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Citation for published version:

Singh, A, Ross, H, Dobbie, F, Kinnunen, T, Logo, DD, Boateng, O, Gilmore, A, Bauld, L & Owusu-dabo, E 2023, 'Extent of illicit cigarette market from single stick sales in Ghana: findings from a cross-sectional survey', *BMJ Open*, vol. 13, no. 3, pp. e062476. <https://doi.org/10.1136/bmjopen-2022-062476>

Digital Object Identifier (DOI):

[10.1136/bmjopen-2022-062476](https://doi.org/10.1136/bmjopen-2022-062476)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

BMJ Open

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BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2022-062476
Article Type:	Original research
Date Submitted by the Author:	03-Mar-2022
Complete List of Authors:	Singh, Arti; Tampere University Ross, Hana; University of Cape Town Research Unit on the Economics of Excisable Products Dobbie, Fiona; The University of Edinburgh College of Medicine and Veterinary Medicine, ; Gallagher, Allen; University of Bath Kinnunen, Tarja; Tampere University Logo, Divine; Ghana Health Service, Research & Development Division-Ghana Health Service; Ministry of Health/Ghana health Service Boateng, Olivia A.; Food and Drug Authority, Tobacco Control and Substance Abuse Gilmore, Anna; University of Bath, Department for Health Bauld, Linda; University of Edinburgh, Usher Institute and UK Centre for Tobacco and Alcohol Studies, College of Medicine and Veterinary Medicine Owusu-Dabo, Ellis; Kwame Nkrumah University of Science and Technology, Department of Global Health
Keywords:	PUBLIC HEALTH, Epidemiology < TROPICAL MEDICINE, STATISTICS & RESEARCH METHODS

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3 **1 Estimating the extent of illicit cigarette sales in Ghana: findings from a cross**
4 **2 sectional survey**

5
6
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32 26

33 27 Keywords: Illicit, cigarette, Ghana, packs, survey, tobacco

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3 **40 ABSTRACT**

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5 **41**
6 **42 Objective** This study aims to measure the size of Ghana's illicit cigarette market, to
7
8 **43** determine the nature and types of illicit cigarettes present in Ghana, and to identify the
9
10 **44** factors associated with illicit cigarettes sales in Ghana.

11
12 **45 Design** A Cross-sectional study using empty cigarette packs generated by 1 day's
13
14 **46** single-cigarette sales collected from cigarette vendors.

15
16
17 **47 Setting** Five large cities (Accra, Kumasi, Takoradi, Tamale, and Bolgatanga) and three
18
19 **48** border towns (Aflao, Paga, and Elubo) in the northern, middle and coastal belt of
20
21 **49** Ghana

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24 **50 Procedure and Participants** Ten areas were randomly selected in each city/town, and
25
26 **51** all shops selling cigarettes within 1 km of the central point were surveyed.

27
28 **52 Outcome measures** (1) estimates of the share of illicit packs in the total cigarette sales
29
30 **53** in Ghana using an empty pack survey method; (2) nature and types of illicit cigarette
31
32 **54** packs; and (3) factors associated with illicit cigarette sales in Ghana.

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35 **55 Results**

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37
38 **56** Of a total of 4461 packs, 19.5% were found to be illicit. Aflao (Ghana-Togo border)
39
40 **57** and Tamale (cigarettes coming from Burkina Faso) had the highest percentage of illicit
41
42 **58** cigarette sales at 98.6% and 45.8% respectively ($p < 0.001$). Over half of the illicit packs
43
44 **59** originated from Togo (51%), followed by Nigeria (14.8%) and then Cote d'Ivoire
45
46 **60** (10.3%). Adjusted and unadjusted logistic regression models indicated that
47
48 **61** convenience stores, border towns, and the northern zone had higher odds of illicit
49
50 **62** cigarette sales.

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53 **63 Conclusion** To effectively tackle illicit cigarettes, market surveillance and
54
55 **64** strengthening supply chain control are required, particularly at the border towns and the
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57 **65** northern region of the country.
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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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3 92 tobacco products (2018) and more recently the ratification of the Protocol in October
4
5 93 2021 (5). Despite this progress, cigarettes continue to remain cheap and affordable in
6
7 94 Ghana (1). The total excise tax on tobacco products in Ghana accounts for only 31.8%
8
9
10 95 of the average retail price, far below the 70% benchmark set by the World Health
11
12 96 Organization (WHO) (1). Although, Ghana does not have an active tobacco industry
13
14 97 (British American Tobacco (BAT) ceased its local production in 2006), BAT continues
15
16 98 to dominate sales of cigarettes and remains the dominant importer of cigarettes into the
17
18 99 country via its manufacturing sites in Ibadan and Zaria in Nigeria (5). The distribution
19
20 100 networks of Ghana's leading tobacco companies are well organised in Ghana's major
21
22 101 urban cities including Greater Accra, Takoradi, Kumasi, and Tamale. The point of sale
23
24 102 of tobacco products including cigarettes in Ghana is mainly via the traditional grocery
25
26 103 retailers (also known as convenience or provision stores), street vendors, kiosks and
27
28 104 drinking bars most of which may be unregulated and without a license to operate (6).
29
30
31 105 An important challenge that exists in many African countries, including Ghana, is that
32
33 106 most governments do not measure the size of illicit tobacco market nor analyze its
34
35 107 features on a regular basis. To fully benefit from the Protocol, policymakers and
36
37 108 implementers seek to connect its normative guidance with empirical data and analysis
38
39 109 on countries' illicit tobacco trade. This means that they are not able to monitor and
40
41 110 adapt measures to control illicit trade (9). In light of the tobacco industry's use of illicit
42
43 111 trade to oppose tobacco control such as including tax increases (7), it is important to
44
45 112 understand the scope and nature of the illicit tobacco trade. To date, there have no
46
47 113 scientific studies to estimate the size of the illicit cigarette market in Ghana (1). The
48
49 114 only available estimates are those produced by the Euromonitor that reports an illicit
50
51 115 cigarette market accounting for 39% of total cigarette sales in 2018 (up from 35% in
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53 116 2017) (10). Estimates by Euromonitor have been criticized for being unreliable and
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3 117 inconsistent, and for lacking independence due to Euromonitor entering into business
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5 118 contracts with Philip Morris International (PMI) (5,11). The objectives of this study
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7
8 119 were to measure the size of Ghana's illicit cigarette market using an empty pack survey
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10 120 method to determine the nature and types of illicit cigarettes present in Ghana, and to
11
12 121 identify the factors associated with illicit cigarettes sales in Ghana.

14 122 **METHODS**

15 123 **Study sites**

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17
18 124 A cross sectional study was conducted during the months of August 2020 to January
19
20 125 2021 in four major cities in Ghana (Accra, Tamale, Kumasi, Takoradi and Bolgatanga)
21
22 126 and four border towns (Aflao, Paga and Elubu) across the three zones of Ghana
23
24 127 (Northern, Middle and Coastal) (Figure 1). These districts were selected to represent
25
26 128 socioeconomic, cultural and geographical diversity.

27
28
29 129 Insert figure 1

30 130 **Research design**

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32
33 131 A modified approach based on the analysis of empty cigarette packs collected directly
34
35 132 from retailers was used. This method was adapted from similar studies in India (8) and
36
37 133 Bangladesh (9) and is particularly useful in countries where single stick sales are a
38
39 134 common practice. Within each large city or border town, up to 10 smaller geographical
40
41 135 areas were selected using Ghana Post Codes. A central point (such as a government
42
43 136 building, market place or taxi station) was determined in each of them for retailer pack
44
45 137 collection. A team of four research assistants and a coordinator walked 1 km along both
46
47 138 sides of a busy street (0.5 km forward and 0.5 km back) starting from the central point
48
49 139 to identify tobacco retailers. All retailers identified were provided with verbal and
50
51 140 written information about the study and requested to sign a consent form if they agreed
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53 141 to participate. Following consent being obtained, an empty bag with a unique identifier
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55 142 was given to retailers and they were asked to deposit all cigarette packs emptied
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3 143 throughout the day as a result of single sticks of cigarette sales in the bag provided. The
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5 144 bags were collected back from the retailers at the end of a 24-hour period and retailers
6
7
8 145 were given a small monetary reward (up to USD 10) commensurate with the number of
9
10 146 packs provided. Consenting retailers also participated in a 20-25 minutes survey on
11
12 147 illicit cigarette sales, common brands, and pricing of cigarettes sold each day. The
13
14 148 sample size equation to obtain the minimum number of packs collected from each
15
16 149 selected city/town was adapted from a toolkit for measuring illicit tobacco in LMICs
17
18 150 (10). We obtained a minimum sample size of 2600 packs to estimate a size of 25%
19
20 151 illicit cigarette sales with a 95% level of confidence.
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23 152 **Classification of packs**

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25 153 Empty cigarette packs were cleaned and assigned unique IDs, and were analysed and
26
27 154 their characteristics recorded. Pack data included the brand name, country of origin, the
28
29 155 presence of graphical and/or textual health warnings, the language of the warning, the
30
31 156 pack size (10/20 stick pack), and compliance of these warning messages with existing
32
33 157 packaging requirement for Ghana. A conservative definition to classify an illicit
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35 158 cigarette pack (packs on which appropriate duties have not been paid) in Ghana
36
37 159 according the Food and Drugs Authority (11), includes at least one of the following
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39 160 attributes:
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44 161 (a) Absence of authentic tax stamps;

45 162 (b) Absence of textual and pictorial warnings;

46 163 (c) Absence of the inscription "*FOR SALE IN GHANA ONLY*" displayed on the side
47
48 164 panel of the product pack and

49 165 (d) Health warnings not in English

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51 166 Trained research assistants evaluated tax stamp authenticity using the tax stamp mobile
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53 167 application developed by the Ghana Revenue Service (12).
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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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3 194 sticks (100%). A total of 871 out of 4461 (19.5%) packs were classified as illicit based
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5 195 on the criteria for classification approved by the FDA. Over half of the packs (58.6%)
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7 196 were collected from drinking bars of which 18.2% were illicit (Table 1). A third
8
9 197 (30.6%) of the packs collected from the northern zone of Ghana were illicit and almost
10
11 198 seven out of 10 (68.5%) packs from the border towns were illicit. Almost all the packs
12
13 199 collected from Aflao (Ghana-Togo border) were illicit (98.6%), followed by Tamale
14
15 200 (45.8%) and the Paga/Hamele (Ghana-Burkina Faso border) (26.6%) and Elubu
16
17 201 (21.1%) (Ghana - Cote d'Ivoire border). In terms of the retail selling points, three out
18
19 202 of 10 (29%) packs collected from convenience stores were illicit, followed by drinking
20
21 203 bars (18.2%) ($p < 0.001$). Over 60% of the packs collected within the price category of
22
23 204 2-7 GHC were illicit. The most common brand of cigarettes sold in Ghana is Rothmans
24
25 205 Kingsize, London Brown/White and Pallmall (Figure 2).

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29 206 Insert Figure 2

30
31 207 Of all the 871 illicit packs, the most common brands were Business Royal (24.1%),
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33 208 followed by Fine (20.8%) and Oris (12.3%). All packs from 555 and London
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35 209 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		

223

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

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

243

244 **DISCUSSION**

245 This study found out that 19.5% of the packs collected were illicit of the total 4461
 246 packs. Majority of the illicit packs were reported from Aflao (Ghana-Togo border)
 247 (98.6%) and Tamale (northern zone with cigarettes coming from Burkina Faso)
 248 (45.8%). Close to half of the illicit packs originated from Togo (51%), followed by
 249 Nigeria (14.8%) and then Cote d'Ivoire (10.3 %). The most common brand of
 250 cigarettes sold in Ghana was from BAT including Rothmans Kingsize, London
 251 Brown/White and Pallmall. One out four of the illicit packs belonged to Business
 252 Royal (Independent Tobacco Company), a fifth were from Fine (unknown company)
 253 and about one out of ten were from Oris brand (Oriental Genral Trading). Absence of
 254 tax stamps, '*for sale in Ghana*' sign and warning labels in English were among the
 255 most common characteristic of the illicit packs. Adjusted and unadjusted logistic
 256 regression models indicated that convenience stores, border towns and northern zone
 257 of the country had higher odds of sale of illicit cigarettes in Ghana.

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

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2
3 261 data on illicit cigarettes sales is lacking. The direct interaction with retailers also
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5 262 allowed us to obtain additional information about the price, the daily retail volume
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7 263 and pack characteristics of the cheapest cigarette brand sold in the store by each
8
9 264 vendor. Our illicit cigarette estimate (19.5%), is lower than the estimates of the
10
11 265 Euromonitor (37% in 2018) (15). This is not surprising based on the lack of
12
13 266 transparency in the Euromonitor data and their funding from the tobacco industry (TI)
14
15 267 (15). The TI is known for quoting high estimates of the illicit market as a means of
16
17 268 deterring governments from imposing tobacco tax increases, which contributes to
18
19 269 ineffective tobacco control and lost opportunities for the governments to collect more
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21 270 revenue.

22
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25
26 271 There are various methods to assess the extent of illicit tobacco in any country, such
27
28 272 as measuring the difference between consumption and tax paid sales (gap analysis),
29
30 273 interviewing smokers, examination of littered cigarette packs and econometric
31
32 274 modeling (16). We employed the empty pack methodology, which is particularly
33
34 275 suitable in countries with single stick sales, such as in India (8), Pakistan (17),
35
36 276 Bangladesh (9) and Argentina (18). Indeed, in our study, despite a ban on single stick
37
38 277 sales, all retailers (100%) sold single sticks, calling for enforcement of the ban. Our
39
40 278 estimates of illicit cigarette sales are similar to countries with a higher tobacco use
41
42 279 prevalence such as Pakistan (17.8%) and Argentina (13.7%) that used a similar
43
44 280 methodology (17,18). Despite the lack of estimates of illicit cigarettes from many
45
46 281 countries in the African Region, countries such as South Africa, Kenya, Gambia and
47
48 282 Nigeria have available estimates of their illicit market. Our estimates were found to be
49
50 283 lower than South Africa (over 30% of the total market in 2017) (19), Nigeria (26.3%)
51
52 284 (20) and Kenya (26%) (21) but higher than the Gambia (8.6%) (22). With the
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54 285 ratification of the Protocol in Ghana, and estimates suggesting 1 out 5 cigarette packs
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3 286 to be illicit, there is an urgent need for governments to address this by fully
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5 287 implementing the recently ratified protocol (which has specific requirements to
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7 288 improve traceability of tobacco products and increase tobacco industry
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9 289 accountability).

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11
12 290 British American Tobacco (BAT) continues to dominate sales of cigarettes as
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14 291 evidenced by the most common cigarettes sold in Ghana (Rothmans Kingsize,
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16 292 London Brown/White and PallMall). This is largely due to the company's long
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18 293 history in Ghana. While the company ceased domestic production in 2006, it remains
19
20 294 the dominant importer of cigarettes into the country. There are also very low-priced
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22 295 brands available, such as BAT's Tusker brand (of which all packs were illicit). While,
23
24 296 all packs from London Brown/White were found to be licit, about 14% of PallMall
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26 297 and 1.6% of Rothmans Kingsize were illicit, demonstrating the industry's
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28 298 involvement in illicit trade. Further, the small-scale convenience stores were found to
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30 299 be a major selling point of illicit cigarettes. These are legally operating, widely
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32 300 available settings to the low-income Ghanaian smoker (who prefers to buy single
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34 301 stick) widely available in both rural and urban locations. Convenience stores were
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36 302 also found to have higher odds of illicit cigarette sales as compared to drinking bars in
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38 303 both the adjusted and unadjusted logistic regression models, indicating that it is a
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40 304 significant predictor of illicit cigarette sales in the country.

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42 305 Geography was found to play an important role in the illicit cigarette market in
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44 306 Ghana. A third of the packs collected from the northern zone of the country were
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46 307 found to be illicit. According to the Euromonitor, the north of Ghana sees particularly
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48 308 strong illicit trade, with most smuggling from Burkina Faso finding their way to this
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50 309 region (15). This could also be strongly linked to the high smoking prevalence in the
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52 310 region as compared to other regions (23). Similarly, border towns were also found to
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3 311 be strong predictors of illicit cigarette sales. Six out of 10 packs collected from border
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5 312 towns were illicit and almost 100% of the packs collected from Aflao (Ghana-Togo
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7 313 border), and close to half of the packs from Tamale (large city in Northern Ghana
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9 314 linked to Burkina Faso) were found to be illicit. This finding is consistent with other
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11 315 studies in Vietnam (24) and Georgia (25) where border towns were more vulnerable
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13 316 to illicit trade. This finding reinforces the need for strengthening patrolling and border
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15 317 control in addition to building capacity and training for authorities belonging to
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17 318 customs, police and immigration. The illicit cigarettes originated from Togo (51%),
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19 319 followed by Nigeria (14.8%) and then Cote d'Ivoire (10.3 %). Nigerian products are
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21 320 mostly smuggled in via Togo and most products smuggled in from Togo originate
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23 321 from BAT's Nigerian operations, with lower taxes in Nigeria enabling these to be
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25 322 sold at a lower price in Ghana. As observed in our study, the health warnings on
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27 323 cigarette packages are also in French, indicating a French-speaking West African
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29 324 source country.

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35 325 In terms of pricing of cigarettes, illicit packs were found to be almost 50% cheaper
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37 326 than licit packs. Africa in general, lags behind other regions (such as European and
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39 327 the Americas) in implementing strong tobacco tax policies (1). Close to 90% of the
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41 328 illicit packs were found in the low price category (2-7 GHC). In Ghana, the total
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43 329 excise tax on tobacco products accounts for only 31.8% of the average retail price, far
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45 330 below the 70% benchmark set by the WHO with no significant change in the
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47 331 affordability of cigarettes since 2010 (1). Over half of the smuggled cigarettes in the
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49 332 study originated from Togo (where cigarette are less affordable as compared to
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51 333 Ghana). Around Ghana's neighboring countries, the total excise tax on tobacco
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53 334 products account for 41.4%, 35.1% and 34.5% of the average retail price in Togo,
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55 335 Nigeria and Cote d'Ivoire respectively. Although, the TI argues that smuggling is
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3 336 heavily influenced by cross-border price differences, and higher taxation increases its
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5 337 profitability, this is highly debatable (26). Available data shows that price levels do
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7 338 not predict levels of illicit trade and the relationship between taxation and smuggling
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9 339 is more complex than it appears (27). An important point to consider is that, regional
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11 340 cooperation and coordination of tobacco tax and price levels remains a powerful
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13 341 strategy to consider in order to weaken the link between tobacco tax increases and
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15 342 illicit trade. Limiting tax discrepancies between neighboring countries can reduce
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17 343 arbitrage opportunities for smugglers at borders. Thus, it is important to intensify
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19 344 implementation efforts for such coordinated measures, for example within the
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21 345 Economic Community of West African States (ECOWAS) region to harmonize tax
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23 346 options (28).

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28 347 Our study findings should be considered in the light of some limitations. First, despite
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30 348 the wide geographical dispersion in the three zones of the country (northern, middle
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32 349 and coastal), the representativeness to the country is limited. Also, as data was
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34 350 collected during COVID-19 lockdown period in Ghana and we could not explore
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36 351 other border towns that were planned due to pertaining restrictions. Secondly, the
37
38 352 empty pack collection relies on retailers to provide us with all the empty packs sold
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40 353 that day. It could be possible that retailers would want to hide the illegal packs, which
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42 354 could underestimate our findings. Nevertheless, retailers were motivated with a
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44 355 monetary reward commensurate with the number of packs collected, which, to an
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46 356 extent, mitigated this issue. Third, our survey was able to collect empty cigarette
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48 357 packs from retailers mainly from drinking bars, kiosks and convenience stores. Thus
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50 358 street hawkers and dealers, if any, who are on the move and sell cigarettes are not
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52 359 covered by the survey.

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58 360 **CONCLUSION**
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3 361 Our study found a total of 19.5% illicit packs in the entire sample of packs collected
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5 362 across the eight cities in Ghana. Our estimate of the illicit cigarette market share is
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7 363 below with the estimates provided by the Euromonitor. This study provides valuable
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9 364 information for policymakers and law enforcement in the region and bringing to light
10
11 365 the inadequacy of the current monitoring and regulatory activities of the FDA and
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13 366 customs. Our findings have three important policy implications; first, the regulatory
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15 367 body and the focal point for tobacco control in Ghana (FDA) in collaboration with the
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17 368 customs, police and immigration, should strengthen the supply chain control and
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19 369 market surveillance at retail points in the towns and cities, particularly those close to
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21 370 the border in the northern and coastal zones of the country, aside from border
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23 371 monitoring and transportation tracing. Secondly, among the ECOWAS member
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25 372 states, there is a need to harmonise excise and taxation levels on tobacco across West
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27 373 Africa. This could reduce the problem of smuggled goods, as the competitive price
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29 374 advantage for some ECOWAS member states would be removed. Finally, with the
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31 375 introduction of Tax Stamp Policy since March 2018, Ghana should also consider the
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33 376 implementation of a supply chain control that resembles a track and trace system (like
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35 377 Kenya), independent of any industry influence to effectively monitor the illicit
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37 378 market.
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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

381 **ACKNOWLEDGEMENTS**

382 We would like to thank all the retailers that provided information and packs for this
383 survey.

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

390 **FUNDING**

391 This work was supported by the Medical Research Council [grant number
392 MR/P027946/2] with funding from the Global Challenges Research Fund and with
393 additional funding from the University of Edinburgh's Scottish Funding Council
394 Global Challenges Research Fund (GCRF) allocation.

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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3 400 The data are owned and shared by the Tobacco Control Capacity Program (TCCP)
4
5 401 and the School of Public Health, KNUST, Ghana. Requests for data sharing can be
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7 402 made to artisingh_uk@yahoo.com.
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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

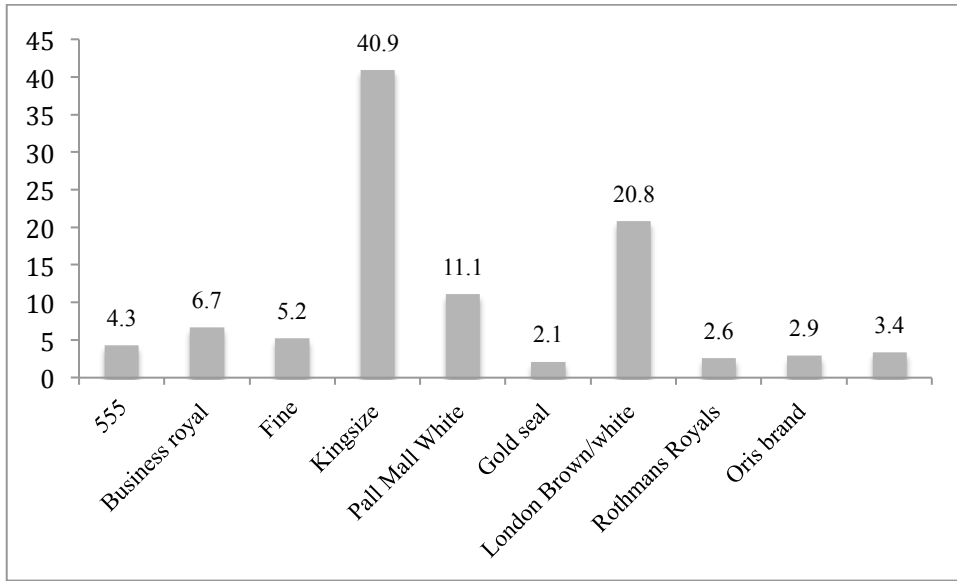
505 Figure 2: Cigarette brands sold in Ghana

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For peer review only



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BMJ Open

Extent of illicit cigarette market from single stick Sales in Ghana: findings from a cross-sectional survey

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2022-062476.R1
Article Type:	Original research
Date Submitted by the Author:	10-Aug-2022
Complete List of Authors:	Singh, Arti; Tampere University Ross, Hana; University of Cape Town Research Unit on the Economics of Excisable Products Dobbie, Fiona; The University of Edinburgh College of Medicine and Veterinary Medicine, ; Gallagher, Allen; University of Bath Kinnunen, Tarja; Tampere University Logo, Divine; Ghana Health Service, Research & Development Division-Ghana Health Service; Ministry of Health/Ghana health Service Boateng, Olivia A.; Food and Drug Authority, Tobacco Control and Substance Abuse Gilmore, Anna; University of Bath, Department for Health Bauld, Linda; University of Edinburgh, Usher Institute and UK Centre for Tobacco and Alcohol Studies, College of Medicine and Veterinary Medicine Owusu-Dabo, Ellis; Kwame Nkrumah University of Science and Technology, Department of Global Health
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology, Global health, Public health, Smoking and tobacco
Keywords:	PUBLIC HEALTH, Epidemiology < TROPICAL MEDICINE, STATISTICS & RESEARCH METHODS

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3 **1 Extent of illicit cigarette market from Single Stick Sales in Ghana: findings from**
4 **2 a cross sectional survey**
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10 5 D. Logo¹, Olivia A. Boateng⁶, Anna Gilmore⁴, Linda Bauld³, Ellis Owusu-Dabo¹
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43 37 Keywords: Illicit, cigarette, Ghana, packs, survey, tobacco
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3 **40 ABSTRACT**

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5 **41**
6 **42 Objective** This study aims to measure the extent of illicit cigarette consumption from
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8 **43** single stick sales, to determine the nature and types of illicit cigarettes present in
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10 **44** Ghana, and to identify the factors associated with illicit cigarettes consumption in
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12 **45** Ghana.

13
14 **46 Design** A Cross-sectional study using empty cigarette packs generated by 1 day's
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16 **47** single stick cigarette sales collected from cigarette vendors.

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18 **48 Setting** Five large cities (Accra, Kumasi, Takoradi, Tamale, and Bolgatanga) and three
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20 **49** border towns (Aflao, Paga/Hamele and Elubo) in the northern, middle and coastal belt
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22 **50** of Ghana.

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24 **51 Procedure and Participants** Ten areas were randomly selected in each city/town, and
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26 **52** all shops selling cigarettes within 1 km of the central point were surveyed.

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28 **53 Outcome measures** (1) estimates of the share of illicit cigarette packs in the total
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30 **54** cigarette sales from vendors selling single stick cigarettes in Ghana; (2) nature and
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32 **55** types of illicit cigarette packs; and (3) factors associated with illicit cigarette sales in
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34 **56** Ghana.

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37 **57 Results**

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39
40 **58** Of a total of 4461 packs, about 20% (95% CI: 18.34-20.66) were found to be illicit.
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42 **59** Aflao (Ghana-Togo border) and Tamale (Ghana-Burkina Faso border) had the highest
43
44 **60** percentage of illicit cigarette sales at 99% and 46% respectively ($p < 0.001$). Over half
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46 **61** of the illicit packs originated from Togo (51%), followed by Nigeria (15%) and then
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48 **62** Cote d'Ivoire (10%). Adjusted and unadjusted logistic regression models indicated that
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50 **63** convenience stores, border towns, pack price and the northern zone had higher odds of
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52 **64** illicit cigarette sales.
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65 **Conclusion** To effectively tackle illicit cigarettes, market surveillance and
66 strengthening supply chain control are required, particularly at the border towns and the
67 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.

68

69 INTRODUCTION

70

71 Illicit tobacco trade continues to remain a threat to global tobacco control efforts. While
72 tobacco consumption is decreasing globally, rapid population growth, increased
73 advertising by the tobacco industry, and growing tobacco consumption among young
74 people in Africa may result in increased number of smokers in the region (1). Further,
75 the availability and accessibility of cheap, illicit tobacco products is particularly
76 attractive to the region's most vulnerable young population and low-income smokers
77 (2).

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

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3 84 Protocol to Eliminate Illicit Trade in Tobacco Products (hereby referred to as “the
4
5 85 Protocol”) entered into force in 2018 (4). This Protocol gives countries an opportunity
6
7
8 86 to prevent tobacco-related morbidity and mortality by enhancing tobacco supply chain
9
10 87 control. Countries that ratify the Protocol commit themselves to adopting a variety of
11
12 88 measures, including track and trace systems to prevent and counter illicit trade.
13
14 89 Ghana, one of the first countries to ratify the World Health Organization’s (WHO)
15
16 90 Framework Convention on Tobacco Control (FCTC) in 2004, has made some
17
18 91 significant progress in tobacco control such as introducing an early advertising ban
19
20 92 (1982), the passage of the Tobacco Control Act (in 2012), banning of single stick sales
21
22 93 (2017), introduction of mandatory graphic health warnings (2018) and tax stamps on
23
24 94 tobacco products (2018) and more recently the ratification of the Protocol in October
25
26 95 2021 (5). Despite this progress, cigarettes continue to remain cheap and affordable in
27
28 96 Ghana (1). For instance, the price of a pack of the most commonly sold brand of
29
30 97 cigarette in Ghana is less than one USD. Although, Ghana does not have an active
31
32 98 tobacco industry (British American Tobacco (BAT) ceased its local production in
33
34 99 2006), BAT continues to dominate sales of cigarettes and remains the dominant
35
36 100 importer of cigarettes into the country via its manufacturing sites in Ibadan and Zaria in
37
38 101 Nigeria (5). The distribution networks of Ghana’s leading tobacco companies are well
39
40 102 organised in Ghana’s major urban cities including Greater Accra, Takoradi, Kumasi,
41
42 103 and Tamale. Tobacco products including cigarettes in Ghana is mostly sold at
43
44 104 unlicensed and unregulated points of sale such as traditional grocery retailers (also
45
46 105 known as convenience or provision stores), street vendors, kiosks and drinking bars (6).
47
48 106 An important challenge that exists in many African countries, including Ghana, is that
49
50 107 most governments do not measure the size of illicit tobacco market nor analyze its
51
52 108 features on a regular basis. To fully benefit from the Protocol, policymakers seek to
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3 109 connect its normative guidance with empirical data and analysis on countries' illicit
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5 110 tobacco trade (ref). In light of the tobacco industry's use of illicit trade to oppose
6
7 111 tobacco control measures such as tax increases (7), it is important to understand the
8
9 112 scope and nature of the illicit tobacco trade. To date, there have been no scientific
10
11 113 studies to estimate the size of the illicit cigarette market in Ghana (1). The only
12
13 114 available estimates are those produced by the Euromonitor that reports an illicit
14
15 115 cigarette market accounting for 39% of total cigarette sales in 2018 (up from 35% in
16
17 116 2017) (8). Estimates by Euromonitor have been criticized for being unreliable and
18
19 117 inconsistent, and for lacking independence due to Euromonitor entering into business
20
21 118 contracts with Philip Morris International (PMI) (5,11). The objectives of this study
22
23 119 were to measure the extent of the illicit cigarette market in selected border and non-
24
25 120 border towns in Ghana using an empty pack survey method from single stick sales. The
26
27 121 study also assessed the nature and types of illicit cigarettes present in Ghana including
28
29 122 the factors associated with illicit cigarettes sales in Ghana.
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33 123 **METHODS**

34 124 **Study sites**

35
36 125 A cross sectional study was conducted during the months of August 2020 to January
37
38 126 2021 in five major cities in Ghana (Accra, Tamale, Kumasi, Takoradi and Bolgatanga)
39
40 127 and three border towns (Aflao, Paga/Hamele and Elubu) across the three zones of
41
42 128 Ghana (Northern, Middle and Coastal) (Figure 1). These districts were selected to
43
44 129 represent socioeconomic, cultural and geographical diversity.
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46
47

48 130 Insert figure 1

49 131 **Research design**

50
51 132 A modified approach based on the analysis of empty cigarette packs collected directly
52
53 133 from retailers was used. This method was adapted from similar studies in India (9) and
54
55 134 Bangladesh (10) and is particularly useful in countries where single stick sales are a
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1
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3 135 common practice. Within each large city or border town, ten smaller geographical areas
4
5 136 were selected using Ghana Post Codes. A central point (such as a government building,
6
7 137 market place or taxi station) was determined in each of them for retailer pack
8
9
10 138 collection. A team of four research assistants and a coordinator walked 1 km along both
11
12 139 sides of a busy street (0.5 km forward and 0.5 km back) starting from the central point
13
14 140 to identify tobacco retailers. All retailers identified were provided with verbal and
15
16
17 141 written information about the study and requested to sign a consent form if they agreed
18
19 142 to participate. Following consent being obtained, an empty bag with a unique identifier
20
21 143 was given to retailers and they were asked to deposit all cigarette packs emptied
22
23 144 throughout the day as a result of single sticks of cigarette sales in the bag provided. The
24
25
26 145 bags were collected back from the retailers at the end of a 24-hour period and retailers
27
28 146 were given a small monetary incentive (up to a maximum amount of USD 10).
29
30 147 Consenting retailers also participated in a 20-25 minutes survey on illicit cigarette
31
32
33 148 sales, common brands, and pricing of cigarettes sold each day. Pack prices were
34
35 149 recorded for each of the 10 and 20 stick packs. The sample size equation to obtain the
36
37 150 minimum number of packs collected from each selected city/town was adapted from a
38
39
40 151 toolkit for measuring illicit tobacco in LMICs (11). We obtained a minimum sample
41
42 152 size of 2600 packs, assuming prevalence of illicit cigarette sales of 25%, with 95%
43
44 153 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
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1
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3 160 cigarette pack in Ghana according the Food and Drugs Authority (FDA), the regulatory
4
5 161 body and the focal point for tobacco control in Ghana (12), includes at least one of the
6
7 162 following attributes:

8
9 163 (a) Absence of authentic tax stamps;

10
11 164 (b) Absence of textual and pictorial warnings (Current pack warnings in Ghana are
12
13 165 required to be a combined picture and text health warning in English to cover 50% of
14
15 166 the front principal display area and 60% of the back principal display area of the pack,
16
17 167 positioned in the lower portion) (13).

18
19 168 (c) Absence of the inscription “*FOR SALE IN GHANA ONLY*” displayed on the side
20
21 169 panel of the product pack and

22
23 170 (d) Health warnings not in English

24
25 171 Trained research assistants evaluated tax stamp authenticity using the tax stamp mobile
26
27 172 application developed by the Ghana Revenue Service (14).

28 29 173 **Analysis**

30
31 174 Data were first entered into excel, cleaned and analyzed via R studio version 1.4.1717.

32
33 175 There was missing information from three of the pack data and these were removed
34
35 176 from the final analysis. The unit of analysis was each cigarette pack. Continuous

36
37 177 variables such as price/pack were changed to categorical (low and high price category)

38
39 178 for 2-7 GHC and 8-14 GHC respectively (1USD=6GHC) for measures of association

40
41 179 and continuous for the regression analysis. Descriptive information was reported as

42
43 180 frequencies and percentages for city, country zone (northern, middle and coastal

44
45 181 zones), retail shop type (drinking bars, convenience stores and kiosks), border and non-

46
47 182 border towns, country of origin (based on the inscription on the packs on sale restricted

48
49 183 to respective country eg. for sale in Togo only or Nigeria etc.) and illicit and licit

50
51 184 cigarette. Pack characteristics such as pictorial health warning (absent/present), textual

52
53 185 health warning (absent/present), warning labels in English (absent/present), tax stamps

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

195 Insert Figure 2

196 **Patient and public Involvement**

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

199 **RESULTS**

200 A total of 425 retailers were approached for the study, of whom 384 (90%) consented
201 to collect packs and participate in the survey. An average of 12 cigarette packs were
202 collected from single stick sales in a 24-hour period. A total of 4461 packs were
203 collected from 384 retailers in the selected cities and towns. All retailers (100%) in the
204 study sold single sticks. A total of 871 out of 4461 (20%, 95% CI: 18.34-20.66) packs
205 were classified as illicit based on the criteria for classification approved by the FDA. A
206 third (31%) of the packs collected from the northern zone of Ghana were illicit and
207 almost seven out of 10 (69%) packs from the border towns were illicit. Almost all the
208 packs collected from Aflao (Ghana-Togo border) were illicit (99%), followed by
209 Tamale (46%) and the Paga/Hamele (Ghana-Burkina Faso border) (27%) and Elubu
210 (21%) (Ghana - Cote d’Ivoire border) (Table 1). In terms of the retail selling points,
211 three out of 10 (29%) packs collected from convenience stores were illicit, followed by

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

215 Insert Figure 3

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

218 Insert Figure 2

219 All packs from 555 and London Brown/White (manufactured by BAT) were licit
 220 (100%) (Table 1).

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

233

	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)
<i>P-value*</i>	<0.001		

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

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

238 Almost all the packs collected were the 20-stick pack (98%). The average price/pack
 239 of the 20-stick packs was 8.5 GHC and that for 10-stick was 3.3 GHC. Illicit packs
 240 had an average price/pack of 5.4 GHC (SD 1.5, range 2-12 GHC) whilst licit pack
 241 was 9.1 GHC (SD 2.1, range 2-14 GHC). Close to half of the illicit packs originated
 242 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)

256

257 **DISCUSSION**

258 This study found out that close to 20% of the packs collected were illicit of the total
 259 4461 packs. Majority of the illicit packs were reported from Aflao (Ghana-Togo
 260 border) (99%) and Tamale (46%). Tamale, although not a border town, is the capital
 261 of the Northern region of Ghana, and has most of the cigarettes smuggled from
 262 Burkina Faso (8). Close to half of the illicit packs originated from Togo (51%),
 263 followed by Nigeria (15%) and then Cote d'Ivoire (10%). The most common brand of
 264 cigarettes sold in Ghana was from BAT including Rothmans Kingsize, London
 265 Brown/White and Pall Mall. One out four of the illicit packs belonged to Business
 266 Royal (Independent Tobacco Company), a fifth were from Fine (unknown company)
 267 and about one out of ten were from Oris brand (Oriental General Trading). The most
 268 common features identified for classifying packs as illicit were the absence of tax
 269 stamps, '*for sale in Ghana*' sign and warning labels not in English. Adjusted and
 270 unadjusted logistic regression models indicated that convenience stores, border towns,
 271 northern zone of the country and price/pack had higher odds of illicit cigarettes
 272 consumption for single stick sales in Ghana.

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

1
2
3 276 Ghana, where data on illicit cigarettes sales is lacking. Our illicit cigarette estimates
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5 277 from single stick sales of 20%, is however, lower than the estimates of the
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7 278 Euromonitor (37% in 2018) (17), which is the only available estimate on illicit
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9 279 cigarettes market in Ghana. Nevertheless, the Euromonitor data is criticised for lack
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11 280 of transparency and their and their funding source from the tobacco industry (TI) (17).
12
13 281 The TI is known for quoting high estimates of the illicit market as a means of
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15 282 deterring governments from imposing tobacco tax increases, which contributes to
16
17 283 ineffective tobacco control and lost opportunities for the governments to collect more
18
19 284 revenue.
20
21 285 There are various methods to assess the extent of illicit tobacco in any country, such
22
23 286 as measuring the difference between consumption and tax paid sales (gap analysis),
24
25 287 interviewing smokers, examination of littered cigarette packs and econometric
26
27 288 modeling (18). We employed a methodology particularly suitable in countries with
28
29 289 single stick sales, similar to methods used in India (9), Pakistan (19), Bangladesh (10)
30
31 290 and Argentina (20). Despite a ban on single stick sales, all retailers (100%) sold
32
33 291 single sticks, calling for enforcement of the ban. Our estimates of illicit cigarette sales
34
35 292 (20%) are also similar to countries with a higher tobacco use prevalence such as
36
37 293 Pakistan (18%) and Argentina (14%) that used a similar methodology (19,20).
38
39 294 Despite the lack of estimates of illicit cigarettes from many countries in the African
40
41 295 Region, countries such as South Africa, Kenya, The Gambia and Nigeria have
42
43 296 available estimates of their illicit market using different methods of estimation. Our
44
45 297 estimates were found to be lower than South Africa (with over 30% of the total
46
47 298 market being illicit) (21), Nigeria (26%) (22) and Kenya (26%) (23) but higher than
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49 299 the Gambia (8.6%) (24). With the recent ratification of the Protocol in Ghana, and
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51 300 estimates suggesting one out of five cigarette packs to be illicit, there is an urgent
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3 301 need for governments to address this by fully implementing ratified protocol (which
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5 302 has specific requirements to improve traceability of tobacco products and increase
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7 303 tobacco industry accountability).

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10 304 British American Tobacco (BAT) continues to dominate sales of cigarettes as
11
12 305 evidenced by the most common cigarettes sold in Ghana (Rothmans Kingsize,
13
14 306 London Brown/White and Pall Mall). This is largely due to the company's long
15
16 307 history in Ghana (25). While the company ceased domestic production in 2006, it
17
18 308 remains the dominant importer of cigarettes into the country (25). There are also very
19
20 309 low-priced brands available, such as BAT's Tusker brand (of which all packs were
21
22 310 illicit). While, all packs from London Brown/White were found to be licit, about 14%
23
24 311 of Pall Mall and 1.6% of Rothmans Kingsize were illicit, demonstrating the
25
26 312 possibility of the industry's involvement in illicit trade. [Note: Removed by editor at
27
28 313 acceptance. Please see final version of manuscript.] Further, the small-scale convenience
29
30 314 stores were found to be a major selling point of illicit cigarettes. These are legally
31
32 315 operating, widely available settings to the low-income Ghanaian smoker (who prefers
33
34 316 to buy single stick) widely available in both rural and urban locations. Convenience
35
36 317 stores were also found to have higher odds of illicit cigarette consumption as
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38 318 compared to drinking bars in both the adjusted and unadjusted logistic regression
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40 319 models, indicating that it may be an important predictor of illicit cigarette sales in the
41
42 320 country.

43
44 321 Geography was found to play an important role in the illicit cigarette market in
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46 322 Ghana. A third of the packs collected from the northern zone of the country were
47
48 323 found to be illicit. According to the Euromonitor (8), the north of Ghana sees
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50 324 particularly strong illicit trade, with most smuggling from Burkina Faso finding their
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52 325 way to this region into Tamale (17). This could also be linked to the high smoking
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3 326 prevalence and lower income population in the region as compared to other regions
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5 327 (27). Similarly, border towns were also found to be strong predictors of illicit
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7 328 cigarette sales. Six out of 10 packs collected from border towns were illicit and almost
8
9 329 100% of the packs collected from Aflao (Ghana-Togo border), and close to half of the
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11 330 packs from Tamale (large city in Northern Ghana linked to Burkina Faso) were found
12
13 331 to be illicit. Border towns have been found to be more vulnerable to the trade of illicit
14
15 332 cigarette and tobacco products in Vietnam (28) and Georgia (29). Our findings
16
17 333 reinforces the need for strengthening patrolling and border control in addition to
18
19 334 building capacity and training for authorities belonging to customs, police and
20
21 335 immigration. The illicit cigarettes originated from Togo (51%), followed by Nigeria
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23 336 (15%) and then Cote d'Ivoire (10%). [Note: Removed by editor at acceptance. Please see
24
25 337 final version of manuscript.]
26
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29
30 338 In terms of pricing of cigarettes, illicit packs were found to be almost 50% cheaper
31
32 339 than licit packs. Africa in general, lags behind other regions (such as European and
33
34 340 the Americas) in implementing strong tobacco tax policies (1). Close to 90% of the
35
36 341 illicit packs were belonged to the low price category (2-7 GHC). Currently, the total
37
38 342 excise tax on tobacco products in Ghana, accounts for only 31.8% of the average
39
40 343 retail price (30). Also, over half of the smuggled cigarettes in the study originated
41
42 344 from Togo where a pack of cigarettes is priced at about one USD and is about 0.50
43
44 345 USD in Ghana (30). The link between tobacco taxation and smuggling has been
45
46 346 doubtful and inconsistent (31). According to a report by the World Bank (32), taxes
47
48 347 and prices have only a limited impact on illicit cigarette market share at country level,
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50 348 contrary to arguments by the tobacco industry. The African region, with low prices
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52 349 and low taxation on tobacco products and high levels of smuggling, provides a good
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3 350 illustration of this observation. This calls for more research to understand the
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5 351 relationship between tobacco taxation and smuggling in Africa.

6
7 352 Our study findings should be considered in the light of some limitations. First, despite
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9 353 the wide geographical dispersion in the three zones of the country (northern, middle
10
11 354 and coastal), the representativeness to the country is limited. Also, as data was
12
13 355 collected during COVID-19 lockdown period in Ghana and we could not explore
14
15 356 other border towns that were planned due to pertaining restrictions at that time.
16
17 357 Secondly, the empty pack collection relies on retailers to provide us with all the
18
19 358 empty packs from previous day's single stick sales. It could be possible that some
20
21 359 retailers would want to hide the illegal packs, which could underestimate our findings.
22
23 360 Nevertheless, retailers were motivated with a monetary incentive, which, to an extent,
24
25 361 mitigated this issue.

30 362 **CONCLUSION**

31
32 363 Our study found a total of 20% illicit packs in the entire sample of packs collected
33
34 364 across the eight border and non-border towns/cities in Ghana. This study provides
35
36 365 valuable information for policymakers and law enforcement in the region and
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38 366 bringing to light the inadequacy of the current monitoring and regulatory activities of
39
40 367 the FDA and customs. Our findings have two important policy implications; first, the
41
42 368 regulatory body and the focal point for tobacco control in Ghana (FDA) in
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44 369 collaboration with the customs, police and immigration, should strengthen the supply
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46 370 chain control and market surveillance at retail points in the towns and cities,
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48 371 particularly those close to the Ghana-Togo and Ghana-Burkina Faso border in the
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50 372 northern and coastal zones of the country, aside from border monitoring and
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52 373 transportation tracing. Secondly, with the introduction of Tax Stamp Policy since
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54 374 March 2018, Ghana should also consider the implementation of a supply chain control
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3 375 that resembles a track and trace system (like Kenya), independent of any industry
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5 376 influence to effectively monitor the illicit market.
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9
10 378 **ACKNOWLEDGEMENTS**

11
12 379 We would also like to thank Michael Ababio and Christopher Bekoe for their role and
13
14 380 contribution in pack collection and fieldwork. We would also like to thank all the
15
16 381 retailers that provided information and packs for this survey.
17
18

19 382 **CONTRIBUTORS**

20
21 383 AS, FD, AG, TK, HR and EOD contributed to the design, conception, acquisition,
22
23 384 analysis and interpretation of the project and data; the drafting and revision of the
24
25 385 manuscript and the approval of the final version to be published. AS and DL
26
27 386 contributed to the acquisition of data. LB contributed to the design and conception of
28
29 387 the project. OB and AG contributed to the drafting and revision of the manuscript and
30
31 388 the approval of the final version to be published.
32
33

34
35 389 **COMPETING INTEREST**

36
37 390 None declared
38
39

40 391 **FUNDING**

41
42 392 This work was supported by the Medical Research Council [grant number
43
44 393 MR/P027946/2] with funding from the Global Challenges Research Fund and with
45
46 394 additional funding from the University of Edinburgh's Scottish Funding Council
47
48 395 Global Challenges Research Fund (GCRF) allocation.
49

50
51 396 **Ethics Approval**

52
53 397 The study protocol was approved by the Committee on Human Research, Publication
54
55 398 and Ethics (Reference number: CHRPE/AP/441/18) and the University of Bath's
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57 399 Research Ethics Approval Committee for Health (REACH) (EP 19/20 063).
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3 **400 Data sharing statement**
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5 401 The data are owned and shared by the Tobacco Control Capacity Program (TCCP)
6
7 402 and the School of Public Health, KNUST, Ghana. Requests for data sharing can be
8
9 403 made to artisingh_uk@yahoo.com/arti.singh@tuni.fi
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11

12 404 Legends for figures

13
14 405 Figure 1: Location of the eight cities for pack collection in Ghana (black arrows)

15
16 406 Figure 2: Causal diagram of illicit cigarette consumption from single stick sales in
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18 407 Ghana (potential confounders were border towns, country zone, pack prices and type of
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20 408 retail shop)
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23
24 409 Figure 3: Cigarette brands sold in Ghana

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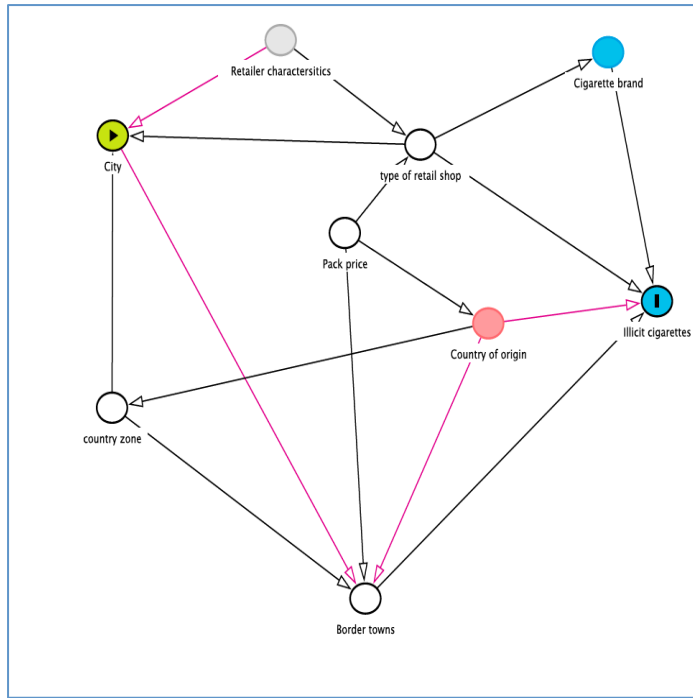


Figure 2: Causal diagram of illicit cigarette consumption from single stick sales in Ghana (potential confounders were border towns, country zone, pack prices and type of retail shop)

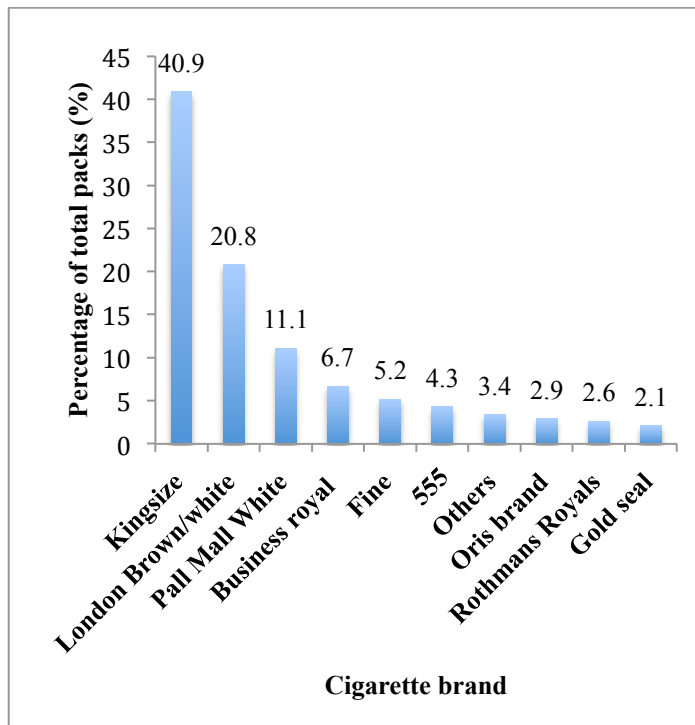


Figure 3: Common cigarette brands sold in Ghana

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.

BMJ Open

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

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2022-062476.R2
Article Type:	Original research
Date Submitted by the Author:	30-Oct-2022
Complete List of Authors:	Singh, Arti; Tampere University Ross, Hana; University of Cape Town Research Unit on the Economics of Excisable Products Dobbie, Fiona; The University of Edinburgh College of Medicine and Veterinary Medicine, ; Gallagher, Allen; University of Bath Kinnunen, Tarja; Tampere University Logo, Divine; Ghana Health Service, Research & Development Division-Ghana Health Service; Ministry of Health/Ghana health Service Boateng, Olivia A.; Food and Drug Authority, Tobacco Control and Substance Abuse Gilmore, Anna; University of Bath, Department for Health Bauld, Linda; University of Edinburgh, Usher Institute and UK Centre for Tobacco and Alcohol Studies, College of Medicine and Veterinary Medicine Owusu-Dabo, Ellis; Kwame Nkrumah University of Science and Technology, Department of Global Health
Primary Subject Heading:	Public health
Secondary Subject Heading:	Epidemiology, Global health, Public health, Smoking and tobacco
Keywords:	PUBLIC HEALTH, Epidemiology < TROPICAL MEDICINE, STATISTICS & RESEARCH METHODS

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3 **1 Extent of illicit cigarette market from Single Stick Sales in Ghana: findings from**
4 **2 a cross sectional survey**
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43 37 Keywords: Illicit, cigarette, Ghana, packs, survey, tobacco
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3 **40 ABSTRACT**

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5 **41**
6 **42 Objective** This study aims to measure the extent of illicit cigarette consumption from
7
8 **43** single stick sales, to determine the nature and types of illicit cigarettes present in
9
10 **44** Ghana, and to identify the factors associated with illicit cigarettes consumption in
11
12 **45** Ghana.

13
14 **46 Design** A Cross-sectional study using empty cigarette packs generated by 1 day's
15
16 **47** single stick cigarette sales collected from cigarette vendors.

17
18 **48 Setting** Five large cities (Accra, Kumasi, Takoradi, Tamale, and Bolgatanga) and three
19
20 **49** border towns (Aflao, Paga/Hamele and Elubo) in the northern, middle and coastal belt
21
22 **50** of Ghana.

23
24 **51 Procedure and Participants** Ten areas were randomly selected in each city/town, and
25
26 **52** all shops selling cigarettes within 1 km of the central point were surveyed.

27
28 **53 Outcome measures** (1) estimates of the share of illicit cigarette packs in the total
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30 **54** cigarette sales from vendors selling single stick cigarettes in Ghana; (2) nature and
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32 **55** types of illicit cigarette packs; and (3) factors associated with illicit cigarette sales in
33
34 **56** Ghana.

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38 **57 Results**

39
40 **58** Of a total of 4461 packs, about 20% (95% CI: 18.3-20.7) were found to be illicit. Aflao
41
42 **59** (Ghana-Togo border) and Tamale (Ghana-Burkina Faso border) had the highest
43
44 **60** percentage of illicit cigarette sales at 99% and 46% respectively ($p < 0.001$). Over half
45
46 **61** of the illicit packs originated from Togo (51%), followed by Nigeria (15%) and then
47
48 **62** Cote d'Ivoire (10%). Adjusted and unadjusted logistic regression models indicated that
49
50 **63** convenience stores, border towns, pack price and the northern zone had higher odds of
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52 **64** illicit cigarette sales.
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65 **Conclusion** To effectively tackle illicit cigarettes, market surveillance and
66 strengthening supply chain control are required, particularly at the border towns and the
67 northern region of the country.

68

69 Strengths and limitations of this study

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

75 **INTRODUCTION**

76
77 Illicit tobacco trade continues to remain a threat to global tobacco control efforts. While
78 tobacco consumption is decreasing globally, rapid population growth, increased
79 advertising by the tobacco industry, and growing tobacco consumption among young
80 people in Africa may result in increased number of smokers in the region (1). Further,
81 the availability and accessibility of cheap, illicit tobacco products is particularly
82 attractive to the region's most vulnerable young population and low-income smokers
83 (2).

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

1
2
3 91 Protocol”) entered into force in 2018 (4). This Protocol gives countries an opportunity
4
5 92 to prevent tobacco-related morbidity and mortality by enhancing tobacco supply chain
6
7 93 control. Countries that ratify the Protocol commit themselves to adopting a variety of
8
9 94 measures, including track and trace systems to prevent and counter illicit trade.
10
11 95 Ghana, one of the first countries to ratify the World Health Organization’s (WHO)
12
13 96 Framework Convention on Tobacco Control (FCTC) in 2004, has made some
14
15 97 significant progress in tobacco control such as introducing an early advertising ban
16
17 98 (1982), the passage of the Tobacco Control Act (in 2012), banning of single stick sales
18
19 99 (2017), introduction of mandatory graphic health warnings (2018) and tax stamps on
20
21 100 tobacco products (2018) and more recently the ratification of the Protocol in October
22
23 101 2021 (5). Despite this progress, cigarettes continue to remain cheap and affordable in
24
25 102 Ghana (1). For instance, the price of a pack of the most commonly sold brand of
26
27 103 cigarette in Ghana is less than one USD. Although, Ghana does not have an active
28
29 104 tobacco industry (British American Tobacco (BAT) ceased its local production in
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31 105 2006), BAT continues to dominate sales of cigarettes and remains the dominant
32
33 106 importer of cigarettes into the country via its manufacturing sites in Ibadan and Zaria in
34
35 107 Nigeria (5). The distribution networks of Ghana’s leading tobacco companies are well
36
37 108 organised in Ghana’s major urban cities including Greater Accra, Takoradi, Kumasi,
38
39 109 and Tamale. Tobacco products including cigarettes in Ghana is mostly sold at
40
41 110 unlicensed and unregulated points of sale such as traditional grocery retailers (also
42
43 111 known as convenience or provision stores), street vendors, kiosks and drinking bars (6).
44
45 112 An important challenge that exists in many African countries, including Ghana, is that
46
47 113 most governments do not measure the size of illicit tobacco market nor analyze its
48
49 114 features on a regular basis. To fully benefit from the Protocol, policymakers seek to
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51 115 connect its normative guidance with empirical data and analysis on countries’ illicit
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3 116 tobacco trade. In light of the tobacco industry's use of illicit trade to oppose tobacco
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5 117 control measures such as tax increases (7), it is important to understand the scope and
6
7 118 nature of the illicit tobacco trade. To date, there have been no scientific studies to
8
9 119 estimate the size of the illicit cigarette market in Ghana (1). The only available
10
11 120 estimates are those produced by the Euromonitor that reports an illicit cigarette market
12
13 121 accounting for 39% of total cigarette sales in 2018 (up from 35% in 2017) (8).
14
15 122 Estimates by Euromonitor have been criticized for being unreliable and inconsistent,
16
17 123 and for lacking independence due to Euromonitor entering into business contracts with
18
19 124 Philip Morris International (PMI) (5). The objectives of this study were to measure the
20
21 125 extent of the illicit cigarette market in selected border and non-border towns in Ghana
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23 126 using an empty pack survey method from single stick sales. The study also assessed the
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25 127 nature and types of illicit cigarettes present in Ghana including the factors associated
26
27 128 with illicit cigarettes sales in Ghana.
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33 **METHODS**

34 **Study sites**

35 131 A cross sectional study was conducted during the months of August 2020 to January
36
37 132 2021 in five major cities in Ghana (Accra, Tamale, Kumasi, Takoradi and Bolgatanga)
38
39 133 and three border towns (Aflao, Paga/Hamele and Elubu) across the three zones of
40
41 134 Ghana (Northern, Middle and Coastal). These districts were selected to represent
42
43 135 socioeconomic, cultural and geographical diversity.
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48 **Research design**

49 137 A modified approach based on the analysis of empty cigarette packs collected directly
50
51 138 from retailers was used. This method was adapted from similar studies in India (9) and
52
53 139 Bangladesh (10) and is particularly useful in countries where single stick sales are a
54
55 140 common practice. Within each large city or border town, ten smaller geographical areas
56
57 141 were selected using Ghana Post Codes. A central point (such as a government building,
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3 142 market place or taxi station) was determined in each of them for retailer pack
4
5 143 collection. A team of four research assistants and a coordinator walked 1 km along both
6
7 144 sides of a busy street (0.5 km forward and 0.5 km back) starting from the central point
8
9 145 to identify tobacco retailers. All retailers identified were provided with verbal and
10
11 146 written information about the study and requested to sign a consent form if they agreed
12
13 147 to participate. Following consent being obtained, an empty bag with a unique identifier
14
15 148 was given to retailers and they were asked to deposit all cigarette packs emptied
16
17 149 throughout the day as a result of single sticks of cigarette sales in the bag provided. The
18
19 150 bags were collected back from the retailers at the end of a 24-hour period and retailers
20
21 151 were given a small monetary incentive (up to a maximum amount of USD 10).
22
23 152 Consenting retailers also participated in a 20-25 minutes survey on illicit cigarette
24
25 153 sales, common brands, and pricing of cigarettes sold each day. Pack prices were
26
27 154 recorded for each of the 10 and 20 stick packs. The sample size equation to obtain the
28
29 155 minimum number of packs collected from each selected city/town was adapted from a
30
31 156 toolkit for measuring illicit tobacco in LMICs (11). We obtained a minimum sample
32
33 157 size of 2600 packs, assuming prevalence of illicit cigarette sales of 25%, with 95%
34
35 158 level of confidence and margin of error of 0.15.

36 159 **Classification of packs**

37 160 Empty cigarette packs were cleaned and assigned unique IDs, and were analysed and
38
39 161 their characteristics recorded. Pack data included the brand name, country of origin, the
40
41 162 presence of graphical and/or textual health warnings, the language of the warning, the
42
43 163 pack size (10/20 stick pack), and compliance of these warning messages with existing
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45 164 packaging requirement for Ghana. A conservative definition to classify an illicit
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47 165 cigarette pack in Ghana according the Food and Drugs Authority (FDA), the regulatory
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166 body and the focal point for tobacco control in Ghana (12), includes at least one of the
167 following attributes:

168 (a) Absence of authentic tax stamps;

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

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

175 (d) Health warnings not in English

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

178 **Analysis**

179 Data were first entered into excel, cleaned and analyzed via R studio version 1.4.1717.
180 There was missing information from three of the pack data and these were removed
181 from the final analysis. The unit of analysis was each cigarette pack. Continuous
182 variables such as price/pack were changed to categorical (low and high price category)
183 for 2-7 GHC and 8-14 GHC respectively (1USD=6GHC) for measures of association
184 and continuous for the regression analysis. Descriptive information was reported as
185 frequencies and percentages for city, country zone (northern, middle and coastal
186 zones), retail shop type (drinking bars, convenience stores and kiosks), border and non-
187 border towns, country of origin (based on the inscription on the packs on sale restricted
188 to respective country eg. for sale in Togo only or Nigeria etc.) and illicit and licit
189 cigarette. Pack characteristics such as pictorial health warning (absent/present), textual
190 health warning (absent/present), warning labels in English (absent/present), tax stamps
191 (absent/present) and “*for sale in Ghana*” sign (absent/present) were captured. The

1
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3 192 relationship between illicit tobacco and the categorical variables (city type, country
4
5 193 zone, type of shops, border and non-border town, price/packs, cigarette brand and
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7 194 country of origin) were first studied using χ^2 or Fisher's exact test (when the number in
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9 195 the table was <6). Due to the binary nature of the outcome variable (licit/illicit), simple
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11 196 and multiple logistic regression was performed to evaluate the unadjusted and adjusted
12
13 197 predictive values of the potential confounding variables respectively based on existing
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15 198 literature (15,16) (Figure 1). Subsequently, a cluster analysis was performed to identify
16
17 199 the effect of vendors on the sale of illicit single e stick sales in Ghana. The results are
18
19 200 presented as odds ratios (OR) with a 95% confidence interval, with significance set at
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21 201 an alpha level of 5% ($p \leq 0.05$).

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26 202 Insert Figure 1

27 28 203 **Patient and public Involvement**

29
30 204 No patients and/or the public were involved in the design, or conduct, or reporting, or
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32 205 dissemination plans of this research.

33 34 206 **RESULTS**

35
36 207 A total of 425 retailers were approached for the study, of whom 384 (90%) consented
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38 208 to collect packs and participate in the survey. An average of 12 cigarette packs were
39
40 209 collected from single stick sales in a 24-hour period. A total of 4461 packs were
41
42 210 collected from 384 retailers in the selected cities and towns. All retailers (100%) in the
43
44 211 study sold single sticks. A total of 871 out of 4461 (20%, 95% CI: 18.34-20.66) packs
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46 212 were classified as illicit based on the criteria for classification approved by the FDA. A
47
48 213 third (31%) of the packs collected from the northern zone of Ghana were illicit and
49
50 214 almost seven out of 10 (69%) packs from the border towns were illicit. Almost all the
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52 215 packs collected from Aflao (Ghana-Togo border) were illicit (99%), followed by
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54 216 Tamale (46%) and the Paga/Hamele (Ghana-Burkina Faso border) (27%) and Elubu
55
56 217 (21%) (Ghana - Cote d'Ivoire border) (Table 1). In terms of the retail selling points,
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218 three out of 10 (29%) packs collected from convenience stores were illicit, followed by
 219 drinking bars (18%) ($p < 0.001$). Over 60% of the packs collected within the price
 220 category of 2-7 GHC were illicit. The most common brand of cigarettes sold in Ghana
 221 is Rothmans Kingsize, London Brown/White and Pall Mall (Figure 2).
 222 Insert Figure 2
 223 Of all the 871 illicit packs collected, the most common brands of single stick sales were
 224 from Business Royal (24%), followed by Fine (21%) and Oris (12%).
 225 All packs from 555 and London Brown/White (manufactured by BAT) were licit
 226 (100%) (Table 1).

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

228

	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)
<i>P-value*</i>	<i><0.001</i>		

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

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

233 Almost all the packs collected were the 20-stick pack (98%). The average price/pack
 234 of the 20-stick packs was 8.5 GHC and that for 10-stick was 3.3 GHC. Illicit packs
 235 had an average price/pack of 5.4 GHC (SD 1.5, range 2-12 GHC) whilst licit pack
 236 was 9.1 GHC (SD 2.1, range 2-14 GHC). Close to half of the illicit packs originated
 237 from Togo (51%), followed by Nigeria (15%) and then Cote d'Ivoire (10 %). About
 238 2% of packs that were destined for Ghana were classified as illicit as the packs did not
 239 conform to the current labeling requirements as approved by FDA.

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

250 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)

251

252 Table 3 shows the results of bivariate and multivariate analysis adjusted for 384
 253 vendors that collected packs from single stick sales. After adjusting for the clustering
 254 effect of vendors, convenience stores had higher odds of illicit cigarette sales in both
 255 the bivariate and multivariate analysis adjusted for vendors. Border towns also had
 256 higher odds of illicit in both bivariate and multivariate models

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258 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)

263 *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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3 291 The TI is known for quoting high estimates of the illicit market as a means of
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5 292 deterring governments from imposing tobacco tax increases, which contributes to
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7 293 ineffective tobacco control and lost opportunities for the governments to collect more
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9 294 revenue.

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12 295 There are various methods to assess the extent of illicit tobacco in any country, such
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14 296 as measuring the difference between consumption and tax paid sales (gap analysis),
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16 297 interviewing smokers, examination of littered cigarette packs and econometric
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18 298 modeling (18). We employed a methodology particularly suitable in countries with
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20 299 single stick sales, similar to methods used in India (9), Pakistan (19), Bangladesh (10)
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22 300 and Argentina (20). Despite a ban on single stick sales, all retailers (100%) sold single
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24 301 sticks, calling for enforcement of the ban. Our estimates of illicit cigarette sales (20%)
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26 302 are also similar to countries with a higher tobacco use prevalence such as Pakistan
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28 303 (18%) and Argentina (14%) that used a similar methodology (19,20). Despite the lack
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30 304 of estimates of illicit cigarettes from many countries in the African Region, countries
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32 305 such as South Africa, Kenya, The Gambia and Nigeria have available estimates of
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34 306 their illicit market using different methods of estimation. Our estimates were found to
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36 307 be lower than South Africa (with over 30% of the total market being illicit) (21),
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38 308 Nigeria (26%) (22) and Kenya (26%) (23) but higher than the Gambia (8.6%) (24).
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40 309 With the recent ratification of the Protocol in Ghana, and estimates suggesting one out
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42 310 of five cigarette packs to be illicit, there is an urgent need for governments to address
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44 311 this by fully implementing ratified protocol (which has specific requirements to
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46 312 improve traceability of tobacco products and increase tobacco industry
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48 313 accountability).

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51 314 British American Tobacco (BAT) continues to dominate sales of cigarettes as
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53 315 evidenced by the most common cigarettes sold in Ghana (Rothmans Kingsize,
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3 316 London Brown/White and Pall Mall). This is largely due to the company's long
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5 317 history in Ghana (25). While the company ceased domestic production in 2006, it
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7 318 remains the dominant importer of cigarettes into the country (25). There are also very
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9 319 low-priced brands available, such as BAT's Tusker brand (of which all packs were
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11 320 illicit). While, all packs from London Brown/White were found to be licit, about 14%
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13 321 of Pall Mall and 1.6% of Rothmans Kingsize were illicit, demonstrating the
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15 322 possibility of the industry's involvement in illicit trade (26). Further, the small-scale
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17 323 convenience stores were found to be a major selling point of illicit cigarettes. These
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19 324 are legally operating, widely available settings to the low-income Ghanaian smoker
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21 325 (who prefers to buy single stick) widely available in both rural and urban locations.
22
23 326 Convenience stores were also found to have higher odds of illicit cigarette
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25 327 consumption as compared to drinking bars in both the adjusted and unadjusted
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27 328 logistic regression models, indicating that it may be an important predictor of illicit
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29 329 cigarette sales in the country.

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31 330 Geography was found to play an important role in the illicit cigarette market in
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33 331 Ghana. A third of the packs collected from the northern zone of the country were
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35 332 found to be illicit. According to the Euromonitor (8), the north of Ghana sees
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37 333 particularly strong illicit trade, with most smuggling from Burkina Faso finding their
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39 334 way to this region into Tamale (17). This could also be linked to the high smoking
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41 335 prevalence and lower income population in the region as compared to other regions
42
43 336 (27). Similarly, border towns were also found to be strong predictors of illicit
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45 337 cigarette sales. Six out of 10 packs collected from border towns were illicit and almost
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47 338 100% of the packs collected from Aflao (Ghana-Togo border), and close to half of the
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49 339 packs from Tamale (large city in Northern Ghana linked to Burkina Faso) were found
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51 340 to be illicit. Border towns have been found to be more vulnerable to the trade of illicit
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3 341 cigarette and tobacco products in Vietnam (28) and Georgia (29). Our findings
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5 342 reinforces the need for strengthening patrolling and border control in addition to
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7 343 building capacity and training for authorities belonging to customs, police and
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9 344 immigration. The illicit cigarettes originated from Togo (51%), followed by Nigeria
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11 345 (15%) and then Cote d'Ivoire (10%).

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13
14 346 In terms of pricing of cigarettes, illicit packs were found to be almost 50% cheaper
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16 347 than licit packs. Africa in general, lags behind other regions (such as European and
17
18 348 the Americas) in implementing strong tobacco tax policies (1). Close to 90% of the
19
20 349 illicit packs were belonged to the low price category (2-7 GHC). Currently, the total
21
22 350 excise tax on tobacco products in Ghana, accounts for only 31.8% of the average
23
24 351 retail price (30). Also, over half of the smuggled cigarettes in the study originated
25
26 352 from Togo where a pack of cigarettes is priced at about one USD and is about 0.50
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28 353 USD in Ghana (30). The link between tobacco taxation and smuggling has been
29
30 354 doubtful and inconsistent (31). According to a report by the World Bank (32), taxes
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32 355 and prices have only a limited impact on illicit cigarette market share at country level,
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34 356 contrary to arguments by the tobacco industry. The African region, with low prices
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36 357 and low taxation on tobacco products and high levels of smuggling, provides a good
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38 358 illustration of this observation. This calls for more research to understand the
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40 359 relationship between tobacco taxation and smuggling in Africa.

41
42 360 Our study findings should be considered in the light of some limitations. First, despite
43
44 361 the wide geographical dispersion in the three zones of the country (northern, middle
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46 362 and coastal), the representativeness to the country is limited. Also, as data was
47
48 363 collected during COVID-19 lockdown period in Ghana and we could not explore
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50 364 other border towns that were planned due to pertaining restrictions at that time.
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52 365 Secondly, the empty pack collection relies on retailers to provide us with all the
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3 366 empty packs from previous day's single stick sales. It could be possible that some
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5 367 retailers would want to hide the illegal packs, which could underestimate our findings.
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8 368 Nevertheless, retailers were motivated with a monetary incentive, which, to an extent,
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10 369 mitigated this issue.

11 370 **CONCLUSION**

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14 371 Our study found a total of 20% illicit packs in the entire sample of packs collected
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16 372 across the eight border and non-border towns/cities in Ghana. This study provides
17
18 373 valuable information for policymakers and law enforcement in the region and
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20 374 bringing to light the inadequacy of the current monitoring and regulatory activities of
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22 375 the FDA and customs. Our findings have two important policy implications; first, the
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24 376 regulatory body and the focal point for tobacco control in Ghana (FDA) in
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26 377 collaboration with the customs, police and immigration, should strengthen the supply
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28 378 chain control and market surveillance at retail points in the towns and cities,
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30 379 particularly those close to the Ghana-Togo and Ghana-Burkina Faso border in the
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32 380 northern and coastal zones of the country, aside from border monitoring and
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34 381 transportation tracing. Secondly, with the introduction of Tax Stamp Policy since
35
36 382 March 2018, Ghana should also consider the implementation of a supply chain control
37
38 383 that resembles a track and trace system (like Kenya), independent of any industry
39
40 384 influence to effectively monitor the illicit market.

41 385 **ACKNOWLEDGEMENTS**

42
43 386 We would also like to thank Michael Ababio and Christopher Bekoe for their role and
44
45 387 contribution in pack collection and fieldwork. We would also like to thank all the
46
47 388 retailers that provided information and packs for this survey.

48 389 **CONTRIBUTORS**

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2
3 390 AS, FD, AG, TK, HR and EOD contributed to the design, conception, acquisition,
4
5 391 analysis and interpretation of the project and data; the drafting and revision of the
6
7 392 manuscript and the approval of the final version to be published. AS and DL
8
9
10 393 contributed to the acquisition of data. LB contributed to the design and conception of
11
12 394 the project. OB and AG contributed to the drafting and revision of the manuscript and
13
14 395 the approval of the final version to be published.

17 396 **COMPETING INTEREST**

18
19 397 None declared

21 398 **FUNDING**

22
23
24 399 This work was supported by the Medical Research Council [grant number
25
26 400 MR/P027946/2] with funding from the Global Challenges Research Fund and with
27
28 401 additional funding from the University of Edinburgh's Scottish Funding Council
29
30 402 Global Challenges Research Fund (GCRF) allocation.

33 403 **Ethics Approval**

34
35 404 The study protocol was approved by the Committee on Human Research, Publication
36
37 405 and Ethics (Reference number: CHRPE/AP/441/18) and the University of Bath's
38
39 406 Research Ethics Approval Committee for Health (REACH) (EP 19/20 063).

42 407 **Data sharing statement**

43
44 408 The data are owned and shared by the Tobacco Control Capacity Program (TCCP)
45
46 409 and the School of Public Health, KNUST, Ghana. Requests for data sharing can be
47
48 410 made to artisingh_uk@yahoo.com/arti.singh@tuni.fi

51 411 **Legends for figures**

52
53 412 Figure 1: Causal diagram of illicit cigarette consumption from single stick sales in
54
55 413 Ghana (potential confounders were border towns, country zone, pack prices and type of
56
57 414 retail shop)

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3 415 Figure 2: Cigarette brands sold in Ghana
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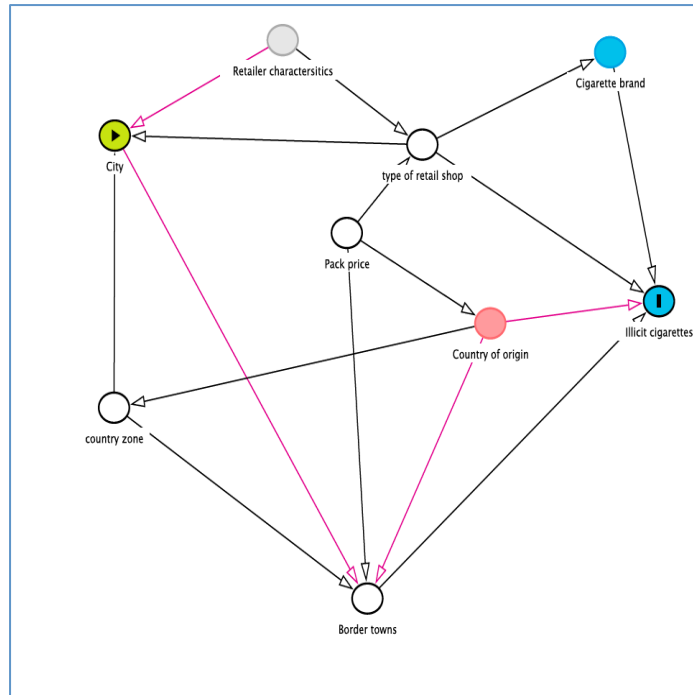


Figure 1: Causal diagram of illicit cigarette consumption from single stick sales in Ghana (potential confounders were border towns, country zone, pack prices and type of retail shop)

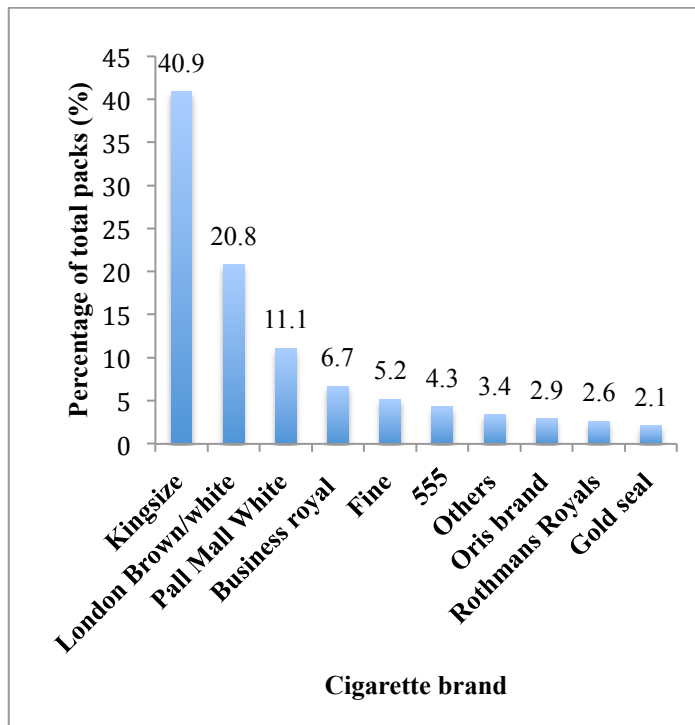


Figure 2: Common cigarette brands sold in Ghana

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60STROBE 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.