). These districts were selected to represent socioeconomic, cultural and geographical diversity.

Insert figure 1

Research design

A modified approach based on the analysis of empty cigarette packs collected directly from retailers was used. This method was adapted from similar studies in India (9) and Bangladesh (10) and is particularly useful in countries where single stick sales are a

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135 common practice. Within each large city or border town, ten smaller geographical areas
136 were selected using Ghana Post Codes. A central point (such as a government building,
137 market place or taxi station) was determined in each of them for retailer pack
138 collection. A team of four research assistants and a coordinator walked 1 km along both
139 sides of a busy street (0.5 km forward and 0.5 km back) starting from the central point
140 to identify tobacco retailers. All retailers identified were provided with verbal and
141 written information about the study and requested to sign a consent form if they agreed
142 to participate. Following consent being obtained, an empty bag with a unique identifier
143 was given to retailers and they were asked to deposit all cigarette packs emptied
144 throughout the day as a result of single sticks of cigarette sales in the bag provided. The
145 bags were collected back from the retailers at the end of a 24-hour period and retailers
146 were given a small monetary incentive (up to a maximum amount of USD 10).
147 Consenting retailers also participated in a 20-25 minutes survey on illicit cigarette
148 sales, common brands, and pricing of cigarettes sold each day. Pack prices were
149 recorded for each of the 10 and 20 stick packs. The sample size equation to obtain the
150 minimum number of packs collected from each selected city/town was adapted from a
151 toolkit for measuring illicit tobacco in LMICs (11). We obtained a minimum sample
152 size of 2600 packs, assuming prevalence of illicit cigarette sales of 25%, with 95%
153 level of confidence and margin of error of 0.15.

154 **Classification of packs**

155 Empty cigarette packs were cleaned and assigned unique IDs, and were analysed and
156 their characteristics recorded. Pack data included the brand name, country of origin, the
157 presence of graphical and/or textual health warnings, the language of the warning, the
158 pack size (10/20 stick pack), and compliance of these warning messages with existing
159 packaging requirement for Ghana. A conservative definition to classify an illicit

cigarette pack in Ghana according the Food and Drugs Authority (FDA), the regulatory body and the focal point for tobacco control in Ghana (12), includes at least one of the following attributes:

(a) Absence of authentic tax stamps;

(b) Absence of textual and pictorial warnings (Current pack warnings in Ghana are required to be a combined picture and text health warning in English to cover 50% of the front principal display area and 60% of the back principal display area of the pack, positioned in the lower portion) (13).

(c) Absence of the inscription “*FOR SALE IN GHANA ONLY*” displayed on the side panel of the product pack and

(d) Health warnings not in English

Trained research assistants evaluated tax stamp authenticity using the tax stamp mobile application developed by the Ghana Revenue Service (14).

Analysis

Data were first entered into excel, cleaned and analyzed via R studio version 1.4.1717.

There was missing information from three of the pack data and these were removed from the final analysis. The unit of analysis was each cigarette pack. Continuous

variables such as price/pack were changed to categorical (low and high price category)

for 2-7 GHC and 8-14 GHC respectively (1USD=6GHC) for measures of association

and continuous for the regression analysis. Descriptive information was reported as

frequencies and percentages for city, country zone (northern, middle and coastal

zones), retail shop type (drinking bars, convenience stores and kiosks), border and non-

border towns, country of origin (based on the inscription on the packs on sale restricted

to respective country eg. for sale in Togo only or Nigeria etc.) and illicit and licit

cigarette. Pack characteristics such as pictorial health warning (absent/present), textual

health warning (absent/present), warning labels in English (absent/present), tax stamps

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(absent/present) and “*for sale in Ghana*” sign (absent/present) were captured. The relationship between illicit tobacco and the categorical variables (city type, country zone, type of shops, border and non-border town, price/packs, cigarette brand and country of origin) were first studied using χ^2 or Fisher’s exact test (when the number in the table was <6). Due to the binary nature of the outcome variable (licit/illicit), simple and multiple logistic regression was performed to evaluate the unadjusted and adjusted predictive values of the potential confounding variables respectively based on existing literature (15,16) (Figure 2). The results are presented as odds ratios (OR) with a 95% confidence interval, with significance set at an alpha level of 5% ($p \leq 0.05$).

Insert Figure 2

Patient and public Involvement

No patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

A total of 425 retailers were approached for the study, of whom 384 (90%) consented to collect packs and participate in the survey. An average of 12 cigarette packs were collected from single stick sales in a 24-hour period. A total of 4461 packs were collected from 384 retailers in the selected cities and towns. All retailers (100%) in the study sold single sticks. A total of 871 out of 4461 (20%, 95% CI: 18.34-20.66) packs were classified as illicit based on the criteria for classification approved by the FDA. A third (31%) of the packs collected from the northern zone of Ghana were illicit and almost seven out of 10 (69%) packs from the border towns were illicit. Almost all the packs collected from Aflao (Ghana-Togo border) were illicit (99%), followed by Tamale (46%) and the Paga/Hamele (Ghana-Burkina Faso border) (27%) and Elubu (21%) (Ghana - Cote d’Ivoire border) (Table 1). In terms of the retail selling points, three out of 10 (29%) packs collected from convenience stores were illicit, followed by

drinking bars (18%) ($p<0.001$). Over 60% of the packs collected within the price category of 2-7 GHC were illicit. The most common brand of cigarettes sold in Ghana is Rothmans Kingsize, London Brown/White and Pall Mall (Figure 3).

Insert Figure 3

Of all the 871 illicit packs collected, the most common brands of single stick sales were from Business Royal (24%), followed by Fine (21%) and Oris (12%).

Insert Figure 2

All packs from 555 and London Brown/White (manufactured by BAT) were licit (100%) (Table 1).

Table 1: **Determinants of illicit cigarette sale in Ghana**

	Illicit cigarette packs (n=871)	Licit cigarettes packs (n=3590)	Total
<i>Country Zone</i>			
Northern	368 (30.6)	835 (69.4)	1203 (100)
Middle	8 (1.2)	656 (98.8)	664 (100)
Coastal (south)	495 (19.1)	2099 (80.9)	2594 (100)
<i>P-value*</i>	<i><0.001</i>		
<i>Border/non-border</i>			

Border	493 (68.5)	227 (31.5)	720 (100)
Non-border	378 (10.1)	3363 (89.1)	3741 (100)
<i>P-value*</i>	<0.001		
<i>City/town (border/non border)</i>			
Accra (non border)	17 (1.5)	1147 (98.5)	1164 (100)
Kumasi (non border)	8 (1.2)	651 (98.8)	659 (100)
Takoradi (non border)	1 (0.1)	767 (99.9)	768 (100)
Bolgatanga (non border)	7 (1.8)	390 (98.2)	397 (100)
Tamale (non border)	345 (45.8)	408 (54.2)	753 (100)
Elubu (Cote d'ivoire border)	44 (21.1)	165 (78.9)	209 (100)
Paga/Hamele (Burkina Faso border)	16 (26.6)	42 (72.4)	58 (100)
Aflao (Togo border)	433 (98.6)	20 (1.4)	453 (100)
<i>P-value*</i>	<0.001		
<i>Shop type</i>			
Drinking bar	477 (18.2)	2139 (81.8)	2616 (100)
Kiosks	31 (5.2)	563 (94.8)	594 (100)
Convenience stores	363 (29.0)	888 (71.0)	1251 (100)
<i>P-value*</i>	<0.001		
<i>Price/pack (GHC)</i>			
Low price (2-7)	778 (61.2)	494 (38.8)	1272 (100)
High price (8-14)	93 (2.9)	3096 (97.1)	3189 (100)
<i>P-value*</i>	<0.001		
<i>Cigarette brand (manufacturer)</i>			
555 (BAT)	0 (0)	190 (100)	190(100)
London Brown/White (BAT)	0 (0)	928 (100)	928 (100)
Pallmall (BAT)	70 (14.2)	433 (85.8)	494 (100)
Business Royal (Independent Tobacco Inc)	210 (70.0)	90 (30.0)	300 (100)
Fine (unknown)	181 (78.3)	50 (21.6)	231 (100)
Rothmans Kingsize (BAT)	29 (1.6)	1798 (98.4)	1827 (100)
Oris (Oriental General Trading Inc)	107 (81.1)	35 (18.9)	132 (100)
Rothmans Royals (BAT)	99 (86.1)	20 (13.9)	115 (100)
Gold Seal (China Tobacco)	85 (91.4)	8 (8.6)	93 (100)
Tusker (BAT)	29 (100)	0 (0)	29 (100)
Others (Fisher, menthol, Cherry etc.)	61(50.0)	61 (50.0)	122 (100)
<i>P-value*</i>	<0.001		

*P-value based on χ^2 or Fisher's exact test

For the classification of illicit packs, majority were characterized by absence of tax stamps (94%), 'for sale in Ghana' sign (92%), warning labels not in English (77%) and absence of text and pictorial warning labels (28%).

Almost all the packs collected were the 20-stick pack (98%). The average price/pack of the 20-stick packs was 8.5 GHC and that for 10-stick was 3.3 GHC. Illicit packs had an average price/pack of 5.4 GHC (SD 1.5, range 2-12 GHC) whilst licit pack was 9.1 GHC (SD 2.1, range 2-14 GHC). Close to half of the illicit packs originated from Togo (51%), followed by Nigeria (15%) and then Cote d'Ivoire (10 %). About

243 2% of packs that were destined for Ghana were classified as illicit as the packs did not
 244 conform to the current labeling requirements as approved by FDA.

245 Table 2 shows the results from adjusted and unadjusted logistic regression of the
 246 factors associated with illicit cigarette sales in Ghana. The odds of illicit cigarette
 247 sales were 1.8 folds and 3.5 folds higher in convenience stores as compared to
 248 drinking bars in the unadjusted and adjusted models respectively (Table 2). Also, the
 249 sale of illicit cigarettes was 19.3 and 67.2 odds higher in border towns as compared to
 250 non-border towns in both the adjusted and unadjusted models respectively. The
 251 middle and coastal country zones had lower odds of illicit cigarettes sales than the
 252 northern zones in both the unadjusted and adjusted regression models respectively.
 253 Also, for every unit increase in price/pack, the odds of illicit cigarette consumption
 254 reduce by almost 60%.

255 Table 2: Unadjusted and unadjusted factors for illicit cigarette sales in Ghana

Variable	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
Retail shop type				
<i>Drinking bars</i>	1		1	
<i>Kiosks</i>	0.25	0.17 - 0.35	0.52	0.28-0.96
<i>Convenience stores</i>	1.83	1.57-2.15	3.47	1.92-6.26
Country Zone				
<i>Northern</i>	1		1	
<i>Middle</i>	0.03	0.01-0.05	0.42	0.16 -1.08
<i>Coastal</i>	0.54	0.46-0.63	0.70	0.39-1.25
Border/non border towns				

<i>Non-border town</i>	1		1	
<i>Border town</i>	19.3	16.0-23.4	67.2	(44.2-102.2)
Pack price	0.39 (coef= -0.94	(0.37-0.42) (-0.99 to - 0.88)	0.39 (coef=-0.95)	(0.36 -0.42) (-1.03 to -0.88)

DISCUSSION

This study found out that close to 20% of the packs collected were illicit of the total 4461 packs. Majority of the illicit packs were reported from Aflao (Ghana-Togo border) (99%) and Tamale (46%). Tamale, although not a border town, is the capital of the Northern region of Ghana, and has most of the cigarettes smuggled from Burkina Faso (8). Close to half of the illicit packs originated from Togo (51%), followed by Nigeria (15%) and then Cote d'Ivoire (10%). The most common brand of cigarettes sold in Ghana was from BAT including Rothmans Kingsize, London Brown/White and Pall Mall. One out four of the illicit packs belonged to Business Royal (Independent Tobacco Company), a fifth were from Fine (unknown company) and about one out of ten were from Oris brand (Oriental General Trading). The most common features identified for classifying packs as illicit were the absence of tax stamps, '*for sale in Ghana*' sign and warning labels not in English. Adjusted and unadjusted logistic regression models indicated that convenience stores, border towns, northern zone of the country and price/pack had higher odds of illicit cigarettes consumption for single stick sales in Ghana.

Our study provides an objective measure and describes the nature of the illicit cigarette market. This plays a critical role in developing comprehensive and effective tobacco control policies, particularly in countries within sub-Saharan Africa such as

276 Ghana, where data on illicit cigarettes sales is lacking. Our illicit cigarette estimates
277 from single stick sales of 20%, is however, lower than the estimates of the
278 Euromonitor (37% in 2018) (17), which is the only available estimate on illicit
279 cigarettes market in Ghana. Nevertheless, the Euromonitor data is criticised for lack
280 of transparency and their and their funding source from the tobacco industry (TI) (17).
281 The TI is known for quoting high estimates of the illicit market as a means of
282 deterring governments from imposing tobacco tax increases, which contributes to
283 ineffective tobacco control and lost opportunities for the governments to collect more
284 revenue.

285 There are various methods to assess the extent of illicit tobacco in any country, such
286 as measuring the difference between consumption and tax paid sales (gap analysis),
287 interviewing smokers, examination of littered cigarette packs and econometric
288 modeling (18). We employed a methodology particularly suitable in countries with
289 single stick sales, similar to methods used in India (9), Pakistan (19), Bangladesh (10)
290 and Argentina (20). Despite a ban on single stick sales, all retailers (100%) sold
291 single sticks, calling for enforcement of the ban. Our estimates of illicit cigarette sales
292 (20%) are also similar to countries with a higher tobacco use prevalence such as
293 Pakistan (18%) and Argentina (14%) that used a similar methodology (19,20).
294 Despite the lack of estimates of illicit cigarettes from many countries in the African
295 Region, countries such as South Africa, Kenya, The Gambia and Nigeria have
296 available estimates of their illicit market using different methods of estimation. Our
297 estimates were found to be lower than South Africa (with over 30% of the total
298 market being illicit) (21), Nigeria (26%) (22) and Kenya (26%) (23) but higher than
299 the Gambia (8.6%) (24). With the recent ratification of the Protocol in Ghana, and
300 estimates suggesting one out of five cigarette packs to be illicit, there is an urgent

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301 need for governments to address this by fully implementing ratified protocol (which
302 has specific requirements to improve traceability of tobacco products and increase
303 tobacco industry accountability).

304 British American Tobacco (BAT) continues to dominate sales of cigarettes as
305 evidenced by the most common cigarettes sold in Ghana (Rothmans Kingsize,
306 London Brown/White and Pall Mall). This is largely due to the company’s long
307 history in Ghana (25). While the company ceased domestic production in 2006, it
308 remains the dominant importer of cigarettes into the country (25). There are also very
309 low-priced brands available, such as BAT’s Tusker brand (of which all packs were
310 illicit). While, all packs from London Brown/White were found to be licit, about 14%
311 of Pall Mall and 1.6% of Rothmans Kingsize were illicit, demonstrating the
312 possibility of the industry’s involvement in illicit trade. [Note: Removed by editor at
313 acceptance. Please see final version of manuscript.] Further, the small-scale convenience
314 stores were found to be a major selling point of illicit cigarettes. These are legally
315 operating, widely available settings to the low-income Ghanaian smoker (who prefers
316 to buy single stick) widely available in both rural and urban locations. Convenience
317 stores were also found to have higher odds of illicit cigarette consumption as
318 compared to drinking bars in both the adjusted and unadjusted logistic regression
319 models, indicating that it may be an important predictor of illicit cigarette sales in the
320 country.

321 Geography was found to play an important role in the illicit cigarette market in
322 Ghana. A third of the packs collected from the northern zone of the country were
323 found to be illicit. According to the Euromonitor (8), the north of Ghana sees
324 particularly strong illicit trade, with most smuggling from Burkina Faso finding their
325 way to this region into Tamale (17). This could also be linked to the high smoking

326 prevalence and lower income population in the region as compared to other regions
327 (27). Similarly, border towns were also found to be strong predictors of illicit
328 cigarette sales. Six out of 10 packs collected from border towns were illicit and almost
329 100% of the packs collected from Aflao (Ghana-Togo border), and close to half of the
330 packs from Tamale (large city in Northern Ghana linked to Burkina Faso) were found
331 to be illicit. Border towns have been found to be more vulnerable to the trade of illicit
332 cigarette and tobacco products in Vietnam (28) and Georgia (29). Our findings
333 reinforces the need for strengthening patrolling and border control in addition to
334 building capacity and training for authorities belonging to customs, police and
335 immigration. The illicit cigarettes originated from Togo (51%), followed by Nigeria
336 (15%) and then Cote d'Ivoire (10%). [Note: Removed by editor at acceptance. Please see
337 final version of manuscript.]
338 In terms of pricing of cigarettes, illicit packs were found to be almost 50% cheaper
339 than licit packs. Africa in general, lags behind other regions (such as European and
340 the Americas) in implementing strong tobacco tax policies (1). Close to 90% of the
341 illicit packs were belonged to the low price category (2-7 GHC). Currently, the total
342 excise tax on tobacco products in Ghana, accounts for only 31.8% of the average
343 retail price (30). Also, over half of the smuggled cigarettes in the study originated
344 from Togo where a pack of cigarettes is priced at about one USD and is about 0.50
345 USD in Ghana (30). The link between tobacco taxation and smuggling has been
346 doubtful and inconsistent (31). According to a report by the World Bank (32), taxes
347 and prices have only a limited impact on illicit cigarette market share at country level,
348 contrary to arguments by the tobacco industry. The African region, with low prices
349 and low taxation on tobacco products and high levels of smuggling, provides a good

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350 illustration of this observation. This calls for more research to understand the
351 relationship between tobacco taxation and smuggling in Africa.
352 Our study findings should be considered in the light of some limitations. First, despite
353 the wide geographical dispersion in the three zones of the country (northern, middle
354 and coastal), the representativeness to the country is limited. Also, as data was
355 collected during COVID-19 lockdown period in Ghana and we could not explore
356 other border towns that were planned due to pertaining restrictions at that time.
357 Secondly, the empty pack collection relies on retailers to provide us with all the
358 empty packs from previous day's single stick sales. It could be possible that some
359 retailers would want to hide the illegal packs, which could underestimate our findings.
360 Nevertheless, retailers were motivated with a monetary incentive, which, to an extent,
361 mitigated this issue.

362 **CONCLUSION**

363 Our study found a total of 20% illicit packs in the entire sample of packs collected
364 across the eight border and non-border towns/cities in Ghana. This study provides
365 valuable information for policymakers and law enforcement in the region and
366 bringing to light the inadequacy of the current monitoring and regulatory activities of
367 the FDA and customs. Our findings have two important policy implications; first, the
368 regulatory body and the focal point for tobacco control in Ghana (FDA) in
369 collaboration with the customs, police and immigration, should strengthen the supply
370 chain control and market surveillance at retail points in the towns and cities,
371 particularly those close to the Ghana-Togo and Ghana-Burkina Faso border in the
372 northern and coastal zones of the country, aside from border monitoring and
373 transportation tracing. Secondly, with the introduction of Tax Stamp Policy since
374 March 2018, Ghana should also consider the implementation of a supply chain control

375 that resembles a track and trace system (like Kenya), independent of any industry
376 influence to effectively monitor the illicit market.

377

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381 retailers that provided information and packs for this survey.

382 **CONTRIBUTORS**

383 AS, FD, AG, TK, HR and EOD contributed to the design, conception, acquisition,
384 analysis and interpretation of the project and data; the drafting and revision of the
385 manuscript and the approval of the final version to be published. AS and DL
386 contributed to the acquisition of data. LB contributed to the design and conception of
387 the project. OB and AG contributed to the drafting and revision of the manuscript and
388 the approval of the final version to be published.

389 **COMPETING INTEREST**

390 None declared

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396 **Ethics Approval**

397 The study protocol was approved by the Committee on Human Research, Publication
398 and Ethics (Reference number: CHRPE/AP/441/18) and the University of Bath's
399 Research Ethics Approval Committee for Health (REACH) (EP 19/20 063).

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Data sharing statement

The data are owned and shared by the Tobacco Control Capacity Program (TCCP) and the School of Public Health, KNUST, Ghana. Requests for data sharing can be made to artisingh_uk@yahoo.com/arti.singh@tuni.fi

Legends for figures

Figure 1: Location of the eight cities for pack collection in Ghana (black arrows)
Figure 2: Causal diagram of illicit cigarette consumption from single stick sales in Ghana (potential confounders were border towns, country zone, pack prices and type of retail shop)
Figure 3: Cigarette brands sold in Ghana

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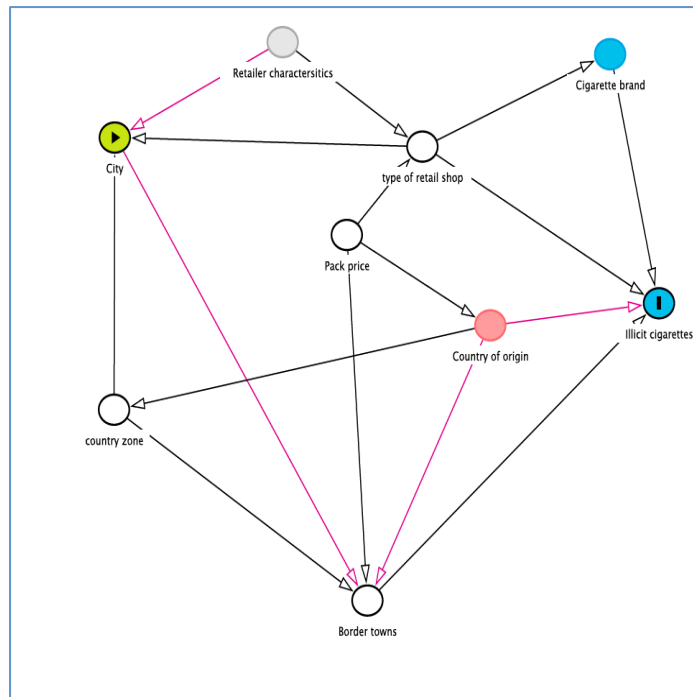


Figure 2: Causal diagram of illicit cigarette consumption from single stick sales in Ghana (potential confounders were border towns, country zone, pack prices and type of retail shop)

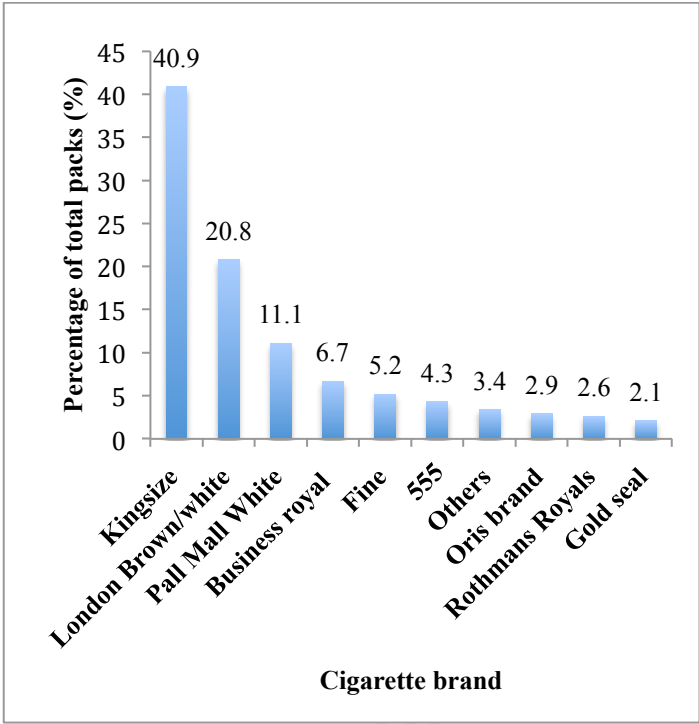


Figure 3: Common cigarette brands sold in Ghana

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	Title and abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	115-138
Objectives	3	State specific objectives, including any prespecified hypotheses	135-138
Methods			
Study design	4	Present key elements of study design early in the paper	148-171
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	141-144
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	151-159
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	243-249
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	196-202
Bias	9	Describe any efforts to address potential sources of bias	252-257
Study size	10	Explain how the study size was arrived at	168-171
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	194-196
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	202-210
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	238-239
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	214-217, Table 1
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	217-228
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	302-306
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear	267-274, Table 2

		which confounders were adjusted for and why they were included	
		(b) Report category boundaries when continuous variables were categorized	241-243
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	282-302
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	399-411
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	303-398
Generalisability	21	Discuss the generalisability (external validity) of the study results	399-401
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	458-461

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Extent of illicit cigarette market from Single Stick Sales in Ghana: findings from a cross sectional survey

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Keywords: Illicit, cigarette, Ghana, packs, survey, tobacco

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40 ABSTRACT

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42 Objective This study aims to measure the extent of illicit cigarette consumption from
43 single stick sales, to determine the nature and types of illicit cigarettes present in
44 Ghana, and to identify the factors associated with illicit cigarettes consumption in
45 Ghana.

46 Design A Cross-sectional study using empty cigarette packs generated by 1 day's
47 single stick cigarette sales collected from cigarette vendors.

48 Setting Five large cities (Accra, Kumasi, Takoradi, Tamale, and Bolgatanga) and three
49 border towns (Aflao, Paga/Hamele and Elubo) in the northern, middle and coastal belt
50 of Ghana.

51 Procedure and Participants Ten areas were randomly selected in each city/town, and
52 all shops selling cigarettes within 1 km of the central point were surveyed.

53 Outcome measures (1) estimates of the share of illicit cigarette packs in the total
54 cigarette sales from vendors selling single stick cigarettes in Ghana; (2) nature and
55 types of illicit cigarette packs; and (3) factors associated with illicit cigarette sales in
56 Ghana.

57 Results

58 Of a total of 4461 packs, about 20% (95% CI: 18.3-20.7) were found to be illicit. Aflao
59 (Ghana-Togo border) and Tamale (Ghana-Burkina Faso border) had the highest
60 percentage of illicit cigarette sales at 99% and 46% respectively ($p<0.001$). Over half
61 of the illicit packs originated from Togo (51%), followed by Nigeria (15%) and then
62 Cote d'Ivoire (10%). Adjusted and unadjusted logistic regression models indicated that
63 convenience stores, border towns, pack price and the northern zone had higher odds of
64 illicit cigarette sales.

Conclusion To effectively tackle illicit cigarettes, market surveillance and strengthening supply chain control are required, particularly at the border towns and the northern region of the country.

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Strengths and limitations of this study

- The empty pack survey required little time and resources to conduct.
- Some retailers may not provide all the packs over the last 24 hours, which could underestimate our findings.
- The study was limited to five cities and three border towns and is not representative of illicit cigarettes sales in Ghana as a whole

INTRODUCTION

Illicit tobacco trade continues to remain a threat to global tobacco control efforts. While tobacco consumption is decreasing globally, rapid population growth, increased advertising by the tobacco industry, and growing tobacco consumption among young people in Africa may result in increased number of smokers in the region (1). Further, the availability and accessibility of cheap, illicit tobacco products is particularly attractive to the region's most vulnerable young population and low-income smokers (2).

Illicit trade of tobacco products is a major public health problem as lower prices of illicit cigarettes lead to increased cigarette consumption (3). Despite the difficulties in measuring the extent of illicit tobacco in the market, available estimates indicates that it was about 11.6% worldwide in 2007 and almost 10% in 2015 (3), and these figures are higher for low and middle income countries (LMICs) including those in the African Region. In response to the threat posed by illicit tobacco trade, the WHO FCTC Protocol to Eliminate Illicit Trade in Tobacco Products (hereby referred to as "the

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Protocol”) entered into force in 2018 (4). This Protocol gives countries an opportunity to prevent tobacco-related morbidity and mortality by enhancing tobacco supply chain control. Countries that ratify the Protocol commit themselves to adopting a variety of measures, including track and trace systems to prevent and counter illicit trade.

Ghana, one of the first countries to ratify the World Health Organization’s (WHO) Framework Convention on Tobacco Control (FCTC) in 2004, has made some significant progress in tobacco control such as introducing an early advertising ban (1982), the passage of the Tobacco Control Act (in 2012), banning of single stick sales (2017), introduction of mandatory graphic health warnings (2018) and tax stamps on tobacco products (2018) and more recently the ratification of the Protocol in October 2021 (5). Despite this progress, cigarettes continue to remain cheap and affordable in Ghana (1). For instance, the price of a pack of the most commonly sold brand of cigarette in Ghana is less than one USD. Although, Ghana does not have an active tobacco industry (British American Tobacco (BAT) ceased its local production in 2006), BAT continues to dominate sales of cigarettes and remains the dominant importer of cigarettes into the country via its manufacturing sites in Ibadan and Zaria in Nigeria (5). The distribution networks of Ghana’s leading tobacco companies are well organised in Ghana’s major urban cities including Greater Accra, Takoradi, Kumasi, and Tamale. Tobacco products including cigarettes in Ghana is mostly sold at unlicensed and unregulated points of sale such as traditional grocery retailers (also known as convenience or provision stores), street vendors, kiosks and drinking bars (6).

An important challenge that exists in many African countries, including Ghana, is that most governments do not measure the size of illicit tobacco market nor analyze its features on a regular basis. To fully benefit from the Protocol, policymakers seek to connect its normative guidance with empirical data and analysis on countries’ illicit

116 tobacco trade. In light of the tobacco industry's use of illicit trade to oppose tobacco
117 control measures such as tax increases (7), it is important to understand the scope and
118 nature of the illicit tobacco trade. To date, there have been no scientific studies to
119 estimate the size of the illicit cigarette market in Ghana (1). The only available
120 estimates are those produced by the Euromonitor that reports an illicit cigarette market
121 accounting for 39% of total cigarette sales in 2018 (up from 35% in 2017) (8).
122 Estimates by Euromonitor have been criticized for being unreliable and inconsistent,
123 and for lacking independence due to Euromonitor entering into business contracts with
124 Philip Morris International (PMI) (5). The objectives of this study were to measure the
125 extent of the illicit cigarette market in selected border and non-border towns in Ghana
126 using an empty pack survey method from single stick sales. The study also assessed the
127 nature and types of illicit cigarettes present in Ghana including the factors associated
128 with illicit cigarettes sales in Ghana.

129 **METHODS**

130 **Study sites**

131 A cross sectional study was conducted during the months of August 2020 to January
132 2021 in five major cities in Ghana (Accra, Tamale, Kumasi, Takoradi and Bolgatanga)
133 and three border towns (Aflao, Paga/Hamele and Elubu) across the three zones of
134 Ghana (Northern, Middle and Coastal). These districts were selected to represent
135 socioeconomic, cultural and geographical diversity.

136 **Research design**

137 A modified approach based on the analysis of empty cigarette packs collected directly
138 from retailers was used. This method was adapted from similar studies in India (9) and
139 Bangladesh (10) and is particularly useful in countries where single stick sales are a
140 common practice. Within each large city or border town, ten smaller geographical areas
141 were selected using Ghana Post Codes. A central point (such as a government building,

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market place or taxi station) was determined in each of them for retailer pack collection. A team of four research assistants and a coordinator walked 1 km along both sides of a busy street (0.5 km forward and 0.5 km back) starting from the central point to identify tobacco retailers. All retailers identified were provided with verbal and written information about the study and requested to sign a consent form if they agreed to participate. Following consent being obtained, an empty bag with a unique identifier was given to retailers and they were asked to deposit all cigarette packs emptied throughout the day as a result of single sticks of cigarette sales in the bag provided. The bags were collected back from the retailers at the end of a 24-hour period and retailers were given a small monetary incentive (up to a maximum amount of USD 10). Consenting retailers also participated in a 20-25 minutes survey on illicit cigarette sales, common brands, and pricing of cigarettes sold each day. Pack prices were recorded for each of the 10 and 20 stick packs. The sample size equation to obtain the minimum number of packs collected from each selected city/town was adapted from a toolkit for measuring illicit tobacco in LMICs (11). We obtained a minimum sample size of 2600 packs, assuming prevalence of illicit cigarette sales of 25%, with 95% level of confidence and margin of error of 0.15.

Classification of packs

Empty cigarette packs were cleaned and assigned unique IDs, and were analysed and their characteristics recorded. Pack data included the brand name, country of origin, the presence of graphical and/or textual health warnings, the language of the warning, the pack size (10/20 stick pack), and compliance of these warning messages with existing packaging requirement for Ghana. A conservative definition to classify an illicit cigarette pack in Ghana according the Food and Drugs Authority (FDA), the regulatory

body and the focal point for tobacco control in Ghana (12), includes at least one of the following attributes:

(a) Absence of authentic tax stamps;

(b) Absence of textual and pictorial warnings (Current pack warnings in Ghana are required to be a combined picture and text health warning in English to cover 50% of the front principal display area and 60% of the back principal display area of the pack, positioned in the lower portion) (13).

(c) Absence of the inscription “*FOR SALE IN GHANA ONLY*” displayed on the side panel of the product pack and

(d) Health warnings not in English

Trained research assistants evaluated tax stamp authenticity using the tax stamp mobile application developed by the Ghana Revenue Service (14).

Analysis

Data were first entered into excel, cleaned and analyzed via R studio version 1.4.1717.

There was missing information from three of the pack data and these were removed from the final analysis. The unit of analysis was each cigarette pack. Continuous variables such as price/pack were changed to categorical (low and high price category) for 2-7 GHC and 8-14 GHC respectively (1USD=6GHC) for measures of association and continuous for the regression analysis. Descriptive information was reported as frequencies and percentages for city, country zone (northern, middle and coastal zones), retail shop type (drinking bars, convenience stores and kiosks), border and non-border towns, country of origin (based on the inscription on the packs on sale restricted to respective country eg. for sale in Togo only or Nigeria etc.) and illicit and licit cigarette. Pack characteristics such as pictorial health warning (absent/present), textual health warning (absent/present), warning labels in English (absent/present), tax stamps (absent/present) and “*for sale in Ghana*” sign (absent/present) were captured. The

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192 relationship between illicit tobacco and the categorical variables (city type, country
193 zone, type of shops, border and non-border town, price/packs, cigarette brand and
194 country of origin) were first studied using χ^2 or Fisher's exact test (when the number in
195 the table was ≤ 6). Due to the binary nature of the outcome variable (licit/illicit), simple
196 and multiple logistic regression was performed to evaluate the unadjusted and adjusted
197 predictive values of the potential confounding variables respectively based on existing
198 literature (15,16) (Figure 1). Subsequently, a cluster analysis was performed to identify
199 the effect of vendors on the sale of illicit single e stick sales in Ghana. The results are
200 presented as odds ratios (OR) with a 95% confidence interval, with significance set at
201 an alpha level of 5% ($p \leq 0.05$).

202 Insert Figure 1

203 **Patient and public Involvement**

204 No patients and/or the public were involved in the design, or conduct, or reporting, or
205 dissemination plans of this research.

206 **RESULTS**

207 A total of 425 retailers were approached for the study, of whom 384 (90%) consented
208 to collect packs and participate in the survey. An average of 12 cigarette packs were
209 collected from single stick sales in a 24-hour period. A total of 4461 packs were
210 collected from 384 retailers in the selected cities and towns. All retailers (100%) in the
211 study sold single sticks. A total of 871 out of 4461 (20%, 95% CI: 18.34-20.66) packs
212 were classified as illicit based on the criteria for classification approved by the FDA. A
213 third (31%) of the packs collected from the northern zone of Ghana were illicit and
214 almost seven out of 10 (69%) packs from the border towns were illicit. Almost all the
215 packs collected from Aflao (Ghana-Togo border) were illicit (99%), followed by
216 Tamale (46%) and the Paga/Hamele (Ghana-Burkina Faso border) (27%) and Elubu
217 (21%) (Ghana - Cote d'Ivoire border) (Table 1). In terms of the retail selling points,

three out of 10 (29%) packs collected from convenience stores were illicit, followed by drinking bars (18%) ($p < 0.001$). Over 60% of the packs collected within the price category of 2-7 GHC were illicit. The most common brand of cigarettes sold in Ghana is Rothmans Kingsize, London Brown/White and Pall Mall (Figure 2).

Insert Figure 2

Of all the 871 illicit packs collected, the most common brands of single stick sales were from Business Royal (24%), followed by Fine (21%) and Oris (12%).

All packs from 555 and London Brown/White (manufactured by BAT) were licit (100%) (Table 1).

Table 1: **Determinants of illicit cigarette sale in Ghana**

	Illicit cigarette packs (n=871)	Licit cigarettes packs (n=3590)	Total
<i>Country Zone</i>			
Northern	368 (30.6)	835 (69.4)	1203 (100)
Middle	8 (1.2)	656 (98.8)	664 (100)
Coastal (south)	495 (19.1)	2099 (80.9)	2594 (100)
<i>P-value*</i>	<0.001		
<i>Border/non-border</i>			
Border	493 (68.5)	227 (31.5)	720 (100)
Non-border	378 (10.1)	3363 (89.1)	3741 (100)
<i>P-value*</i>	<0.001		
<i>City/town (border/non border)</i>			
Accra (non border)	17 (1.5)	1147 (98.5)	1164 (100)
Kumasi (non border)	8 (1.2)	651 (98.8)	659 (100)
Takoradi (non border)	1 (0.1)	767 (99.9)	768 (100)
Bolgatanga (non border)	7 (1.8)	390 (98.2)	397 (100)
Tamale (non border)	345 (45.8)	408 (54.2)	753 (100)
Elubu (Cote d'Ivoire border)	44 (21.1)	165 (78.9)	209 (100)
Paga/Hamele (Burkina Faso border)	16 (26.6)	42 (72.4)	58 (100)
Aflao (Togo border)	433 (98.6)	20 (1.4)	453 (100)
<i>P-value*</i>	<0.001		
<i>Shop type</i>			
Drinking bar	477 (18.2)	2139 (81.8)	2616 (100)
Kiosks	31 (5.2)	563 (94.8)	594 (100)
Convenience stores	363 (29.0)	888 (71.0)	1251 (100)
<i>P-value*</i>	<0.001		
<i>Price/pack (GHC)</i>			
Low price (2-7)	778 (61.2)	494 (38.8)	1272 (100)
High price (8-14)	93 (2.9)	3096 (97.1)	3189 (100)
<i>P-value*</i>	<0.001		
<i>Cigarette brand (manufacturer)</i>			
555 (BAT)	0 (0)	190 (100)	190 (100)
London Brown/White (BAT)	0 (0)	928 (100)	928 (100)

Pallmall (BAT)	70 (14.2)	433 (85.8)	494 (100)
Business Royal (Independent Tobacco Inc)	210 (70.0)	90 (30.0)	300 (100)
Fine (unknown)	181 (78.3)	50 (21.6)	231 (100)
Rothmans Kingsize (BAT)	29 (1.6)	1798 (98.4)	1827 (100)
Oris (Oriental General Trading Inc)	107 (81.1)	35 (18.9)	132 (100)
Rothmans Royals (BAT)	99 (86.1)	20 (13.9)	115 (100)
Gold Seal (China Tobacco)	85 (91.4)	8 (8.6)	93 (100)
Tusker (BAT)	29 (100)	0 (0)	29 (100)
Others (Fisher, menthol, Cherry etc.)	61(50.0)	61 (50.0)	122 (100)
P-value*	<0.001		

*P-value based on χ^2 or Fisher's exact test

For the classification of illicit packs, majority were characterized by absence of tax stamps (94%), 'for sale in Ghana' sign (92%), warning labels not in in English (77%) and absence of text and pictorial warning labels (28%).

Almost all the packs collected were the 20-stick pack (98%). The average price/pack of the 20-stick packs was 8.5 GHC and that for 10-stick was 3.3 GHC. Illicit packs had an average price/pack of 5.4 GHC (SD 1.5, range 2-12 GHC) whilst licit pack was 9.1 GHC (SD 2.1, range 2-14 GHC). Close to half of the illicit packs originated from Togo (51%), followed by Nigeria (15%) and then Cote d'Ivoire (10 %). About 2% of packs that were destined for Ghana were classified as illicit as the packs did not conform to the current labeling requirements as approved by FDA.

Table 2 shows the results from adjusted and unadjusted logistic regression of the factors associated with illicit cigarette sales in Ghana. The odds of illicit cigarette sales were 1.8 folds and 3.5 folds higher in convenience stores as compared to drinking bars in the unadjusted and adjusted models respectively (Table 2). Also, the sale of illicit cigarettes was 19.3 and 67.2 odds higher in border towns as compared to non-border towns in both the adjusted and unadjusted models respectively. The middle and coastal country zones had lower odds of illicit cigarettes sales than the northern zones in both the unadjusted and adjusted regression models respectively.

Also, for every unit increase in price/pack, the odds of illicit cigarette consumption reduce by almost 60%.

Table 2: Unadjusted and adjusted factors for illicit cigarette sales in Ghana

Variable	Unadjusted		Adjusted	
	OR	95% CI	OR	95% CI
Retail shop type				
<i>Drinking bars</i>	1		1	
<i>Kiosks</i>	0.25	0.17 - 0.35	0.52	0.28-0.96
<i>Convenience stores</i>	1.83	1.57-2.15	3.47	1.92-6.26
Country Zone				
<i>Northern</i>	1		1	
<i>Middle</i>	0.03	0.01-0.05	0.42	0.16 -1.08
<i>Coastal</i>	0.54	0.46-0.63	0.70	0.39-1.25
Border/non border towns				
<i>Non-border town</i>	1		1	
<i>Border town</i>	19.3	16.0-23.4	67.2	(44.2-102.2)
Pack price	0.39 (coef= -0.94)	(0.37-0.42) (-0.99 to - 0.88)	0.39 (coef=-0.95)	(0.36 -0.42) (-1.03 to -0.88)

Table 3 shows the results of bivariate and multivariate analysis adjusted for vendors that collected packs from single stick sales. After adjusting for the clustering effect of vendors, convenience stores had higher odds of illicit cigarette sales in both the bivariate and multivariate analysis adjusted for vendors. Border towns also had higher odds of illicit in both bivariate and multivariate models

Table 3: Effect of clustering by vendors* on illicit cigarette sales

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Variable	Bivariate		Multivariate	
	OR	95% CI	OR	95% CI
Retail shop type				
<i>Drinking bars</i>	1		1	
<i>Kiosks</i>	0.25	0.11 - 0.53	0.52	0.16-1.69
<i>Convenience stores</i>	1.83	1.03-3.26	3.47	1.22-9.84
Country Zone				
<i>Northern</i>	1		1	
<i>Middle</i>	0.03	0.01-0.08	0.42	0.01 -2.51
<i>Coastal</i>	0.54	0.30-0.95	0.70	0.22-2.27
Border/non border towns				
<i>Non-border town</i>	1		1	
<i>Border town</i>	19.3	8.80-42.40	67.2	(17.62-256.41)
Pack price	0.39 (coef= -0.94)	(0.31-0.50) (-0.99 to -0.89)	0.39 (coef=-0.95)	(0.32 -0.46) (-1.05 to -0.89)

*Adjusted for the clustering effect of vendors on illicit cigarette sales (n=384)

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267 **DISCUSSION**

268 This study found out that close to 20% of the packs collected were illicit of the total
269 4461 packs. Majority of the illicit packs were reported from Aflao (Ghana-Togo
270 border) (99%) and Tamale (46%). Tamale, although not a border town, is the capital
271 of the Northern region of Ghana, and has most of the cigarettes smuggled from
272 Burkina Faso (8). Close to half of the illicit packs originated from Togo (51%),
273 followed by Nigeria (15%) and then Cote d'Ivoire (10%). The most common brand of
274 cigarettes sold in Ghana was from BAT including Rothmans Kingsize, London
275 Brown/White and Pall Mall. One out four of the illicit packs belonged to Business
276 Royal (Independent Tobacco Company), a fifth were from Fine (unknown company)
277 and about one out of ten were from Oris brand (Oriental General Trading). The most
278 common features identified for classifying packs as illicit were the absence of tax
279 stamps, '*for sale in Ghana*' sign and warning labels not in English. Adjusted and
280 unadjusted logistic regression models indicated that convenience stores, border towns,
281 northern zone of the country and price/pack had higher odds of illicit cigarettes
282 consumption for single stick sales in Ghana.

283 Our study provides an objective measure and describes the nature of the illicit
284 cigarette market. This plays a critical role in developing comprehensive and effective
285 tobacco control policies, particularly in countries within sub-Saharan Africa such as
286 Ghana, where data on illicit cigarettes sales is lacking. Our illicit cigarette estimates
287 from single stick sales of 20%, is however, lower than the estimates of the
288 Euromonitor (37% in 2018) (17), which is the only available estimate on illicit
289 cigarettes market in Ghana. Nevertheless, the Euromonitor data is criticised for lack
290 of transparency and their and their funding source from the tobacco industry (TI) (17).

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291 The TI is known for quoting high estimates of the illicit market as a means of
292 deterring governments from imposing tobacco tax increases, which contributes to
293 ineffective tobacco control and lost opportunities for the governments to collect more
294 revenue.

295 There are various methods to assess the extent of illicit tobacco in any country, such
296 as measuring the difference between consumption and tax paid sales (gap analysis),
297 interviewing smokers, examination of littered cigarette packs and econometric
298 modeling (18). We employed a methodology particularly suitable in countries with
299 single stick sales, similar to methods used in India (9), Pakistan (19), Bangladesh (10)
300 and Argentina (20). Despite a ban on single stick sales, all retailers (100%) sold single
301 sticks, calling for enforcement of the ban. Our estimates of illicit cigarette sales (20%)
302 are also similar to countries with a higher tobacco use prevalence such as Pakistan
303 (18%) and Argentina (14%) that used a similar methodology (19,20). Despite the lack
304 of estimates of illicit cigarettes from many countries in the African Region, countries
305 such as South Africa, Kenya, The Gambia and Nigeria have available estimates of
306 their illicit market using different methods of estimation. Our estimates were found to
307 be lower than South Africa (with over 30% of the total market being illicit) (21),
308 Nigeria (26%) (22) and Kenya (26%) (23) but higher than the Gambia (8.6%) (24).
309 With the recent ratification of the Protocol in Ghana, and estimates suggesting one out
310 of five cigarette packs to be illicit, there is an urgent need for governments to address
311 this by fully implementing ratified protocol (which has specific requirements to
312 improve traceability of tobacco products and increase tobacco industry
313 accountability).

314 British American Tobacco (BAT) continues to dominate sales of cigarettes as
315 evidenced by the most common cigarettes sold in Ghana (Rothmans Kingsize,

London Brown/White and Pall Mall). This is largely due to the company's long history in Ghana (25). While the company ceased domestic production in 2006, it remains the dominant importer of cigarettes into the country (25). There are also very low-priced brands available, such as BAT's Tusker brand (of which all packs were illicit). While, all packs from London Brown/White were found to be licit, about 14% of Pall Mall and 1.6% of Rothmans Kingsize were illicit, demonstrating the possibility of the industry's involvement in illicit trade (26). Further, the small-scale convenience stores were found to be a major selling point of illicit cigarettes. These are legally operating, widely available settings to the low-income Ghanaian smoker (who prefers to buy single stick) widely available in both rural and urban locations. Convenience stores were also found to have higher odds of illicit cigarette consumption as compared to drinking bars in both the adjusted and unadjusted logistic regression models, indicating that it may be an important predictor of illicit cigarette sales in the country.

Geography was found to play an important role in the illicit cigarette market in Ghana. A third of the packs collected from the northern zone of the country were found to be illicit. According to the Euromonitor (8), the north of Ghana sees particularly strong illicit trade, with most smuggling from Burkina Faso finding their way to this region into Tamale (17). This could also be linked to the high smoking prevalence and lower income population in the region as compared to other regions (27). Similarly, border towns were also found to be strong predictors of illicit cigarette sales. Six out of 10 packs collected from border towns were illicit and almost 100% of the packs collected from Aflao (Ghana-Togo border), and close to half of the packs from Tamale (large city in Northern Ghana linked to Burkina Faso) were found to be illicit. Border towns have been found to be more vulnerable to the trade of illicit

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341 cigarette and tobacco products in Vietnam (28) and Georgia (29). Our findings
342 reinforces the need for strengthening patrolling and border control in addition to
343 building capacity and training for authorities belonging to customs, police and
344 immigration. The illicit cigarettes originated from Togo (51%), followed by Nigeria
345 (15%) and then Cote d'Ivoire (10%).

346 In terms of pricing of cigarettes, illicit packs were found to be almost 50% cheaper
347 than licit packs. Africa in general, lags behind other regions (such as European and
348 the Americas) in implementing strong tobacco tax policies (1). Close to 90% of the
349 illicit packs were belonged to the low price category (2-7 GHC). Currently, the total
350 excise tax on tobacco products in Ghana, accounts for only 31.8% of the average
351 retail price (30). Also, over half of the smuggled cigarettes in the study originated
352 from Togo where a pack of cigarettes is priced at about one USD and is about 0.50
353 USD in Ghana (30). The link between tobacco taxation and smuggling has been
354 doubtful and inconsistent (31). According to a report by the World Bank (32), taxes
355 and prices have only a limited impact on illicit cigarette market share at country level,
356 contrary to arguments by the tobacco industry. The African region, with low prices
357 and low taxation on tobacco products and high levels of smuggling, provides a good
358 illustration of this observation. This calls for more research to understand the
359 relationship between tobacco taxation and smuggling in Africa.

360 Our study findings should be considered in the light of some limitations. First, despite
361 the wide geographical dispersion in the three zones of the country (northern, middle
362 and coastal), the representativeness to the country is limited. Also, as data was
363 collected during COVID-19 lockdown period in Ghana and we could not explore
364 other border towns that were planned due to pertaining restrictions at that time.
365 Secondly, the empty pack collection relies on retailers to provide us with all the

empty packs from previous day's single stick sales. It could be possible that some retailers would want to hide the illegal packs, which could underestimate our findings. Nevertheless, retailers were motivated with a monetary incentive, which, to an extent, mitigated this issue.

CONCLUSION

Our study found a total of 20% illicit packs in the entire sample of packs collected across the eight border and non-border towns/cities in Ghana. This study provides valuable information for policymakers and law enforcement in the region and bringing to light the inadequacy of the current monitoring and regulatory activities of the FDA and customs. Our findings have two important policy implications; first, the regulatory body and the focal point for tobacco control in Ghana (FDA) in collaboration with the customs, police and immigration, should strengthen the supply chain control and market surveillance at retail points in the towns and cities, particularly those close to the Ghana-Togo and Ghana-Burkina Faso border in the northern and coastal zones of the country, aside from border monitoring and transportation tracing. Secondly, with the introduction of Tax Stamp Policy since March 2018, Ghana should also consider the implementation of a supply chain control that resembles a track and trace system (like Kenya), independent of any industry influence to effectively monitor the illicit market.

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CONTRIBUTORS

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390 AS, FD, AG, TK, HR and EOD contributed to the design, conception, acquisition,
391 analysis and interpretation of the project and data; the drafting and revision of the
392 manuscript and the approval of the final version to be published. AS and DL
393 contributed to the acquisition of data. LB contributed to the design and conception of
394 the project. OB and AG contributed to the drafting and revision of the manuscript and
395 the approval of the final version to be published.

396 **COMPETING INTEREST**

397 None declared

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403 **Ethics Approval**

404 The study protocol was approved by the Committee on Human Research, Publication
405 and Ethics (Reference number: CHRPE/AP/441/18) and the University of Bath’s
406 Research Ethics Approval Committee for Health (REACH) (EP 19/20 063).

407 **Data sharing statement**

408 The data are owned and shared by the Tobacco Control Capacity Program (TCCP)
409 and the School of Public Health, KNUST, Ghana. Requests for data sharing can be
410 made to artisingh_uk@yahoo.com/arti.singh@tuni.fi

411 **Legends for figures**

412 Figure 1: Causal diagram of illicit cigarette consumption from single stick sales in
413 Ghana (potential confounders were border towns, country zone, pack prices and type of
414 retail shop)

Figure 2: Cigarette brands sold in Ghana

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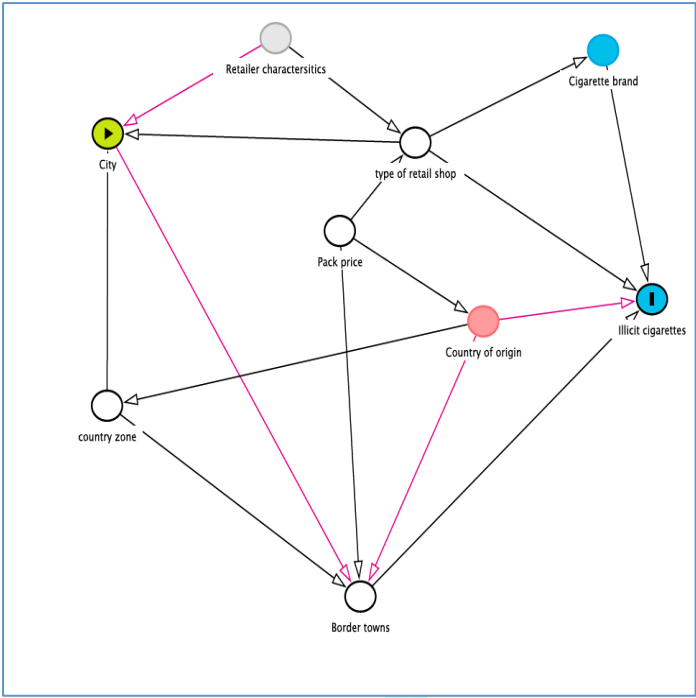


Figure 1: Causal diagram of illicit cigarette consumption from single stick sales in Ghana (potential confounders were border towns, country zone, pack prices and type of retail shop)

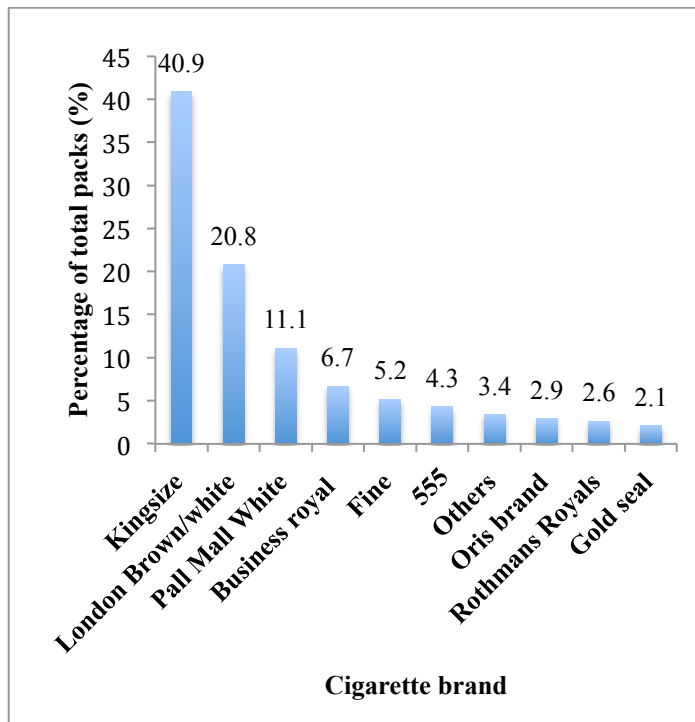


Figure 2: Common cigarette brands sold in Ghana

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Title and abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Page 2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Page 4-5
Objectives	3	State specific objectives, including any prespecified hypotheses	Page 5
Methods			
Study design	4	Present key elements of study design early in the paper	Page 5-6
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Page 5-6
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	Page 6-7
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Page 7-8
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Page 7-8
Bias	9	Describe any efforts to address potential sources of bias	Page 7-8
Study size	10	Explain how the study size was arrived at	Page 6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Page 7-8
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Page 7-8
		(b) Describe any methods used to examine subgroups and interactions	N/A
		(c) Explain how missing data were addressed	Page 7
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Pages 8-10
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Pages 8-10
		(b) Indicate number of participants with missing data for each variable of interest	N/A
Outcome data	15*	Report numbers of outcome events or summary measures	Pages 10-11
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Pages 10-11

		(b) Report category boundaries when continuous variables were categorized	Pages 10-11
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	Page 11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Page 15-16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Page 12-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	Page 15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Page 17

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.